Research in Brief

Space Media

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ABSTRACT

This article proposes the notion of space media as a way of defining media that connect humans with outer space. It is suggested that six areas related to contemporary media theory are particularly relevant to understanding space media: epistemology, anthropogenesis, planetary mediums, infrastructure, imaginaries, and remains. The article further suggests that the field of media studies needs to take account of outer space and, as a result, alter its own current practice.

Keywords: Outerspace; Space media; Media theory

RÉSUMÉ

Cet article propose la notion de médias de cosmos comme une façon de définir les médias qui relient les humains à l'espace extra-atmosphérique. Il est suggéré que six domaines liés à la théorie contemporaine des médias sont particulièrement pertinents pour comprendre les médias de cosmos: l'épistémologie, l'anthropogenèse, les média planétaires, les infrastructures, les imaginaires et les vestiges. L'article suggère que la domaine des études sur les médias doit tenir compte de cosmos extra-atmosphériques et, par conséquent, modifier sa propre pratique actuelle.

Mots clés : Cosmos; Médias de cosmos; Théorie des médias

Introduction

We, the Space Media Working Group of the McLuhan Centre for Culture and Technology at the University of Toronto, define *space media* as those technologies, techniques, ways of knowing, and modes of existence that bring humans into contact with outer space. The threshold that divides Earth from outer space is profoundly arbitrary from the perspective of any sentient being not living on Earth. Earth spins, rotates, and expands according to the same laws and dynamics as any other body in the universe. Earth is as much a part of outer space as Mars, Jupiter,

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the Sun, or Gliese 667 Cc. Space media are the means by which human and outer space are bound together.

This article tracks the emergence of a field that has lurked somewhere in the peripheral visions of media studies, yet with proper optics comes into plain sight. Interest in space media is everywhere: in the media studies that investigate the planetary scale boundaries of new technology; in the observational, geological, infrastructural, embodied, and aesthetic practices of making the universe known and situating our existence within it; in the constructive, destructive, and reconstructive acts that shape the Earth. Our aim is to provide a starting point for addressing why media studies must be a necessary and central player in the analysis of outer space. We do so by drawing upon a number of key concepts, theoretical orientations, and methodological approaches which help orient and disrupt common associations and understandings of outer space. In the analysis that follows we draw upon work in media studies that addresses outer space media systems, work that offers alien concepts for space media, and work that provides methodological guidance. We do this by considering space media as it relates to epistemology, imaginaries, bodies, infrastructure, remains, and medium. Equally important to us is the provocation that drawing outer space into the central orbit of media studies will necessarily reorient media studies and throw it off its current axis. Bodies colliding in space produce bidirectional effects.

Epistemology

"See the unseeable" (Galison & Kessler, 2019, p. 73) describes one of the recent breakthroughs made by space media: the Event Horizon Telescope's black hole "photograph," which was first unveiled to the public in March of 2019. It had been long surmised that capturing an image of a black hole was impossible, seeing as no light can escape a black hole and photography is light dependent. It took hundreds of scientists using data from six telescopes on four continents to collectively produce an acceptable and agreed-upon image for public use. Even so, outer space remains mostly unseeable. To this day, the overwhelming light of the sun blinds humans to outer space, relegating space observation to the dark of night or to autonomous technical media such as the Perseverance Mars Rover or the James Webb Space Telescope, which not only observe outer space but dwell within it. On the day of Perseverance's landing, NASA marvelled at media's epistemological extension, "We can't believe that we're really doing science now on the surface of Mars" (Strickland, 2021, para. 30).

Outer space confounds and amplifies the human focus on "the nature of matter, and … the possibility that there may be forms of matter that are imperceptible—because they were either too far away, too dim, or intrinsically invisible" (Bertone & Hooper, 2016, p. 2). This has been the fundamental question pursued by scientific investigation in its struggle to make sense of the cosmos. The very meaning of *cosmos* is "the universe seen as a well-ordered whole" (cosmos, 2021).

This relation between seeing and sense-making is foundational to Western epistemologies (Crary, 1990), and all cosmological images are bound to specific visual cultures (Kessler, 2012). In *The Question Concerning Technology in China*, Yuk Hui (2016) calls for a shift from cosmology to "cosmotechnics." He proposes that we must consider technics as neither *techne* nor modern technology but as *a variety of cosmotechnics* that unfold across different geographic regions, cultural traditions, and historical periods. Hui defines (2019) cosmotechnics as the "unification between the cosmic order and the moral order through technical activities," (p. 2), which emphasizes the situatedness of technology in specific realities. As he notes, much of our inherited Eurocentric thinking on technology is a mono-technological culture that leads to the endless exploitation of resources and life on Earth, which is at the heart of the discourses around the Anthropocene (Hui, 2019).

Hui is not the only person to suggest a reopening of the question of media technology by conceiving of non-European cosmotechnics and their histories as they relate to outer space. Competing and alternative epistemologies draw from other senses and experiences to map and make sense of outer space (Smiles, 2020). For some Indigenous cultures, oral storytelling, shamanistic space travel, and narrative have also done the work of establishing and maintaining the role that outer space plays in cosmological matters, though careful consideration should be taken to draw parallels across such epistemologies as if they shared a kinship (Casumbal-Salazar, 2017). Afrofuturists have repeatedly engaged with outer space and space media—such as spacesuits, ships, and rockets—as a means toward "radical futures of racial justice through the establishment of extraterrestrial black communities" (Ruth Rand, 2018, para. 16). In contrast to Western futurisms that depict a "raceless promised land" (Nelson, 2002, p. 5), Afrofuturists have situated the "Afronaut," or the Black person in space, to challenge contemporary and historical oppression on Earth with the image of "safe spaces" (Hamilton, 2017, p. 18) for Black life.

