



# Gestures of Cosmic Relation and the Search for Another Earth

LISA MESSERI

*Anthropology, Yale University, USA*

**Abstract** Astronomers searching for an Earth-like planet elsewhere in our galaxy imagine the significance of such a discovery. They tell each other a story about pointing to the star around which such an exoplanet exists and knowing with certainty that *there* is a world upon which humans could comfortably live. The story, told in white papers, at scientific conferences, and to broader publics, features a mother astronomer explaining to her children the potential worlds that await them in the cosmos. This essay uses this myth as a starting point to examine relationships between humans, outer space, Earth, and environment as astronomers stretch the concept of habitability beyond Earth and across the universe. The gesture of pointing embodies a tension, one that both pushes the analytic gaze outward while also pulling it back to Earth. This double movement frames analyses of contemporary understandings of Earth's place in the universe, of the mother astronomer as symbolic of both the progress of women's standing in science as well as a problematic rearticulation of women as close to nature, and of other social configurations the exoplanet imagination extends beyond Earth. Terrestrial entanglements spread through the galaxy, simultaneously decentering Earth as uniquely meaningful and holding up our planet as the ultimate destination. Outer space, far from being removed from Earthly matters, offers a different scale and perspective for examining technocultural relations.

**Keywords** ecofeminism, exoplanet astronomy, gender, narrative, NASA, nature, planetary science

## Introduction

In the movie *Apollo 13*, Tom Hanks's Jim Lovell, having just witnessed Neil Armstrong's televised historic first steps, sits in his backyard, stares up at a destination he longs to set foot on, and uses his thumb to block out the Moon's presence in the sky. Later in the movie, with his life imperiled, his damaged ship comes around the dark side of the Moon and blue Earth hangs above the Moon's gray surface. Again Lovell raises his thumb, this time to block out Earth, the destination to which he hopes to return. This gesture was not a figment of the filmmaker's imagination but a movement encoded in the astronaut's memory of his experience in space. In a 2010 interview, the real Jim

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*Environmental Humanities* 9:2 (November 2017)

DOI 10.1215/22011919-4215325 © 2017 Duke University Press

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Lovell recalled the power of this memory when detailing his experience on Apollo 8: “I could put my thumb up and hide the Earth completely. Then it dawned on me how completely insignificant we are. Everything I had ever known—my family, my country, my world—was behind my thumb.”<sup>1</sup> This was a well-practiced anecdote (also shared in 2007’s *In the Shadow of the Moon*) and one told by other Apollo astronauts. Here’s Neil Armstrong: “It suddenly struck me that that tiny pea, pretty and blue, was the Earth. I put up my thumb and shut one eye, and my thumb blotted out the planet Earth. I didn’t feel like a giant. I felt very, very small.”<sup>2</sup> Similarly, Buzz Aldrin described how “the Earth was eventually so small I could blot it out of the universe simply by holding up my thumb.”<sup>3</sup>

Compare this Apollo-era configuration of body, space, and Earth with a more contemporary gesture of cosmic relation drawn from exoplanet astronomy, the search for and study of planets orbiting stars other than our Sun. Instead of recalling a past experience of an achieved success, this story describes a sought-after future and an accomplishment yet to be realized:

“Which one is it, Mommy?” asked the older of her two children. They had walked away from the campfire, and gazing now at the familiar pattern of stars in the night sky, a question far different from any ever asked by thousands of generations of human beings drifted off in the cool night air. “Look at the bright star over there,” the woman responded to them “now move your eyes a little to the right, and you’ll see that slightly fainter star. The planet belongs to that one. It’s almost exactly the size of the Earth, is just a little closer to its sun than we are to ours, and the space telescope that your mommy helped build found oxygen in its atmosphere. That world has air that creatures like us could breathe.” “Who lives there?” asked the younger one. “No one knows,” the woman replied, “but maybe they are looking at us, right now, wondering the same thing.”<sup>4</sup>

The astronomer here is not gesturing to our own Earth, but to another Earth. This discovery of a planet just like our own is the holy grail of exoplanet astronomy, and this imagination of a future moment gets told again and again within the community and to wider publics. To preface another telling, exoplanet astronomer Natalie Batalha asked her interviewer on NPR, “When you look up in the sky . . . what do you feel? . . . There’s a profound sense of loneliness, I think, that the universe is so big and I’m so small.” To counter this insignificance, Batalha brought in the story told above to show that the discovery of an Earth-like exoplanet will offer a different way of thinking about the universe: “Imagine in the near term future, you know, your grandchild or your great grandchild and his mother can point to a star and say, “That star, that star right there has a

1. Atkinson, “Conversation with Jim Lovell, Part 2.”
2. Hanbury-Tenison, *Oxford Book of Exploration*, 559.
3. Quoted in Garb, “Perspective or Escape?” 270.
4. Lunine et al., “Worlds Beyond,” 5.

planet just like Earth and it harbors life.' That's a different perspective."<sup>5</sup> Batalha is suggesting that instead of the smallness felt by Armstrong and other stargazers, the knowledge that a planet like ours exists elsewhere in the universe will proffer a sense of connection, making us feel less alone and more connected to the vast universe.

