

Journal of Theoretical & Philosophical Criminology

ISSN: 2166-8094

Jtpcrim July/August 2025: 35-58

A Prospective Typology of Astrocide*

Yarin Eski, Vrije Universiteit Amsterdam (y.eski@vu.nl)

Abstract

Space expansionism, embodied by space mining companies and planned space colonization, dominates the space agenda. It is an inherently exploitative agenda that could have entirely annihilative consequences in the future, although its intentions are already underway. Criminology, and particularly space criminology, has only begun to analyze these developments critically. Analogous to European colonial expansionism, which was driven by unbridled capitalism and led to genocide and later ecocide, space expansionism could result in astrocide. Yet, any future-oriented understanding of astrocide, defined as the destructive exploitation and total annihilation of celestial bodies and any potential extraterrestrial life, remains absent. Therefore, by learning from current definitions of astrocide and drawing on genocide studies, a prospective typology of astrocide is introduced, adapting Vahakn N. Dadrian's genocide framework (1975) to outer space. Four forms of astrocide are proposed: latent astrocide (interplanetary contamination and planetary defense), utilitarian astrocide (exploitation of extraterrestrial nullius), optimal astrocide (terraforming), and biocultural astrocide (transhumanism).

Keywords: astrocide, space criminology, typology, Dadrian, genocide, prospective theorizing

*This contribution is based on a revised and expanded version of a paper I delivered, titled *Toward a Prospective Typology of Astrocide*, at the Crime, Justice & Society Seminar Series of the Edinburgh Law School, University of Edinburgh, on April 2, 2025 (Source: <https://www.law.ed.ac.uk/news-events/events/cjs-seminar-yarin-eski>).

1. Introduction

Of course you can terraform Mars. Why would they think you can't? You totally can (Elon Musk in D'Agostino, 2019 – online source).

Space mining companies and space colonization, as envisioned by billionaires such as Elon Musk and Jeff Bezos, dominate the space expansionist agenda, which is an inherently exploitative agenda. Criminology, particularly space criminology, has begun to analyze these developments critically (Eski & Lampkin, 2025; Lampkin & White, 2023; Rothe & Collins, 2025). These developments could have obliterating effects in the future and should raise significantly greater criminological concern prospectively, as genocide and ecocide have received mostly retrospectively. Therefore, this contribution will deliver a criminological focus on *astrocide*, which comprises the total annihilative outcome of deliberate exploitation, fundamental alteration, and mass destruction of celestial bodies and extraterrestrial life and ecosystems by the dominant space-faring actors, which are at this moment large space corporations, such as SpaceX, and space agencies, such as NASA and ESA. In particular, it will focus on *astrocide* as the future outcome of the contemporary, inherently exploitative agenda of mining and colonization initiatives in space. In doing so, it seeks to anticipate future harm in a way that parallels how genocide and ecocide studies have analyzed historical atrocities.

Unlike retrospective criminologies of European colonialist expansion to the “New World,” driven by unbridled capitalism that led to genocide of Indigenous people and ecocide of their environments (Crook, 2024), specifically space criminology has the opportunity to provide a future-oriented critical exploration of *astrocide*. Therefore, this paper proposes a *prospective* typology of *astrocide* grounded in Vahakn N. Dadrian's typology of genocide (1975). It is a typology that has influenced other work acknowledging genocide as a concept in the broadest sense, capturing not just one type of total annihilation but, more importantly, a spectrum of modes of systematic, (un)intentional destruction, primarily humans killing other humans *en masse*, but also animals and the environment (De Waal, 1997; Jones, 2016; Lemkin, 2005 [1944]; Moses, 2010; Schabas, 2010; Totten, Bartrop & Jacobs, 2008). This typology has been used and enriched by criminologists and victimologists as well (cf. Day & Vandiver, 2000; Hagan & Raymond-Richmond, 2009; Eski, 2021; Rafter, 2016; Woolford, 2006).

The aim of this typology is to offer an important cautionary perspective, primarily forecasting what might occur in the future, in order to enable current (space) criminology to think differently about justice, responsibility, and what it means to protect life and ecosystems—beyond just Earth. By considering *astrocide* now and exploring its potential future manifestations off-Earth, criminology and law could even identify *astrocidal intent* in some of the current space exploration plans and ambitions.