Cosmological investigation has been the work of media for millennia; for media are epistemological tools that most profoundly select, store, and process (Kittler, 1999) information, extending the capacities of sense-making beyond the scope of immediate bodily sensation, memory, and cognition (McLuhan, 1964). Outer space might be the most challenging of all such epistemological projects. For instance, 85 percent of the universe remains unmediated, as dark matter continues to thwart attempts to be captured, even though physicists have been trying to prove its existence through the use of technical media for decades (Bertone & Hooper, 2016; Prescod-Weinstein, 2021). The capacity of media systems to reorient space and time (Innis, 1951) or commit "time axis manipulation" (Krämer, 2006, p. 99) hit their limits when attempting to reach the edges of the universe and the Big Bang. Human time is primarily measured according to Earth's movement in space, its daily rotation, seasonal orientation, annual orbit, and lunar companion.

Outer space is not only out there but through media, it is inherent to earthly organization. The spatial and temporal biases of deep space telescopes are epic. The intertwined etymology of sight and knowledge, seeing and scale, implied by scope is further *magnified* through *tele*. Simply put, outer space and the cosmos have always been media specific.

Cosmological claims are grounded in media logics. The capacity to map the movement of celestial bodies creates the potential to organize social, political, and productive life according to calendars, to "logistical media" (Peters, 2012, p. 41). Such capacities are often used as a civilizational benchmark, and with the extensive use of satellite images, archaeologists have located several more ancient *alignment structures* that date back as far as 10,000 years (Sherrer, 2018). Ancient astronomical observatories produced observational uniformity to rationalize data collection by building large infrastructures and earthworks that situated observers in exact spots at specified times, providing viewfinders to focus observation. Stonehenge is likely the most famous example, though not the oldest. The processing of celestial data was "hardwired" into these ancient alignment structures. While such data did have to pass through the "bottleneck of the signifier" (Kittler, 1999, p. 4), individual vision was replaced with mechanized observation, though specialists were employed at least as far back as 2400 BCE in China. Astrological maps and charts depended upon such observatories and would come to bestow the human world with meaning by offering predictions that guided agriculture, daily life, and political strategy. Space media have historically been, and remain, powerful political tools.

Alien life and especially alien intelligence mark out a different set of media theoretical questions. Two specific areas of inquiry mark the field's theoretical terrain. First is the question of identification. How can one locate "a true signal amid an infinity of noise" (Peters, 1999, p. 251) to identify and then assess an alien species? Second, how would such signals be made intelligible? In terms of identification and assessment, we can look to the first maps of Mars published in the 1880s, which featured networks of "canali" that were claimed to be indicative of a more advanced species. Such a species within a militaristic framework would obviously pose a threat, a logic fictionalized by H.G. Wells (1897) in *War of the Worlds* (Packer & Reeves, 2020). The establishment of the United States Space Force in 2019 is an indication that nations continue to treat the cosmos as a potential battlespace, thus turning all technologies used to locate alien life or technology into "enemy detection media" (Packer & Reeves, 2020, p. 29). Conversely, the Search for ExtraTerrestrial Intelligence Institute assumes that alien signals "would be sent by scientists eager to engage in scholarly exchange rather than by mindless bureaucrats, conquistadores or con artists" (Peters, 1999, p. 250). Bridging the communicative divide between species remains an insurmountable task on Earth, so the likelihood of success with extraterrestrials

seems optimistic, myopic (given our inability to speak with dolphins, for instance), and hubristic.

Figure 1: Group of sun spots and veiled spots* and two coronal holes on the sun**

Notes: *Observed on June 17, 1875, at 7:30 a.m. by E.L. Trouvelot (left); **Observed by NASA's Solar Dynamics Observatory on March 16, 2015 (right)

Imaginaries

Illustrators Émile-Antoine Bayard and Alphonse-Marie de Neuville were some of the first published artists to depict space flight as scientifically accurately as possible with their work in the 1865 novel *From the Earth to the Moon* by Jules Verne (1865). While these are early artistic speculations on space flight specifically, other artists, such as E.L. Trouvelot (see Figure 1), had been drawing what they had seen through telescopes since the 1800s. Prior to that, images of the cosmos exist in almost every culture around the world. Technology constantly mediates our view of places we cannot go, even on Earth, and increasingly so as we extend into the greater unknown. In 1930, Else Bostelmann used a tethered phone cord from the depths of the ocean to illustrate what William Beebe saw in his expeditions in a sealed underwater capsule called the Bathysphere. These illustrations of undersea creatures were published in *National Geographic*, alongside scientific documentation of Beebe's discoveries. The rendering of images with digital or analogue media—whether in novels, journals, or magazines—fuels social understanding of unknown places; these images, however, are produced according to the limitations or conditions of their particular media. Although NASA's Solar Dynamics Observatory's 2015 image of solar flares resembles Trouvelot's 1875 image, in some ways remarkably, the two renditions are vastly different from what one might "see" when looking at the same phenomenon, and they are likely to be different from solar images produced 100 years from now.

As we use technology such as telescopes or satellites to look further into outer space, the images we see are increasingly tethered to our perception and world history (Parks, 2005). Decades of satellite use have shaped the way we interpret

nature, to the point where our own accounts are either felt to be obsolete or unobtainable (Berland, 1996). While technological advances and the detail on available images may seem to be objective, this "gaze from nowhere" (Haraway, 1988 p. 581) is tied to militarist, capitalist, and colonial motivations that seek to be the only source of truth. Satellites, telescopes, and other space media create an infrastructure for image production through which much of our popular imagery is produced and understood. Although infrastructures individually might feel neutral or necessary, they are all sitting on top of much larger systems that are invisible by design; by its very nature, infrastructural power fades into the background (Parks, 2005; Peters, 2015).

Social and cultural understanding of space is both a reference for and an outcome of the designing process (Parks, 2005). When we are designing space media that directly produces or indirectly contributes to the production of imagery, we are invoking a specific set of ideas that make images understandable to us based on a mutually agreed upon relationship to the material world (Balsamo, 2011). Even benign imagery undergoes decades of negotiation to become its current form (Bowker & Star, 1999; Peters, 2015). It is through this negotiation of imagery and established infrastructure that space media hold us to a particular visual understanding of outer space. Those who participate in the creation of aesthetics and imagery also participate in the process of designing the future, a commodified interpretation of how we have learned to think of space itself (Balsamo, 2011). When Rick Guidice drew NASA renderings of space settlements in the 1970s (see Figure 2), the images served not only to reinforce but also to provide reference for how one might conceptualize human life in space.