As these tales of cosmic relations suggest, astronomy does not stand apart from terrestrial pursuits but rather deeply informs understandings about Earth and our modes of being in the world. The most significant legacy of the Apollo missions was not a deeper scientific understanding of the moon but rather a view of Earth from space that became totemic for the environmental movement.<sup>6</sup> Even though human space flight was meant to push us further into the solar system, the Apollo astronaut's gesture of cosmic relation directs our attention back down toward Earth, refocusing on the one planet known to be capable of sustaining life.<sup>7</sup> Contained within this gesture is a hope that we will be stewards of this special planet but also a troubling image of how humans, with the sweep of a hand, can obliterate Earth.<sup>8</sup>

Gestures of cosmic relations resist straightforward interpretation. The gesture that exoplanet astronomers have put forth to capture their cosmic view, that of a mother astronomer pointing, similarly contains layers in need of decoding. It directs our gaze outward beyond Earth and the gesture of pointing suggests connection rather than absence. But it also invites an imagination of this other planet as a human destination, even as it might itself host life. Further, in describing a planet as Earth-like and livable, this gesture extends the idea of environment beyond our planet but also recenters Earth as the measure for mattering in the universe. It celebrates the role of female scientists while also reinforcing problematic associations between nurturing mother and (alien) Earth. The quest to find a planet like our own, as with human space flight, promises greater understanding of places elsewhere in the universe but also provides a mirror for examining terrestrial relations.

This article takes as its object of inquiry the mythology surrounding the search for an Earth-like planet, variously called a True Earth Analogue, a mirror Earth, Earth's twin, a habitable world, or the Goldilocks planet. I encountered the story, or myth, recounted above several times during ethnographic work I undertook in the exoplanet community from 2009 to 2011. At the conclusion of my fieldwork, the promise of detecting such a planet loomed large. Following the 2009 launch of the Kepler space telescope, dedicated to the search for exoplanets and with technical specs capable of detecting an

5. "Exoplanets and Love."

6. Cosgrove, "Contested Global Visions"; Garb, "Use and Misuse of the Whole Earth Image"; Jasanoff, "Heaven and Earth"; Lazier, "Earthrise"; and Poole, *Earthrise*. For work by environmental historians of outer space, see Anker, "Ecological Colonization of Space"; Degroot, "Catastrophe Happening in Front of Our Very Eyes"; Maher, *Apollo in the Age of Aquarius*; and Rand, "Orbital Decay."

7. Latour, "Telling Friends from Foes."

8. We can also read this gesture more starkly as symbolic of masculine domination. See Gaard, "Animals in (New) Space."

Earth-sized exoplanet, numerous discoveries have been announced of planets *almost* like our own. A recent headline-making discovery introduced a planetary system around a star much dimmer and cooler than our own, which nonetheless is believed to contain planets potentially capable of hosting life.<sup>9</sup> Though astronomers have not yet determined the size of these planets, the promise of future research made this discovery exciting. Even as these new planets remain mysterious and alien, the myth of the future mother astronomer pointing to an Earth-like exoplanet encapsulates what the community believes this preliminary work is building toward.

What kind of relation does pointing create between Earth and other worlds? What informs such a gesture, and what ideas and associations get propelled into space or pulled back down to Earth? In the next section, I discuss how pointing to another Earth matters for how we see our own planet and its “place in the universe.” Even as the mother astronomer points upward, exoplanet astronomy remains grounded in earthly understandings of nature, environment, and life as we know it. In the face of an infinite and varied cosmos, this framing of the search for an Earth-like planet ensures that Earth itself is not reduced to insignificance. However, it remains necessary to follow the pointing finger and extend the analytic gaze beyond Earth. I will thus consider social and political relations that are likewise being extended into the cosmos.<sup>10</sup> Does the mother astronomer suggest that women’s historical and problematic association as close to nature is supplemented by a closeness to culture as well? Or does replacing the alienness of other planets with the familiarity of Earth-like descriptions risk repeating the colonizer’s false assumption of empty, conquerable space? By using the conversations in and technologies of exoplanet astronomy to read culture into outer space, I argue that while these imaginations might lack immediate, material consequences, they nonetheless point toward potential future enactments of the relationship between humans, Earth, and outer space.