To make a first step toward the prospective typology, this contribution will, first, trace the (definitional) initial glimmerings of *astrocide*. Next, the potential of prospective criminology for doing so will be discussed, followed by a concise overview of Dadrian's typology of genocide (1975). The remainder and larger part of this paper will use his typology to present a prospective typology of *astrocide*, consisting of *latent astrocide* (through interplanetary contamination and planetary defense), *utilitarian astrocide* (through astral resource exploitation of *extraterra nullius*), *optimal astrocide* (through terraforming), and *biocultural astrocide* (through transhumanism).

2. Initial glimmerings of *astrocide*

Any criminological typology must be evaluated by examining its intellectual foundation. This foundation involves imagination shaping clearly defined concepts, followed by a structured typology whose feasibility is assessed through diverse sources (Driver, 1968). An explicit definition of “*astrocide*,” based on a small body of scientific literature on *astrocide*, conceptualizes it as the

'destruction of astronomical progeny or phenomena or natural terrestrial environments beyond the Earth, especially when conducted deliberately by humans' (Taylorian, 2021: 63). Astrocide has also been defined as the monotheistic refutation or the death of astrology (Kaldellis, 2013: 57-58), essentially, the nullification of astrology.

Deudney (2020) offers the most detailed definition of astrocide as an inevitable outcome of unrestricted human expansion into space, comprising the destruction of Earth from above, and with it, the extinction of humanity. In the *Astrocene*, a 'very distinct phase of the Anthropocene,' he writes, resources and energies from space are detectable, then as they become influential in planetary balances, and finally as they come to dominate them' (id. 326). For Deudney, who also seems to be using a prospective approach, the end result of the Astrocene is astrocide as 'the extinction of humanity caused directly or indirectly by large-scale human space expansion—[and] must join the list of threats to the survival of humanity that already includes cosmocide, terracide, and other technogenic threats' and is, therefore, 'a form of technologically enabled species suicide' (Deudney, 2020: 362). He claims, 'large-scale space expansion promises astrocide, not reduction of existential risks,' yet a 'species death by astrocide can be avoided much more easily than by cosmocidal, terracidal, or other technogenic threats, simply by saying no' (id.: 371). Major space activities, often seen as progress, actually pose catastrophic risks, including human extinction by astrocide, turning these supposed steppingstones "for all humankind," into dangerous slippery slopes that, he concludes, should be approached with extreme caution, or avoided (id.: 378). Eventually, Deudney's astrocide warns of space expansion's dangers that are presented as positive, and he advocates a responsible, Earth-centered approach.

Due to his advocacy for halting space militarization, asteroid research, and space settlement because of the existential risk of astrocide, critics accuse him of engaging in space pessimism that rejects 'any further space exploration on the grounds of an instrumental calculation: that the mere costs or risks of polluting space and/or damaging vitally important technology that already exists there, combined with the possibility of nuclear exchange, outweigh in advance any possible gains' (Simpson et al., 2024: 8). This space pessimism, critics argue, may inadvertently sustain current models of space exploration rather than prompting more ethical alternatives, conceding to capitalist control by adopting an instrumental political logic.

Reflecting to an extent such pessimism, space criminological literature (Eski, 2023; Lampkin & White, 2023; Rothe & Collins, 2023; Takemura, 2018) analyzes environmental harms in space, including orbital debris, space mining, and atmospheric pollution. For example, Eski, although not phrasing it directly as astrocide, speaks of how the self-annihilating nature of humans extends into outer space (2023), where humans will engage in mass exploitation and total annihilation of celestial bodies, and even kill or prevent future extraterrestrial life from emerging. Lampkin speaks of harm to the space environment as a 'form of ecocide or astrocide, whereby environs are either destroyed, or prevented from materialising, as a direct consequence of anthropogenic activity' (2025: 95). Still, both authors refrain from delving further into the concept of astrocide. It is a missed opportunity, because in conceptualizing astrocide, space criminology could benefit from the validity of pessimism (within criminology) without falling into disengagement and inaction, while offering theoretical depth (Matthews, 2010: 137-138), as this paper attempts by projecting a typology of probable future forms of astrocide.

3. Prospective criminology and genocide typology

3.1 Expanding retrospective criminology through a prospective lens

Generally, once new domains of crime and crime control have presented themselves, criminology remains reactive, or worse, inactive, often slowly developing after-the-fact studies on, for example, maritime crime, aviation crime and cybercrime (cf. Eski & Wright, 2023; Dekker, 2011; Jaishankar, 2018). In other words, criminologists tend to respond only after significant harm has occurred.