Figure 2: Cutaway view of a toroidal colony by Rick Guidice

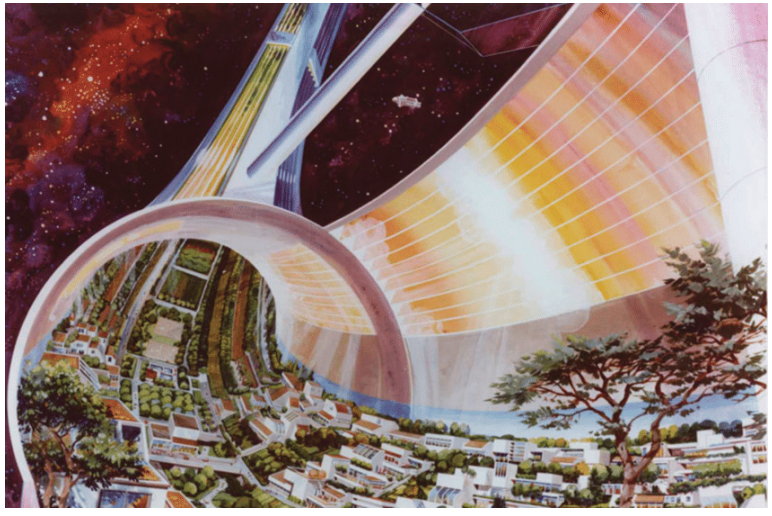

Photo credit: NASA Ames Research Center

Bodies

What is the cosmic space of the body? What is the body's cosmic field of operation? What are the body's cosmic modes of address and existence? Even more critically, whose bodies are worthy of cosmic existence? From microorganisms to animals, from astronauts to space workers, addressing the body is a risk because there is no one body from which to problematize and understand the concrete mediations of space media. Alternately defined as normative, malleable, transformable, and even disposable—as that which can be dislocated, harvested, domesticated, bred, and cryonized, that is, conceptualized in turn as medical subjects, organisms, vessels, representatives of Noah's ark, extensions of the senses, cyborgs, and simulations—bodies have been the subject of endless cosmic remappings. Outer space as "an environment we need technology to enter" (Monchaux, 2011) is a location whereby bodies are made "real and possible," (p.5) actualized as we know them and also virtualized in their potential metamorphoses. Space media is thus a "symptom and a source of mutating visions" (Helmreich, 1998, p. 11) about bodies and their unnatural couplings with technology.

Space media refuses to produce commentaries on whether or not bodies can survive and thrive in outer space. Rather, its premise is that the act of sending bodies to space, in fact and in fiction, is political. By putting emphasis on the politics of migrating bodies, our objective is to engage with the "consequences of the encounter between meaning and matter," (Webb Keane quoted in Helmreich, 2007, p. 632) that is, to engage with the new materializations of bodies brought about by outer space. Put otherwise, we actively seek to avoid the reduction of bodies to the commentaries of social constructionists and instead capture the nascent tendencies threaded by their cosmic materializations.

Spacesuits, writes architect Nicholas de Monchaux (2011), mediate the uninhabitable. Cyborgs, writes cultural anthropologist Stefan Helmreich (2007), thread bodies "into a media ecology of communication and control, networked into a semiotic order that extends, modulates, and conditions our senses" (p. 622). These two quotes encapsulate the point of friction from which space media seeks to investigate the body: its modes of habitability, on the one hand, and its metamorphosis (physical, psychic, and semiotic), on the other. Space media looks at bodies and environments in action with the objective of problematizing the economy of their co-origins and co-becoming in virtue of connections, limitations, and affinities. To achieve this, the image of the cyborg should be mobilized not as a prosthesis for the spatial representation of the body but as "a prosthesis for cultural theorizing" (Helmreich, 1998, p. 24).

The cyborg (Clynes & Kline, 1960) is both the image of a possibility and a constraint: it mediates the uninhabitable, making it possible for bodies to live in inhospitable environments; it also shields/protects bodies from these uninhabitable conditions (Krueger, 2009). The cyborg produces a double image of the body: one

as we know it and one as it could be. It is within this ambiguity that space media seeks to diagram the modes of existence of cosmic bodies.

The hybrid image of the cyborg, half body/half spacecraft in a "vital if not biologically generative association" (Olson, 2010, p. 175), that informed the early stages of space travel is now outdated. Recent space missions, including extrasolar explorations (rendered possible through remote sensing and electromagnetism) and galactic travel, have given rise to new integrative systems beyond conventional human and robotic flight (Launius & McCurdy, 2007). The false opposition between humans and robots has shifted into a contrast between artificial intelligence and biotechnology. In *Ce que Gagarin a vu: condition orbitale et transcendence technique*, Elie During (2017) addresses the temporal and spatial scales of space exploration. He suggests that probes and satellites constitute a technological prosthesis that form an inorganic body that extends the human sensorium. Seeking to assess the meaning and impact of this inorganic body, he contrasts the technical transcendence of space travel with its associated subjective dimensions to propose that space is a location to visit more than to inhabit, in that it offers an unspoken opening of the Earth's field. Thus, for During (2017), outer space is less about the discovery of a new place than it is about the discovery of a new planetary point of view, which gives humanity a new point of view of itself. Space media captures this shift by reinscribing the image of the cyborg as more than a prosthesis of human experience, that is, as an image that is no longer problematized ontologically as a transgression (Lamarre, 2012) or historically as a technical artifactuality (Hansen, 2006; Mitchell & Hansen, 2010) but culturally in terms of a machine ecology (Lamarre, 2012). Space exploration presents us with an opportunity to think of a technical culture where bodies can exist between machines; where they can connect with their potentialities and "insert themselves into the true tendency of technical evolution" (Lamarre, 2012, p. 61).