### **Exoplanet Astronomy and “Our Place in the Universe”**

For millennia, thinkers have wondered about whether planets exist around other stars. In 1995, two Swiss astronomers offered definitive proof of a planet orbiting a star like our sun. This planet, however, was not like any in our solar system. It was larger than Jupiter and orbited closer to its star than Mercury does to our sun. The astronomical community greeted the discovery with excitement. However, these scientists immediately

9. This was the February 2017 discovery of the Trappist-1 system of seven rocky exoplanets orbiting a single star, three of which might potentially be habitable. The star, however, is an ultracool dwarf star, and while this discovery was treated with tremendous popular and scientific attention, much research remains to assess terrestrial similarities. See Gillon et al., “Temperate Earth-Sized Planets.” Also greeted with excitement was the August 2016 announcement of an Earth-sized planet orbiting our nearest star, Proxima Centauri. Similar differences between this star and our sun diminished speculation that this planet was Earth’s twin. See Anglada-Escudé et al., “Terrestrial Planet Candidate.”

10. For a programmatic call to consider the sociality of outer space, see Valentine, Olson, and Battaglia, “Encountering the Future.”

began wondering if this newly detected system, so different from ours, was an anomaly, or was it our solar system that was unique. The early days of exoplanet astronomy uncovered many more systems like this first one, but as detection methods improved, astronomers were eventually able to find smaller planets, some of which are about the size of Earth. In addition to the size of the planet, astronomers consider several other factors when evaluating the excitement of a particular discovery. While some of these Earth-sized planets, like the one mentioned in the introduction, orbit smaller, colder stars, a True Earth Analogue would be in orbit around a main sequence star like the sun. More important than the type of star, the distance at which the planet orbits determines if it is a potentially “habitable” planet. A planet orbiting in a star’s “habitable zone” is at a distance such that it is possible for liquid water (a prerequisite for life as we know it) to exist continuously on the surface. While there have been a number of potentially habitable planets discovered, technical limitations prohibit characterization of the surface and atmosphere, keeping the knowledge of actual habitability shrouded in mystery. Though astronomers have not yet detected a rocky and aqueous Earth-size planet orbiting a sun-like star in the habitable zone, the astronomer in the myth is pointing to such a planet and thus providing an indelible imagination for the community of a likely and, hopefully, near future.

Articulations of *what* the future is are often accompanied by *why* this future matters. What is the significance of detecting a habitable world? In 2008, the US National Science Foundation (NSF) convened an exoplanet taskforce to outline the goals of this relatively small and newly formed research community. The report produced by this committee, chaired by astronomer Jonathan Lunine, stated in its cover letter, “the detection of planets just like our Earth (‘Earth analogues’) is at last within reach technologically.”<sup>11</sup> It was therefore pertinent for this taskforce to contemplate the philosophical significance, as they called it, of detecting other Earths. To wit, the discovery of a world like our own, the authors of this report asserted, would be nothing less than the completion of the Copernican revolution. If Copernicus unsettled Earth from the center of the solar system, discovering an Earth-like planet that is potentially habitable would deliver the final blow to Earth exceptionalism. Life could exist elsewhere. As written in the report, “Humankind stands today at the threshold of answering one of humankind’s most ancient questions: is our home world the only suitable abode for life like us in the cosmos?”<sup>12</sup>

There are two distinct unknowns packed into these speculations. The first is the question of detecting other life. The second is simply the detection of a planet capable of housing life as we know it. The question of life is no doubt a motivator for many scientists in this field, but at the same time exoplanet astronomy has worked hard to disentangle itself from astrobiology and the fringe project of searching for extraterrestrial

11. Lunine et al., “Worlds Beyond,” 4.

12. *Ibid.*

intelligent life. As astronomer Debra Fischer explained to me, astrobiology “profoundly underlies this whole search and is rarely discussed.” When I asked why, she responded that astrobiologists “were penalized for looking for little green men. And so the [exoplanet] community became very sensitive to that.” Exoplanet astronomers therefore carefully frame their work as a search for the conditions of life, rather than life itself. “Habitability” captures this more mundane framing. Exoplanet astronomers are swapping out a biological imagination in favor of one informed by geological *terracentrism*.<sup>13</sup> We see this in the assumption that a habitable planet is Earth-like and vice versa. Further, that the detection of a habitable planet itself, even if life upon it is unknown, is the significant finding suggests that *terra* rather than *bios* is the foundation upon which exoplanet astronomers are building cosmic relations.<sup>14</sup>

This is not to say that the “little green men” are completely absent; they do occasionally make veiled appearances. Returning to the exoplanet community report, the discussion on the implications of detecting an Earth-like exoplanet concludes by speculating on how knowing of the existence of such a world would change the way we looked up at the night sky. We would also be tempted “with wild dreams of flight. Surely that too would make us refocus our energies to hasten the day when our descendants might dare to try to bridge the gulf between two inhabited worlds.”<sup>15</sup> The story of the mother astronomer gesturing to the sky and inviting her children to build a bridge with their imaginations ends this section of the report. As quoted above, the mother explains, “That world has air that creatures like us could breathe.” The emphasis on the air over the creatures illustrates the *terracentrism* that motivates finding an Earth-like, habitable planet.