Criminology (and victimology for that matter) has had a particularly problematic past of playing catch-up with studying the most atrocious crimes and victimization on Earth, including state crime, corporate crime, human rights violations, genocide, and ecocide (cf. Chambliss, 1989; Day & Vandiver, 2000; Eski, 2021; Haveman & Smeulers, 2008; Pearce & Tombs, 1990; South, 2009). Criminology's tendency to catch up belatedly, or even deny serious harms, reflects the enduring power of the State (and corporate sector) over criminology, deploying it as an instrumentalized scientific discipline of and for the State to scientifically convert criminality into definite, analyzable, preferably statistical, and homogeneous categories of crime (Young, 2011). As such, studies of state crimes such as genocide, despite being an established research field within criminology (cf. Green & Ward, 2000; Slapper & Tombs, 1999; Walklate & McGarry, 2015), remain to be considered "deviant knowledge" and problematically un(der)funded (Walters, 2003).

Although criminologists often analyze crimes that have already occurred, there are specific fields of criminology though that have been and continue to be forward-looking, such as (astro-)green criminology (cf. Lampkin, 2020; Sarliève, 2020; Takemura, 2019; White, 2017), in particular regarding the future of ecocide (Crook, 2024; Crook et al., 2018; Higgins et al., 2012) that draws convincingly on Raphael Lemkin's concept of genocide, first articulated in 1944 (2005 [1944]).

Notwithstanding the fact that the most robust criminological insights are derived from studying historical and empirical realities that form the empirical foundation that makes any form of prospective analysis possible and credible, to enrich retrospective criminology even more, a prospective approach is utilized here. Prospectively typologizing astrocide represents a proactive effort to prevent criminology from falling into future denial, as criminology once had toward genocide (Haveman & Smeulers, 2008), yet it fits the more recent prospective approaches within (astro-) green criminology and space criminology more broadly (Lampkin & White, 2023; Rothe & Collins, 2023; Takemura, 2019).

Incorporating fiction or imagined scenarios aligns well with prospective approaches (Egan, Kim & Akdere, 2023; Gümüşay & Reinecke, 2024; Muñoz & Dimov, 2023; Pavez, Godwin & Spreitzer, 2021), especially when criminologists shift the focus from past and present crimes to potential future abuses, particularly regarding the implications of emerging technologies and global power dynamics (Pemberton, 2014). Prospective criminologies on state crime and adaptations to it in analyses of it, address a wide range of future offenses and harms (Friedrichs, 2010; Rothe & Collins, 2023). In the simplest sense of the idea of prospective criminology, and in relation to state crime specifically, it is about the following question:

Will unimaginably good things, or unimaginably bad things – or some complex mix of these – occur? But much is at stake in anticipating the worst-case scenarios of what may lie ahead, in the spirit of a "prospective" criminology of crimes of states (Rothe & Friedrichs, 2018: 187).

To deliver a possible answer to this extraordinarily complex question, as Friedrichs argued (2010), prospective criminology should be grounded in a thorough understanding of past crimes and harms, while also incorporating a coherent framework that accounts for the rapidly changing dynamics of, specifically, globalization and postmodernity. It must be, therefore, retrospective, and prospective at the same time, as Rothe and Collins (2023) did with their prospective criminology of space weaponization as state-corporate crime and its environmental harms, adopting a zemiological approach.

The aimed at prospective criminological typology here consists, therefore, of realistic speculation about possible futures of astrocide that is based on knowledge of the real world (Heinlein & Serling in Joy, 2021: 235) and is oriented toward a future multitude of, in this case, types of astrocide and their possible state-corporate actors (Jasanoff & Kim, 2015), with the possibility to explore astrocidal intent now. In doing so, the astrocide typology follows the line of delivering prospective knowledge development in the fields of the social sciences with a specific socio-technological focus, as well as computational studies, environmental studies, business

studies, and military studies (cf. Burnam-Fink, 2015; Johnson, 2022; Merrie et al. 2018; Mubin et al. 2016; Popper, 2015; Schwarz, 2014).