To repeat, at the crossroad of habitability and bodily metamorphoses, space media proposes to diagram the genealogy of the body's technological couplings—bodies as we know them—while at the same time capturing the occasion to open them to new modalities of existence—bodies as they could be. Space media looks at the immediacy of the relations between bodies and environments to insist on the creative dimensions of this encounter in order to reflect on alien politics of inhabitation. The bodies of space media are thus bodies taken in their environmental modalities as mediators of life, life forms, and lifeways.

Infrastructure

Space media foregrounds our (near) total dependence on infrastructure. Much of our communication systems as well as navigation and meteorological information are carried by satellite constellations in the Geostation Earth Orbit, a (contested) extension of our political-economic sovereignties on Earth (Collis, 2009; Gabrys, 2016,

Parks, 2005). To overcome gravity, spacecrafts are propelled by launch systems, a product of constant human engagement, and the ground segments of space infrastructure: launch sites, tracking stations, and mission control centres (Holdway, 2003; Lal, Balakrishnan, Caldwell, Buenconsejo, & Carioscia, 2018; Peldszus, 2020). Once in space, humans and non-human species rely on habitable enclosures that translate bodies into living systems whose data is being collected and streamed to monitoring stations for real-time analysis and control (Aronowsky, 2019; Olson, 2010).

Space infrastructure embodies and enables intricate systems of interconnectivity between Earth and outer space. Our earthly and space activities do not unfold *above* infrastructure but *within* it. Infrastructure structurally envelops complex configurations: data gathering, data storing, and the processing capacities of media. It provides a testing ground for probing the limits of human capacity, offering a materialized condensation for the progressivist mode of futurity wherein the borders between habitability and inhospitality are negotiated (O'Reilly & Salazar, 2017).

Space infrastructure refuses to be constricted to any centrally organized locale. It operates as highly networked systems and the corresponding formation of human social, political, and cultural milieus (Larkin, 2013; Parks, 2015; Star, 1999; Starosielski, 2015). In *Roadside*'s third edited collection, "Infrastructure On/Off Earth," Christine Bichsel (2020) interrogates the meaning embedded in the slash between "on/off Earth" for space infrastructure. As per Bichsel (2020), the slash is helpful to reveal the terra-centric assumptions and theoretical limitations currently informing the "infrastructural turn" (p. 2) in the social sciences. "On/off" alludes to simultaneity and relatedness, but also to the separation of geographical domains and temporalities with arbitrarily constructed boundaries (Friedman, 2010).

Space infrastructure comes into being via a convoluted interplay of "on Earth" and "off Earth." The International Space Station's modular segments, robotic arms, living quarters, and experimental bays constitute a highly elaborate architecture that constantly collects and distributes data, structuring intense, all-encompassing mediation that gives form to life in orbit. It constructs a multilayered orchestration of "communicative spaces" that link both its terrestrial and orbital exterior via the Tracking and Data Relay Satellite System (Damjanov & Crouch, 2020). The analytics of the extreme (environments) do not merely inform our understanding of humanness, environment, temporality, and multi-species entanglements on an apocalyptic Earth, they also give shape to the imagination of extraterrestrial futures and modes of existence that cannot yet be fully martialized but that humankind strives toward (Valentine, Olson, & Battaglia, 2012). Earth and outer space are enacted as mutually constitutive categories in our infrastructural lives. Space infrastructure diagrams a kind of (post-planetary) *processual emergence* in the Simondonian sense wherein Earth and outer space take shape as relational modalities of existence.

Bichsel (2020) uncovers the "power asymmetry" (p. 4) embedded in space infrastructure. "On Earth" (p. 4), so far, remains the dominant epistemological

and normative framework that governs the imaginaries and material configuration of space activity. Space infrastructure is haunted by colonizing impulses—seeking to extend human expansion into new territories and saving a Noah's Ark of earthly species from environmental degradation and possible atomic apocalypse on Earth (Anker, 2005). Skeptical scholars such as Isabelle Stengers (2015) and McKenzie Wark (2015) have criticized the exploitative hegemonies of space infrastructure and its emerging status as the next capitalist frontier.

But how can we imagine outer space without reproducing the existing hegemonies of colonial terminology and capitalist exploitation? Bichsel (2020) has pointed out that thinking *in* and *through* the processual relationalities of media opens up opportunities to subvert the hegemonies that undergird current space infrastructures. Media informs our understanding of outer space. Hence, it is not enough to have media simply exist without being questioned. As Andrew Feenberg (2002) writes, "the most important question to ask about modern societies is therefore what understanding of human life is embodied in the prevailing technical arrangements" (p. 19). To unpack the implications of media, according to Lisa Parks (2015), we need to think not only about "what they represent [as] they relate to a history of style, genre, or meaning but also … more *elementally* about what they are made of and how they arrived" (p. 256). More importantly, we need to be attentive to the politics of space media infrastructure at its different stages: planning, implementation, and ultimately, obsolescence, that is, when space media becomes dysfunctional and is thus "disposed" *somewhere.*

Remains

Ever since the launch of Sputnik 1 into space on October 4, 1957, thousands of space media have been sent into Earth orbit and beyond. Media, however, are not forever operational. Technologies can and do, in fact, "die" in the lonesome weightlessness of outer space. The obsolescence of these media objects, combined with the astronomical costs associated with the retrieval of dysfunctional or broken space artefacts, has led to the proliferation of what has been referred to as "orbital debris": abandoned or broken human-made objects in orbit.

Some space media have also surprised with their *un*willingness to die: the Mars rover Opportunity, for example, was forecast to last only three months after landing on the Martian surface in 2004. In reality, it kept going for another 15 years, until a heavy Martian sandstorm covered its solar panels and rendered it powerless. Despite its endurance, Opportunity has become a complex dead medium on another planet, a relic of human scientific exploration, and thus a media archaeological instrument of the future. As Siegfried Zielinkski (2006) points out, the extension of media infrastructures into space has even left some unexpected objects, such as analogue cameras, floating in space. When astronauts of the MIR space station were done taking pictures of Earth for filmmaker Andrei Ujica's doc-

umentary *Out of the Present*, the roll was removed and the camera was discarded through the escape hatch: "taking it back to Earth would have been too expensive, and it was not considered worthwhile to develop a special program just to destroy a few kilograms of media technology" (p. 2). Due to a mixture of engineering, economic, and environmental constraints, both the analogue camera and the Martian rover are left to decay off Earth, remains of a culture that once was, waiting for discovery by future historians (Parikka, 2013).