As chair of the exoplanet taskforce, Lunine oversaw the writing of this report and is the author of the myth, which is still being told and retold today. In fact, this was already a second telling. Lunine first told this story four years earlier during a testimony before the President’s Commission on Moon, Mars, and Beyond, the name for the Bush-era space policy, in April 2004. Then, when only 120 exoplanets were known to exist, Lunine ended his testimony with two possible futures, both ten years off in the then distant year of 2014. In both, a scientist sits around a campfire with her children. The first possible future is one in which NASA did not invest in the development of a dedicated mission to find a habitable planet. The scientist mother, then, cannot definitively tell her children whether a planet like ours exists elsewhere in the universe. In the second future, however, NASA did develop and fly advanced detection satellites, and the

13. I avoid using the handier *geocentrism* in order to take seriously the claim made by these astronomers that they are completing the Copernican revolution. *Terracentrism* is not a gravitational recentering of Earth, and yet these moves to decenter Earth can never fully escape how the ways in which we know the universe are grounded in how we know ourselves and our planet.

14. This was the dynamic I observed during my fieldwork in the formative days of exoplanet astronomy. There are indications today that, with exoplanet astronomy having securely established itself, *bios* is reentering the conversation in a more central, less coded way.

15. Lunine et al., “Worlds Beyond,” 5.

familiar scene of the mother pointing to a star and identifying a habitable planet for her son unfolds.

In 2009, NASA fulfilled Lunine's second scenario with the launch of the Kepler space telescope. While it has discovered thousands of exoplanets, several of which are only slightly larger than Earth, the True Earth Analogue remains elusive. In 2011, as the exoplanet community was praising Kepler as an unparalleled success, astronomer Sara Seager brought together the prominent researchers in the field to a small conference at MIT. Called "The Next Forty Years of Exoplanets," the meeting began with a slide depicting the silhouettes of two children pointing excitedly to the sky. Once more, the vision of the future as first articulated by Lunine animated this scene. The text under the image explained the goal for the next forty years: "We want to show our children, grandchildren, nieces, and nephews a dark sky, point to a star visible to the naked eye, and tell them, 'that star has a planet like Earth.'"

The story is pervasive because it succinctly captures the aspirations of a scientific community and gives human meaning to an endeavor that, like other space sciences, is often criticized as being disconnected from earthly activities. Exoplanet astronomers are arguing that it is through the grand technological feat of detecting a world like our own that humans will finally feel less cosmically alone. The question of "our place in the universe," astronomers claim, will finally be answered, and this answer will come in the form of the detection of a habitable planet. This is the planet to which astronomers hope to one day be able to point and for now resign themselves to telling each other about this moment in a future time and place.

Whereas *Apollo* astronauts positioned Earth as special because of its uniqueness, today's exoplanet astronomers suggest that Earth's significance is attached to its standing relative to other planets in the universe. Anthropologist Stefan Helmreich, sorting through his ethnographic work with astrobiologists studying "extremophiles" (organisms capable of surviving in, from the human perspective, extreme environments), proposes "extraterrestrial relativism" as a "relativism about 'nature' over culture—and, more than this, a relativism about Earthly nature."<sup>16</sup> If to think as a cultural relativist is to allow for multicultural being against the backdrop of a stable nature, to think as an extraterrestrial relativist is to invite multiple natures both on Earth and in the cosmos. In this regard, "extraterrestrial relativism is a *non-anthropocentric relativism* in which humans (as well as other creatures, and, at its limits, life itself) may be entirely absent."<sup>17</sup> It positions the conditions of life as relative to an only partially understandable nature.<sup>18</sup> Indeed, the early days of exoplanet astronomy were marked by discoveries that challenged singular understandings of solar system formation and planetary composition.

16. Helmreich, "Extraterrestrial Relativism," 1126. For further thinking on outer space and relationality, see Battaglia, Valentine, and Olson, "Relational Space."

17. Helmreich, "Extraterrestrial Relativism," 1126–27.

18. *Ibid.*, 1130.