Worth mentioning, is that prospective typologizing is different from precrime-insights feeding into predictive (AI-)policing with its discriminatory effects (Egbert & Mann, 2021; Sheehey, 2019; Zedner, 2007). Instead, prospection could enhance criminology's theoretical navigation of multiple possible futures that are becoming increasingly complex (Gümüşay & Reinecke, 2024: 5), such as space expansionism (Rothe & Collins, 2025, 2023). Creating a typology of plausible future forms of astrocide then involves a shift, going from mere projections to imaginative engagement, and from neutral observation to values-driven theorizing, as Tombs and Whyte (2003) suggested regarding their partisan criminologies of state-corporate crime. That is why the prospective typology of astrocide presented here tries to push criminology to go beyond reactive analysis and to actively contribute to shaping the future, in this case, regarding astrocide. In doing so, criminology could start delivering, instead of an after-the-fact criminology, a *before-the-act* conceptualization of the crimes of crimes (Rafter, 2016) once taken to a cosmic level.

3.2 Dadrian's typology of genocide

In prospecting *astrocide*, Fein's (2018) call to use 'the sociological imagination as a lens to understand how good and evil emerges from social action' is followed, which is a method employed in anticipating the futures of genocide in order to prevent them. Likewise, the criminological imagination (Young, 2011) enables us to think structurally and critically about future harm, even before they materialize. This imagination is not tethered to cataloging past atrocities but instead allows us to abstract ideal-types from historical patterns and processes of genocide, to be 'drawn as scripts to be enacted by fictive states' (Fein, 2018: 3). In doing so, astrocide is approached not just as a speculative sci-fi concern, but as a criminologically intelligible extension of terrestrial patterns of domination and destruction.

To do this, I apply Vahakn N. Dadrian's 1975 *Typology of Genocide*. He identifies five types of genocide based on power asymmetries, ideological rationales, and systemic violence, by which Dadrian offers a framework for understanding genocide as a recurring form of power-based harm wherein dominant groups seek to coerce, control, or annihilate subordinate groups. These acts are shaped by structural inequalities and the perpetrators' intent that determine the scale and nature of the violence.

By applying this typological method to astrocide, this paper aims to uncover how the destruction of celestial bodies could become systematized through state and/or corporate power, justified through ideology (e.g., progress, survival, colonization), and executed through technologies of coercion, resembling genocide. Importantly, I focus on genocide rather than ecocide, as astrocide—though involving ecological harm—is better understood through the lens of intentional domination, hierarchies of worth, and the instrumental use of destruction. Meaning, Dadrian's typology of genocide provides a conceptual apparatus for this; particularly in capturing the symbolic and material erasure of cosmic otherness under expanding regimes of extraction and control. Thus, the return to Dadrian's 1975 work is not historical nostalgia but a critical move to conceptualize astrocide as a future-oriented form of structural harm, echoing familiar genocidal logics in outer space environs. The five key types of genocide he identified are:

- a) **cultural genocide**, which comprises the erasure of a group's identity through forced assimilation, suppression of language, destruction of traditions, or systematic religious conversion. It is not about directly physically exterminating but instead seeking to dissolve the distinctiveness of a minority group (e.g., forced Christianization of Indigenous peoples in North America and the suppression of Armenian cultural identity within the Ottoman Empire);
- b) **latent genocide**, which occurs as an indirect consequence of political or military actions, such as forced deportations, economic deprivation, or warfare that disproportionately

affects certain groups (e.g., the Trail of Tears, during which thousands of Cherokee people perished following forced relocation);

c) **retributive genocide**, which is motivated by vengeance or deterrence, often used by dominant groups to punish perceived threats from a minority population (e.g., the Russian pogroms against Jews in the late 19th and early 20th centuries, where violent attacks were used to deter (political) resistance);

d) **utilitarian genocide** is motivated by economic, demographic, or political interests, in which a group is eliminated for perceived practical gains rather than ideological hatred (e.g., the Spanish Inquisition's persecution of Jews and Moors, allowing for the seizure of wealth and land, or resource-driven conflicts, such as the exploitation of Indigenous lands for commercial gain in which the logic of utilitarian genocide echoes);

e) **optimal genocide**, which is the most extreme form of genocide, as it involves the total annihilation of a targeted group, often facilitated by totalitarian regimes with unchecked power (e.g., the Holocaust, where, amongst others, six million Jews were systematically exterminated by Nazi Germany).

The typology has remained relevant for contemporary discussions in genocide studies on, for example, Rwanda (1994), Myanmar (Rohingya crisis), and Sudan (Darfur conflict) (cf. Kiernan, 2007). Dadrian's typology has also been used by several criminologists and victimologists studying genocide retrospectively (cf. Alvarez, 2009; Liwerant, 2007; Pruitt, 2021; Smeulers & Grünfeld, 2011) but will now be used prospectively.