Archeologists have already noted the value of space exploration artefacts for the study of human material culture, with some scholars having called for the preservation of these remains as cultural heritage (Gorman, 2019; O'Leary & Capelotti, 2015). Space media represent the extension of human material culture into interplanetary space and can provide archeologists with a glimpse into the history of space exploration. This history, however, is traditionally told through hegemonic narratives in which only certain technologies have a role. If we turn the focus toward abandoned and obsolete space media, we can enforce the archaeological approaches with what Zielinski (2006) calls "anarchaeology": the idea that the history of media does not so much depict a linear progression as one eclectically branching toward new inventions and dead-end streets. Following Zielinksi's advice, it is only through uncovering the individual media of outer space that we can fully comprehend our extraplanetary present/presence. What do we uncover when we let satellites or space shuttles speak in their radical presence (Roy, 2017)? And what can we learn through assuming the perspective of what remains?

It is important to note that not all remains are extraplanetary after their obsolescence. Satellites and other space artefacts have been increasingly taken in by the gravitational pull of the Earth and fallen back to their planet of origin. These "orbital ruins," as Parks (2013) terms them, pose security and ecological concerns, threatening populations, properties, and the environment itself with their re-entry into the atmosphere and impact on the planet. Take, for example, the Soviet reconnaissance satellite Kosmos 954, which malfunctioned and crashed into the Great Slave Lake of the Northwestern Territories in 1978. Kosmos 954 was powered by a thermionic converter carrying uranium-235, which meant that its debris littered radioactive material across the region, contaminating the area for years to come (Harland & Lorenz, 2005; Parks, 2009). When orbital debris crashes into the Earth, it "[inscribes] its presence in the geological crust or underwater, and [becomes] both techno-trash and archaeological relic" (Parks, 2013). As such, the existence of electronic waste in space, as well as its potential return to Earth, "entangles … the extraterrestrial into a geological discourse" (Parikka, 2015, p. 129).

Sean Cubitt (2017) reminds us that space media are implicated in questions of geology and ecology, not only upon their potential return to the planet but already *during* their departure: space launches are themselves anthropocenic indicators as they inscribe themselves onto the geological layer of the Earth through

the release of hydrochloric acid, carbon monoxide, and aluminium oxide. In fact, space media, as all technologies, are always already entangled with the earthly geophysical environment—whether we are talking about seventeenth-century telescopes or the spacecraft created in the twenty-first century, the construction of these media relies on extractivist environmental practices for the acquisition of its constituting metals. For the materialist media theorists, the elemental properties of media reveal that nature and technology have never been separate (Gabrys, 2011; Hogan, 2015; Mattern, 2017; Peters, 2015). The affordances of natural materials shape the technomediation of cultures. What would computers be without silicon, or spacecraft without aluminium? As Jussi Parikka (2015) writes, with the technological extensions into outer space "[t]he material memory of the earth continues outside its surface. The junk orbit is one of future media fossils, which as a project fuses a deep time interest with the technological realities of contemporary geopolitics" (p. 127). Geology thus becomes a powerful tool for a media materialist analysis of space media.

Medium

Approaches to space media are invested in assessing media that make the universe knowable for us and shape the ways we see and approach it. Equally, these mediated practices are about theorizing the changes that planetary attachments bring to our body and senses; for example, space media comes into play when we are breaking our "terrestrial habits of movement and orientation" (Jue, 2020, p. 2) by entering gravitational fields that differ from the Earth (Boucher, 2016). These often human-centric approaches resonate with the different understanding of media in the history of media theory. For example, Mark Hansen (2006) explains, media theory often oscillates between two visions: on one hand we have a definition of a medium as a "technical form" (p. 298) and on the other we can define "the medium as an *environment for life*" (p. 299). For Hansen, "the medium, and mediation as such, *necessarily involves the operation of the living, the operation of human embodiment*" (p. 300).

Turning a planet into a medium often begins with human embodiment. Jennifer Gabrys (2016) argues that communication technologies can remake people and environments. Drawing on Marshall McLuhan's idea of Sputnik turning the Earth programmable and Felix Guattari's notion of "planetary computerization," Gabrys (2016) is talking about mediation at the planetary scale, where different sensing technologies "give rise to new ecologies" (p. 15). Terraforming a planet such as Mars into one livable for humans could mean technically altering its atmosphere and climate (McKay, Toon, & Kasting, 1981). The designs for life in outer space have to deal with extreme environments, but they also reflect our desires and anxieties (Scharmen, 2018). Jussi Parikka (2015) moves from ecology to geology and points out that there is a growing interest in mapping the resources

that can be mined and extracted "outside our planetary scale" (p. 129). One example is lunar ice, which exists in the soil as tiny ice grains and could be mined and turned into rocket fuel that would make interplanetary travel easier (Patel, 2020). Space media at the astronomical scale are understood infrastructurally, geologically, and ecologically through particular human embodiments that produce the view of the world (Vogl, 2008).

This view is constructed not only by infrastructures but also other imaginaries. Consider the iconic "Earthrise" photo in which the Earth becomes visible from behind the moon (see Bratton, 2016; Farman, 2010; Gabrys, 2016; Russill, 2017). While much has been written about how "Earthrise" allowed us to see the Earth in a new way, less has been written about the fact that the Apollo 8 mission also indicates the moment where the moon occulted humans from seeing the Earth for the first time. In the case of occultation, the celestial scale media are mass media in the sense that they are a large body of matter that obstructs human vision and, while doing so, refuses to become reduced to human embodiment.