But a different relativism marks the search for a habitable planet, one that I would argue is a response and perhaps rejection of this strain of extraterrestrial relativism. In the wake of exotic, alien exoplanets, the quest to find life beyond Earth seemed more challenging than ever as possible planetary natures (possible conditions for life) became infinite. The terracentrism that I here mark as intrinsic to the search for a habitable exoplanet is, as Helmreich describes, a nonanthropocentric relativism. Yet it rejects extraterrestrial configurations that are not recognizably terrestrial. This terracentrism accentuates only planets that are like Earth (and in turn assigns significance only to those futures in which we *know* Earth's relation to other habitable worlds), resisting the pluralism of early exoplanet discoveries. These astronomers attempt to hold Earth steady, rethinking the alien as the familiar, domesticating the extraterrestrial.

However, the contemporary gesture of cosmic relation, along with its terracentrism, is only possible because of the earlier Apollonian gesture that relativized Earth. Helmreich describes this as extraterrestrializing Earth—making Earth itself other.<sup>19</sup> From spaceship Earth to the Gaia hypothesis to terrestrial analog research, a past half-century of thinkers remade Earth as always already planetary and alien. The habitability of Earth can only be defined relative to the inhabitability of our neighboring planets. To articulate the discovery of a habitable exoplanet as meaningful requires simultaneously making the extraterrestrial familiar and Earth alien.

The quest to find an Earth-like planet requires a deep understanding of Earth itself. Even as the mother astronomer points up and outward, how exoplanet astronomers make their work significant returns us to the ground upon which the astronomer stands. The terracentrism that underwrites this endeavor frames Earth as special but, the astronomer hopes, not unique. If we are to now follow the astronomer's gesture into the sky, what imagery and imaginaries from this myth might extend beyond Earth?

### **Colonizing Mother (Other) Earth**

The search for a habitable exoplanet is the search for Earth as we have never known it. Scientists searching for another Earth are looking for *ideal* indicators of habitability.<sup>20</sup> Under what stable conditions, they ask, would terrestrial life be most likely to flourish? Though in the current climate crisis the present habitability of Earth would still be detectable, it perhaps won't be too much longer (on a cosmic timescale) before an alien observer of Earth might find the conditions undesirable. In explaining to her children, "that world has air that creatures like us can breathe," the astronomer in the myth represents how the community is looking for markers of a pristine Earth as opposed to a human-altered Earth. The models that predict the "biomarkers" they seek to detect are

19. See also Messeri, "Resonant Worlds."

20. Some scholarship in environmental ethics finds certain nonanthropocentrism perspectives troublesome as imagining Earth as one among many might make the task of preserving our planet seem unimportant in the cosmic scheme. This article runs counter to this logic, showing repeatedly how astronomers take on this cosmic view without abandoning terrestrial groundings. See Manson, "Anthropocentrism, Exoplanets, and the Cosmic Perspective."



based on ideal ecosystems, not those that include byproducts of the industrial complex humans have built on Earth.

This is a nostalgic quest for an Earth at its best; an Edenic Earth. Historian Carolyn Merchant writes of the deep-seated and long-lasting Western desire to recover Eden. Merchant finds elements of both progress and decline depending on who is spinning the story and when it is being told. “For many Americans, humanity’s loss of the perfect Garden of Eden is among the most powerful of all stories. . . . We search for ways to reclaim our loss.”<sup>21</sup> The habitable exoplanet is Edenic in that it is a planet of stability, particularly desirable in the age of the Anthropocene when planetary change on Earth is newly image-able.<sup>22</sup> The prospect of repairing our own planet is daunting, prompting dreams of extending humanity’s presence beyond Earth. Through the myth and associated scientific imaginations of human life on exoplanets, we catch glimpses of the cultural traces that are already extending beyond Earth, mingling with cosmic natures. The figure of the mother astronomer and the perpetuation of the colonizing mind-set offer, following Merchant, opportunities to read both progress and stagnation, if not decline, into the cosmic gestures that direct us beyond Earth.

It is striking that the figure of the mother is a constant character in this story of cosmic connection. Read pragmatically, it recasts the gender of the stereotypical scientist, painting a progressive picture of the future of exoplanet astronomy. At the same time, that this woman is a mother who connects Earth with an other through her pointing extends the myth of woman’s closeness to nature into the cosmos. Drawing together the progressive and conservative imageries surrounding the mother astronomer suggests that as technology facilitates our view further into the universe, being close to this cosmic nature requires also being close to the high-tech culture that produces it.

The mother astronomer is modeled on several women who have made important contributions to the growing field of exoplanet astronomy. Women have long been involved in American astronomy, as amateurs, technicians, or spousal aids.<sup>23</sup> While female astronomers remain in the minority,<sup>24</sup> exoplanet astronomy has several women leading the field.<sup>25</sup> During my ethnographic research, I observed these women scientists

21. Merchant, *Reinventing Eden*, 3.

22. See Boes, “Beyond Whole Earth,” for an analysis of the semiotic shift from the static Whole Earth image to Google Earth imagery capable of highlighting a changing planetary surface.

23. Pang, “Gender, Culture, and Astrophysical Fieldwork”; Rossiter, “‘Women’s Work’ in Science.”

24. The American Astronomical Society conducts periodic demographic surveys of the field, available here: [www.aas.org/csww/](http://www.aas.org/csww/). Social media recently brought to public attention the attending micro- and macro-aggressions women face throughout their training and work in the male-dominated field. A Twitter hashtag #AstroSH and many attending blog posts gave voice to the large number of women who were victims of or observed sexual harassment in their astronomy and astrophysics departments. One of the founders of American exoplanet astronomy, Geoff Marcy, was a key figure in these allegations.

25. Some departments have even achieved gender parity, as described by Harvard astronomer Charbonneau, “Women in Astronomy.” Other measures, like invited conference speakers, show that exoplanet astronomy is more on par with other subfields, with only around 25 percent of invited speakers being women: “Percentages of Conference Invited Speakers Who Are Women.”

train female graduate students, networking them with important senior researchers. Yet, structural barriers remain, especially for women who are also mothers. Seager, with whom I worked closely and whose illustration of the story using a photograph of her sons I describe in the previous section, was tragically widowed at a young age. Her husband was the primary caretaker of their two small children and household. Upon his passing, suddenly facing the more traditional gender roles her husband had filled, Seager saw with fresh eyes how even something as benign as required face-to-face meetings for a project discriminated against (typically women) caretakers.<sup>26</sup>

The fictional mother astronomer represents the ideal work-life balance that her real-life counterpart struggles to obtain. As much as the Earth-like exoplanet to which she points is a desired future, so too is this historically illusive balance. Women's reproductive abilities, Sherry Ortner has argued, symbolically and materially pull them away from culture and toward nature while also toward the home with its less appreciated labor.<sup>27</sup> The mother astronomer challenges the exclusive association between women and nature, making room for culture. The text of the myth featuring the mother astronomer carefully notes that the astronomer helped build the telescope that facilitated such an important discovery. Rather than simply portraying a closeness to nature, the mythic female figure propagated in these tellings of exoplanet astronomy's future honors the women leading the field today, provides a figure for today's female astronomers to strive toward, and rejects a nature/culture distinction by offering a sense of "having it all."

We can see another example of Earthly genderings and associations being recast beyond Earth by returning to the lineage of the cosmic gesture and how the imagination of our planet shapes the imagination of other Earths. Scholars, including Merchant and Ortner, have troubled the relationship between women and nature, detailing how the imagined entanglement of the two implicates both as entities to be tamed and exploited.<sup>28</sup> The space age extraterrestrializing of Earth replaced one entanglement with another, swapping out Mother Earth for Gaia, a delicately balanced goddess symbolically extinguished and made to reappear by the male astronaut's pivoting thumb.<sup>29</sup> Gaia was further feminized through the language James Lovelock and coauthors used, both in describing Gaia as a "she" that "Man" must protect and by accentuating fertility as Gaia's most prized feature. Despite their imagination of Gaia's interlocking organic and inorganic, human and nonhuman systems as an alternative to anthropocentrism, androcentrism persisted.<sup>30</sup>

26. Seager, "So Many Exoplanets . . . So Few Women Scientists."

27. Ortner, "Is Female to Male as Nature Is to Culture?"

28. To offer a few touchstones from this vast literature: Griffin, *Woman and Nature*; Merchant, *Death of Nature*; and Warren, *Ecofeminism*.

29. Garb, "Perspective or Escape?"

30. Murphy, "Sex-Typing the Planet." See also Plumwood, "Androcentrism and Anthropocentrism"; and Litfin, "Gendered Eye in the Sky."

The shift in cosmic gesture from blotting thumb to extended pointer potentially shifts us away from gendered planets just as the nuanced reading of the mother astronomer disrupts the essentialized relationship between women and nature.<sup>31</sup> As exoplanet astronomers replace the search for life with the quest to find a habitable planet, the terracentrism of this project swaps language of fertility for utility. “Habitable” planets are no longer necessarily Gaia-like animate life-forms, personified as human (and, more specifically, female). Available now is a more dispassionate imagination of a planet as an environment. Further, the definition of habitable zone (the donut-shaped region around a star in which a habitable planet must orbit) is not based on an organic measure. Rather, as already mentioned, the habitable zone is one in which a planet’s surface temperature could sustain liquid water. In reducing the conditions for life to its inanimate components, exoplanet astronomers remain agnostic about the animacy of detected planets.