Chris Russill (2017) recommends taking the non-human perspective seriously and understanding the Earth as a medium in itself: "The earth is an optical medium … The planet's habitability rests on how it processes light" (Maddalena & Russill, 2015, p. 3188). In fact, for Russill (2017) the Earth is a "medium long before it is our home, a ship, an ecosystem, a globe, Gaia, a blue marble, or any of the other popular figurations of the earth." He points out that it is the human experience of the existential crisis, from ozone holes to the Anthropocene, that have forced us to think about the Earth as a medium. While his focus is on Earth, he alludes to thinking of all celestial objects, including moons, planets, and interstellar objects, as media in themselves. This is the moment for the Oumuamua, an interstellar object, to enter our vision. This object was observable for eleven days in 2017 (Loeb, 2021). Controversial claims were made, even by astronomers, that this object was something that had not been witnessed before and should be at least considered to be of alien origin (Loeb, 2021).

The Oumuamua might have been an alien transport medium, a communication medium, a part of non-human space media. What is important, however, is that we do not need aliens to show the problems of human embodiment (or extension) as a defining characteristic of media. Space media challenges the human perspective and brings along a geocentric criticism. The celestial scale of space media shows that the geocentric and anthropocentric approaches, our "specific planetary situatedness" (Bratton, 2016, p. 355), are not given. Space media reorients our view—epistemologically, culturally, and politically—and necessitates a need for "off-Earth" perspectives (Bichsel, 2020; Bratton, 2019).

Conclusion

The task of this article has been to build grounds for and advance space media research. The six conceptual approaches identified here—epistemology, imaginaries,

bodies, infrastructure, remains, and medium—do not aim to form an inclusive definition of space media. Rather, they are lines of flight (Deleuze & Guattari, 1987) to help us make connections between what exists and what can become.

A program that investigates space media can emerge from these notions and can be further built around various lines of inquiry. The first examines the history and materiality of different technologies of space media, including satellites, space stations, rovers, rockets, and communication technologies. The second is about the cosmological, epistemological, and ethical projects of space media and how we culturally and politically locate our own space and role in it. The third examines media representations of outer space's related activities in journalism, popular culture, science, science communication, and science fiction. The fourth is a project of space media theory that seeks to understand how voyages into outer space change the way we conceive, understand, and define the notion of media, its roles and impacts. The fifth project traces the contested and emergent political economies of exploration, colonization, capitalization, and the communization of interplanetary existence through media as it becomes a project not only for nation states but also for commercial actors, civilians, artists, and media practitioners.

Not all media is space media, but many media can and have become part of it. Space media invokes the spatial turn of media theory in the early 2000s that examined "spaces created by media, and the effects that existing spatial arrangements have on media forms as they materialize in everyday life" (Couldry & McCarthy, 2003, p. 2) without focusing on the obvious: the creation of outer space. The limits of the outer, the outside, the external are defined by the limits and constraints of space media: the methods of travel, instruments of research, politics of representation, and theories of matter, to give a few examples. In other words, what is understood as outer space does not exist without media that makes it known and poses the very limits of its knowability.

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References

Anker, Peder. (2005). The ecological colonization of space. *Environmental History, 10*(2), 239–268

Aronowsky, Leah. (2017). Of astronauts and algae: NASA and the dream of multispecies spaceflight. *Environmental Humanities, 9*(2), 359–377. doi:10.1215/22011919-4215343

Balsamo, Anne. (2011). *Designing culture: The technological imagination at work*. Durham, NC: Duke University Press.

Berland, Jody. (1996). Mapping space: Imaging technologies and the planetary body. *Technoscience and cyberculture*, 123–138.

Bertone, Gianfranco, & Hooper, Dan. (2018). A history of dark matter. *Reviews of Modern Physics, 90*(4), 045002, 1–32. doi:10.1103/RevModPhys.90.045002

Bichsel, Christine. (2020). Introduction: Infrastructure on/off Earth. *Roadsides*, *3*, 1–7. doi: 10.26034/roadsides-202000301

Boucher, Marie-Pier. (2016). Architectures of aliveness: Building beyond gravity. In C.N. Terranova & M. Tromble (Eds.), *The Routledge Companion to Biology in Art and Architecture,* New York, NY: Routledge.

Bowker, Geoffrey C., & Star, Susan Leigh. (1999). *Sorting things out: Classification and its Consequences*. Cambridge, MA: MIT Press.

Bratton, Benjamin H. (2016). *The stack: On software and sovereignty.* Cambridge, MA: MIT Press.

Bratton, Benjamin H. (2019, September 18). Excerpt: *The terraforming* by Benjamin H. Bratton. *Strelka Mag.* URL: https://strelkamag.com/en/article/excerpt-bratton-the-terraforming [August 14, 2021].

Casumbal-Salazar, Iokepa. (2017). A fictive kinship: Making "modernity," "ancient Hawaiians," and the telescopes on Mauna Kea. *Native American and Indigenous Studies, 4*(2), 1–30. doi: 10.5749/natiindistudj.4.2.0001

Clynes, Manfred E., & Kline, Nathan S. (1960, September). Cyborgs and space. *Astronautics*.

Collis, Christy. (2009). The geostationary orbit: A critical legal geography of space's most valuable real estate. *Sociological Review, 57*(1), 47–65. doi:10.1111/j.1467-954X.2009.01816.x

cosmos. (2021). *Oxford Reference*. doi:10.1093/oi/authority.20110803095641467. [August 16, 2021].

Couldry, Nick, & McCarthy, Anna. (2003). Introduction: Orientations: mapping MediaSpace. In N. Couldry & A. McCarthy (Eds.), *MediaSpace* (pp. 1–18). New York, NY: Routledge.

Crary, Jonathan. (1990). *Techniques of the observer*. Cambridge, MA: MIT Press.

Cubitt, Sean. (2017). *Finite media: Environmental implications of digital technologies*. Durham, NC: Duke University Press.