However, if feminizing Earth positioned humans as protectors, does stripping habitable exoplanets of both personification and inhabitants reassert the imagination of the empty frontier, long a problematic feature of space flight?<sup>32</sup> From calling habitats beyond Earth “colonies” to framing Mars as the next step in America’s manifest destiny, space exploration risks repeating the mistaken colonial assumption of the new territory, in this case the cosmos, as empty.<sup>33</sup> The limits of today’s instruments commit scientists to describing planets as only “potentially” habitable. This potential could refer to the potential inhabitation of life forms already there, but just as easily this could slip to the potential for us humans to one day inhabit these distant worlds. In the exoplanet community report discussed in the previous section, the authors describe the allure of habitable planets: “a handful of stars in our night sky will forever hold a special place in our imagination, tempting us with wild dreams of flight.”<sup>34</sup>

NASA’s Jet Propulsion Laboratory (JPL), in a recent public outreach campaign, created a series of posters called “Visions of the Future” further tempting viewers to imagine inhabiting exoplanets.<sup>35</sup> Styled after the 1930s Works Progress Administration posters that encouraged tourists to “See America,” the series presents stylized snapshots of moons and planets in our solar system and beyond. There were four initial posters of exoplanets (fig. 1), each presenting a vision of the future in which humans have yielded to temptation and ventured beyond Earth.

31. Not all scholars view this essentializing as negative. One strand of ecofeminism capitalized on this relationship to encourage women to act as stewards of environmental movements. However, it was the embracing of essentialism that caused many feminist scholars to reject the “ecofeminist” label even as others continue to correct perceived misreadings of the field. See Moore, “Ecofeminism as Third Wave Feminism?”; and Phillips and Rumens, “Introducing Contemporary Ecofeminism.”

32. Limerick, “Imagined Frontiers.”

33. Anker, “Ecological Colonization of Space”; Dittmer, “Colonialism and Place Creation in Mars Pathfinder Media Coverage.”

34. Lunine et al., “Worlds Beyond,” 5.

35. “Visions of the Future.”

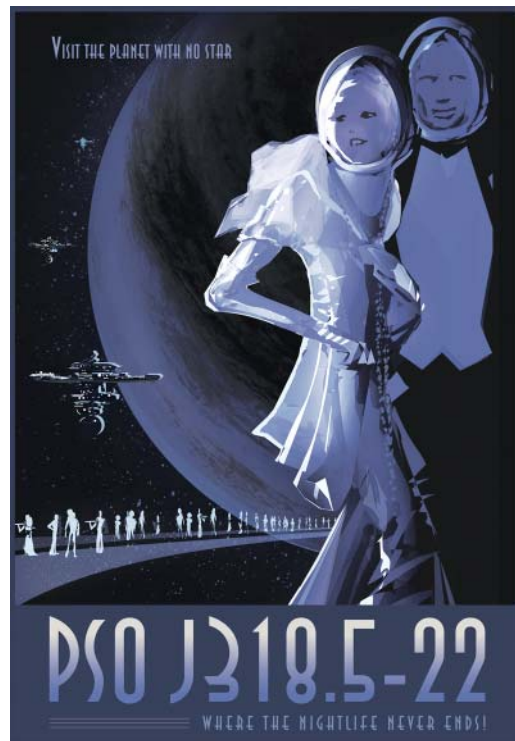
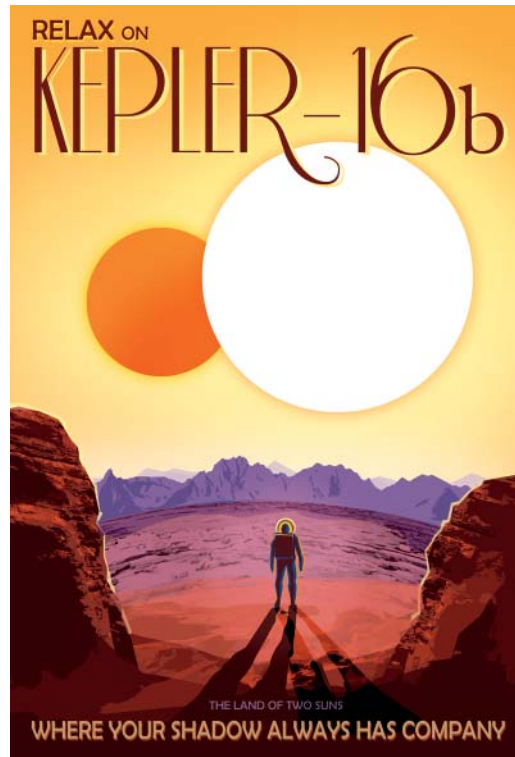


Figure 1. JPL's "Visions of the Future" series. Each poster takes a trait (more gravity relative to Earth [a]; two host stars [b]; star redder than the Sun [c]; planet orbiting no star [d]) of a known exoplanet and imagines human life. Courtesy NASA/JPL-Caltech.