Damjanov, Katarina, & Crouch, David. (2020). Mooring a space station: Media infrastructure and the inhuman environment. *Roadsides*, *3*, 7–14. doi:10.26034/roadsides-202000302

Deleuze, Gilles, & Guattari, Félix. (1987). *A thousand plateaus: Capitalism and schizophrenia*. Minneapolis, MN: University of Minnesota Press.

de Monchaux, Nicholas. (2011). *Spacesuit: Fashioning Apollo*. Cambridge, MA: MIT Press.

During, Élie. (2017, March/April). Ce que Gagarin a vu: condition orbitale et transcendance technique. *Esprit, 3*(Mars), 59–67. URL: https://esprit.presse.fr/article/during-elie/ce-que-gagarine-a-vu-condition-orbitale-et-transcendance-technique-39258 [June 28, 2021].

Farman, Jason. (2010). Mapping the digital empire: Google Earth and the process of postmodern cartography. *New Media & Society*, *12*(6), 869–888.

Feenberg, Andrew. (2002). *Transforming technology: A critical theory revisited.* Oxford, UK: Oxford University Press.

Friedman, Susan Stanford. (2010). Planetarity: Musing modernist studies. *Modernism/modernity, 17*(3), 471–99.

Gabrys, Jennifer. (2016). *Program Earth: Environmental sensing technology and the making of a computational planet.* Minneapolis, MN: University of Minnesota Press.

Galison, Peter, & Kessler, Elizabeth. (2019). To see the unseeable: Peter Galison in conversation with Elivabeth Kessler. *Aperture,* (237), 72–77.

Gorman, Alice. (2019). *Dr Space Junk vs The Universe: Archaeology and the future*. Cambridge, MA: MIT Press.

Hamilton, Elizabeth C. (2017). Afrofuturism and the technologies of survival. *African Arts*, *50*(4), 18–23. doi:10.1162/AFAR_a_00371

Hansen, Mark B.N. (2006). Media theory. *Theory, Culture & Society*, *23*(2–3), 297–306. doi:10.1177/0263276406023002256

Haraway, Donna. (1988). Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies, 14*(3), 575–599.

Harland, David M., & Lorenz, Ralph. (2005). *Space systems failures: Disasters and rescues of satellites, rockets and space probes*. Berlin, DE: Springer.

Helmreich, Stefan. (1998). *Silicon second nature. Culturing artificial life in a digital world.* Berkeley, CA: University of California Press.

Helmreich, Stefan. (2007). An anthropologist underwater: Immersive soundscapes, submarine cyborgs, and transductive ethnography. *American Ethnologist, 34*(4), 621–641. doi: 10.1525/ae.2007.34.4.621

Hogan, Mél. (2015). Data flows and water woes: The Utah Data Center. *Big Data & Society, 2*(2), 1–12. doi: 10.1177/2053951715592429

Hui, Yuk. (2016). *The question concerning technology in China: An essay in cosmotechnics.* Cambridge, MA: MIT Press.

Hui, Yuk. (2019). COSMOTECHNICS. *Angelaki, 25*(4), 1–2. doi:10.1080/0969725X.2020.1790828

Innis, Harold. (1951). *The bias of communication*. Toronto, CA: University of Toronto Press.

Jue, Melody. (2020). *Wild Blue Media: Thinking through Seawater.* Durham, NC: Duke University Press.

Kessler, Elizabeth. (2012). *Picturing the cosmos: Hubble Space Telescope images and the astronomical sublime*. Minneapolis, MN: University of Minnesota Press.

Kittler, Friedrich. (1999). *Gramophone, film, typewriter.* Stanford, CA: Stanford University Press.

Krämer, Sybille. (2006). The cultural techniques of time axis manipulation: On Friedrich Kittler's conception of media. *Theory, Culture & Technology, 23*(7–8), 93–109. doi:10.1177/0263276406069885

Krueger, Ted. (2009, March 2). Mediated perception: Towards an experience of extreme environments, mutamorphosis. *MutaMorphosis: Challenging Arts and Sciences.* URL: https://mutamorphosis.wordpress.com/2009/03/02/mediated-perception-towards-an-experience-of-extreme-environments/ [June 28, 2021].

Lal, Bhavya, Balakrishnan, Asha, Caldwell, Becaja M., Buenconsejo, Reina S., & Carioscia, Sara A. (2018). *Global trends in Space Situational Awareness (SSA) and Space Traffic Management (STM)*. IDA Document D-9074. Washington, DC: Science & Technology Policy Institute.

Lamarre, Thomas. (2012). Humans and machines. *Inflexions*, 5. Open Humanities Press. URL: http://www.inflexions.org/n5_lamarrehtml.html [June 28, 2021].

Launius, Roger D., & McCurdy, Howard. (2007). Robots and humans in space flight: Technology, evolution, and interplanetary travel. *Technology in Society, 29*(3), 271–282. doi:10.1016/j.techsoc.2007.04.007

Larkin, Brian. (2013). The politics and poetics of infrastructure. *Annual Review of Anthropology,* [42], 327–343. doi:10.1146/annurev-anthro-092412-155522

Loeb, Avi. (2021). *Extraterrestrial: The first sign of intelligent life beyond earth.* Boston, MA: Houghton Mifflin Harcourt Publishing.

Maddalena, Kate, & Russill, Chris. (2016). Is the Earth an optical medium? An interview with Chris Russill. *International Journal of Communication, 10*, 3186–3202.

Mattern, Shannon C. (2017). *Code + clay… data + dirt: Five thousand years of urban media.* Minneapolis, MN: University of Minnesota Press.

McKay, Christopher P., Toon, Owen B., & Kasting, James F. (1991). Making Mars habitable. *Nature, 352*(6335), 489–496. doi:10.1038/352489a0

McLuhan, Marshall. (1964). *Understanding media: The extensions of man.* New York, NY: McGraw Hill Education Press.

Mitchell, W.J.T., & Hansen, Mark B.N. (2010). *Critical terms for media studies.* Chicago, IL: University of Chicago Press.