Exoplanet tourists are depicted reproducing Earthly social configurations. Extreme sports participants and the solitary cowboy explorer of the Western frontier experience planets HD 40307g and Kepler-16b.<sup>37</sup> The American dream in the form of a white picket fence is prominent on Kepler-186f. And on the sunless exoplanet PSO J318.5-22, a perpetual nightclub lures in a tuxedoed man and his cocktail dress-wearing date. Anthropologist Michael Oman-Reagan critiques these displays of “white, binary-gendered, human couples,” wondering why, in the fanciful imaginations of other worlds (indeed other natures) human nature is remarkably unothered.<sup>38</sup> What stories can we tell of outer space exploration if we acknowledge the bias of those telling the story and represent a sociality otherwise in addition to the planet made otherwise through extraterrestrial relativism?

The mother astronomer and these other visions of the future urge us to look at the stars with a different perspective. Indeed, there is something quite new about these exoplanets composed of environments that stretch the imagination. But which social relations will be reinforced and which questioned? Who will have the power to shape these futures? Right now, scientists control the narrative, and we see evidence of both progress, in highlighting woman as mother and astronomer, and stagnation, in the reproduction of social and gender norms across a cosmos perceived as waiting to be colonized. The myths surrounding the search for a habitable planet might be fanciful, but they are not without consequence. Parsing the layers of meaning they contain points us toward the assumptions regarding the relationships between humans and environments as well as which relationships need to be challenged through more disruptive imaginings.

### Conclusion

One of JPL’s “Visions of the Future” posters features a woman leaning into a man, sitting in his arms underneath an apple tree that could be from the Garden of Eden. They look out over a lake, rolling hills, and a snowy mountain in the distance. The poster is captioned “Earth: Your Oasis in Space.” Unlike the exoplanet posters where the visitors are always wearing space helmets, this couple, though dressed in space suits, have their helmets resting on the ground nearby: these are travelers returned home. After experiencing other worlds, returning to our own is at last a return to Eden.

The quest to find a habitable planet and the cosmic gesture that extends our gaze beyond Earth simultaneously pulls us back home. This tension—the push and pull captured by the astronomer pointing toward the stars—is a different cosmic imagination than the earlier gesture of the Apollo astronaut blotting out Earth with his thumb. That gesture prompted an exclusive focus on Earth as the only habitable world. But the

37. Most exoplanets do not have names of their own but rather a letter (“b,” “c,” etc.) appended to their host star’s name, which is often a catalog name.

38. Oman-Reagan, “Queering Outer Space.”

Apollonian view from above also exposed Earth as a planet, similar to other objects in the solar system yet special because of its life-sustaining environment. Decades later, as exoplanet astronomy has finally offered empirical evidence for the long-held assumption that there are infinite worlds, a search is underway to see just how Earth-like a planet we can find elsewhere in the galaxy. The imagination of a future in which we can point to such a planet is one that, rather than depicting Earth as isolated, depicts Earth as connected.

And if Earth is connected then how we understand the cosmos is inseparable from how we understand Earth. This is true both for conceptions of the environment and life as well as the social and the political. Great potential lies in an imagination that expands the system in which we consider Earth to take part, but this project requires a critical eye toward what relations are extended beyond Earth.

LISA MESSERI is an assistant professor of sociocultural anthropology at Yale University. Her book, *Placing Outer Space: An Earthly Ethnography of Other Worlds* was published with Duke University Press in 2016 and examines place-making practices of planetary scientists. She has articles published in *American Ethnologist*, *Social Studies of Science*, *Technology and Culture*, *Astropolitics*, and *Environment and Society*. Her current research focuses on the resurgent community of virtual reality innovators.

### Acknowledgments

I wish to thank my fellow presenters and discussants on panels during which previous versions of this article were delivered, especially Debora Battaglia and Susan Lepselter at the 2015 American Ethnological Society meeting and Juan Francisco Salazar, Cristian Simonetti, Jessica O'Reilly, and Valerie Olson at the 2015 American Anthropological Association meetings. Additional thanks to the guest editors of this issue, Juan Francisco Salazar and Istvan Praet, as well as Astrida Neimanis and the editorial team at *Environmental Humanities*, and the peer reviewers who lent their time and ideas to further guide the development of this article.

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