National Geographic. (1934, July–December). Else Bostelmann. In *National Geographic, Vol. 66*, p. 694.

Nelson, Alondra. (2002). Introduction: Future texts. *Social Text, 20*(2[71]), 1–15. doi:10.1215/01642472-20-2_71-1

O'Leary, Beth Laura, & Capelotti, P.J. (Eds.). (2015). *Archaeology and heritage of the human movement into space*. Cham, CH: Springer International Publishing. doi:10.1007/978-3-319-07866-3

Olson, Valerie. (2010). The ecobiopolitics of space biomedicine. *Medical Anthropology, 29*(2), 170–193. doi:10.1080/01459741003715409

O'Reilly, Jessica, & Salazar, Juan Francisco. (2017). Inhabiting the Antarctic. *The Polar Journal, 7*(1), 9–25. doi:10.1080/2154896X.2017.1325593.

Packer, Jeremy, & Reeves, Joshua. (2020). *Killer apps: War, media, machine*. Durham, NC: Duke University Press.

Parikka, Jussi. (2013). *What is media archaeology?* Cambridge, UK: Polity Press.

Parikka, Jussi. (2015). *A geology of media*. Minneapolis, MN: University of Minnesota Press.

Parks, Lisa. (2005). *Cultures in orbit: Satellite and the televisual*. Durham, NC: Duke University Press.

Parks, Lisa. (2009). When satellites fall: On the trails of Cosmos 954 and USA 193. *Flow Journal*. URL: https://www.flowjournal.org/2009/06/when-satellites-fall-on-the-trails-of-cosmos-954-and-usa-193lisa-parks-uc-santa-barbara/ [28 June 2021].

Parks, Lisa. (2013). Orbital ruins. *NECSUS*, *#Waste*. URL: https://necsus-ejms.org/orbital-ruins/ [28 June 2021].

Parks, Lisa. (2015). Stuff you can kick: Toward a theory of media infrastructures. In P. Svensson & D.T. Goldberg (Eds.), *Between humanities and the digital* (pp. 355–373). Cambridge, MA: MIT Press.

Patel, Neel V. (2020, May 19). Here's how we could mine the moon for rocket fuel. *MIT Technology Review*. URL: https://www.technologyreview.com/2020/05/19/1001857/how-moon-lunar-mining-water-ice-rocket-fuel/ [June 28, 2021].

Peldszus, Regina. (2020). Space infrastructure resilience: Reflections on recovered launch debris. *Roadsides, 3*, 30–41. doi:10.26034/roadsides-202000305

Peters, John Durham. (1999). *Speaking into the air*. Chicago, IL: University of Chicago Press.

Peters, John Durham. (2012). Calendar, clock, tower. In J. Stolow (Ed.), *Deus in machina: Religion and technology in historical perspective* (pp. 25–42). New York, NY: Fordham University Press.

Peters, John Durham. (2015). *The marvelous clouds: Toward a philosophy of elemental media*. Chicago, IL: University of Chicago Press.

Prescod-Weinstein, Chanda. (2021) *The disordered cosmos: A journey into dark matter, spacetime,& dreams deferred*. New York, NY: Bold Type Books.

Roy, Elodie A. (2017). For a radical media archaeology: A conversation with Wolfgang Ernst. *NECSUS*, *#True*. URL: https://necsus-ejms.org/for-a-radical-media-archaeology-a-conversation-with-wolfgang-ernst/ [June 28, 2021].

Russill, Chris. (2017). Is the Earth a medium? Situating the planetary in media theory. *Ctrl-Z: New Media Philosophy*, *7*. URL: http://www.ctrl-z.net.au/articles/issue-7/russill-is-the-earth-a-medium/ [June 28, 2021].

Ruth Rand, Lisa. (2018, January 14). Colonizing Mars: Practicing other worlds on Earth, *Brewminate*. URL: https://brewminate.com/colonizing-mars-practicing-other-worlds-on-earth [June 28, 2021].

Scharmen, Fred. (2018, August). The shape of space. *Places Journal*. URL: https://placesjournal.org/article/the-shape-of-space/ [June 28, 2021].

Sherrer, Deborah. (2018) *Ancient observatories-timeless knowledge*. Standford, CA: Stanford Solar Center. URL: http://solar-center.stanford.edu/AO/Ancient-Observatories.pdf [June 28, 2021].

Smiles, Deondre. (2020). The settler logics of (outer) space. *Society + Space*. URL: https://www.societyandspace.org/articles/the-settler-logics-of-outer-space [June 28, 2021].

Star, Susan Leigh. (1999). The ethnography of infrastructure. *American Behavioral Scientist, 43*(3), 377–391. doi:10.1177/00027649921955326

Starosielski, Nicole. (2015) *The undersea network*. Durham, NC: Duke University Press.

Stengers, Isabelle. (2015). *In catastrophic times: Resisting the coming of barbarism*. London, UK: Open Humanities Press.

Strickland, Ashley. (2021, February 19). Incredible new images shared by Perseverance rover after Mars landing. *CNN*. URL: https://www.cnn.com/2021/02/19/world/mars-rover-new-images-scn-trnd/index.html [June 28, 2021].

Valentine, David, Olson, Valerie A., & Battaglia, Debbora. (2012). Extreme: Limits and horizons in the once and future cosmos. *Anthropological Quarterly, 85*(4), 1008–1026. doi:10.1353/anq.2012.0066

Verne, Jules. (1865). *From the Earth to the Moon* [Originally published in French: De la terre à la lune]. (First published in English in 1867)

Vogl, Joseph. (2007). Becoming-media: Galileo's telescope. *Grey Room*, *29*, 14–25.doi: 10.1162/grey.2007.1.29.14

Wark, McKenzie. (2015). *Molecular red: Theory for the Anthropocene.* London, UK: Verso.

Wells, H.G. (1898). *The war of the worlds.* Leipzig, DE: B. Tauchnitz.

Zielinski, Siegfried. (2006). *Deep time of the media: Toward an archaeology of hearing and seeing by technical means.* Cambridge, MA: MIT Press.