4. A prospective typology of astrocide

While Dadrian proposed *five* forms of genocide, this prospective framework identifies *four* types of astrocide, each grounded in contemporary examples of space exploration (Joy, 2021), to highlight how the criminogenic origins—or *criminogenesis*—of astrocide may already be present in current space activities, having their astrocidal effects in the near future or far future. The types of astrocide that follow are not mutually exclusive and therefore not absolute but rather *ideal*-typical, presented in a different order than Dadrian's genocide types, and are subdivided into:

1. Latent astrocide: a) interplanetary contamination and b) planetary defense
2. Utilitarian astrocide: astral exploitation of *extraterra nullius*
3. Optimal astrocide: terraforming
4. Biocultural astrocide: transhumanism

A point of clarification is necessary here: while the term astrocide includes unintended and latent harms, including interplanetary contamination or planetary defense, this does not undermine its grounding in the logic of genocide. As Dadrian (1975) shows, not all genocidal violence results from immediate or explicit intent. For instance, latent and utilitarian genocide involve indirect mechanisms, structural neglect, or long-term patterns of domination, resulting in mass annihilation. This means that astrocidal intent as it will be referred to in the typology may not always be overt or declared, and instead could evolve through systemic indifference, techno-political logics, or speculative planning that enables catastrophic harm in the future without direct animus. Recognizing this spectrum of intent allows astrocide to remain conceptually coherent while encompassing both deliberate and emergent annihilative outcomes in outer space. The typology that follows is therefore designed to accommodate both direct and indirect pathways to destruction, spanning from *unintentional* contamination to ideologically driven, *intentional* exploitation of celestial bodies and even aimed for planetary transformation, and the gray zones in between.

4.1 Latent astrocide: a) interplanetary contamination and b) planetary defense

A) Interplanetary contamination

So far thirty-two off-Earth landings have been completed. These included missions to the Moon, Mars, Venus, asteroids, a comet, and Saturn's moon Titan, that were undertaken with scientific purposes, whereas sample-collection missions have specifically focused on asteroids.² No landings, however, have taken place on Mercury, Jupiter, Uranus, Neptune, or Pluto yet, but several orbiters and flybys have studied these planets (Britannica, 2023). The Artemis mission to the Moon, the Mars Sample Return missions, and the Dragonfly mission to Titan are planned to take place (NASA, 2024).

These missions introduce human presence and material impact to previously untouched celestial environments (Haramia, 2025), as seen, for instance, in extraterrestrial sample return missions and returning space crews that could endanger both off-Earth and on-Earth ecologies. For example, lunar dust has posed threats, given its toxic effects from its sharp, chemically reactive particles that may cause respiratory diseases like silicosis. More concretely, the Apollo astronauts have experienced temporary symptoms (e.g., coughs, throat irritation, watery eyes, blurred vision), due to lunar dust contamination inside spacecraft (James & Kahn-Mayberry, 2009). This implies that (undetectable) extraterrestrial microbes can cause bodily harm or (lethal) pandemics or similar outbreaks we have not encountered before (Bianciardi, 2022; Spry, 2022; Witze, 2023).

That is why ethical principles exist not only to protect us, but also to safeguard the richness and diversity of celestial bodies and extraterrestrial life without harming or destroying it (Randolph & McKay, 2013). It is not just Earth, or just the Moon or just Mars that require protection separately; it is about how we also can bring lunar microbes to Mars and Martian microbes to the Moon, back to Earth, etc. In other words, concerns about *interplanetary* contamination address our responsibility towards other parts of the cosmos and the potential for our actions to have unintended consequences. Therefore, sterilization must be taken seriously (Johnson et al., 2015).

To address this, international policies have been established to control contamination during space exploration (Bergstrom & Rummel, 2004), necessitating strict clean room standards, hardware sterilization, and trajectory constraints for missions. However, sterilization efforts for complete elimination of microbial hitchhikers remain challenging and some researchers argue that microbial introduction is inevitable and propose viewing microbes as primary colonists rather than accidents (Lopez et al., 2019), supposedly best handled by developing "Proactive Inoculation Protocols" while maintaining efforts to track and avoid harmful contamination. Whether through accident or reckless intent, introducing Earth-based organisms to another planet where it has no natural predators, a fundamental alien ecosystem disruption could follow, wreaking existential and totally annihilative havoc driving native extraterrestrial (micro)organisms to extinction, including those we are unable to detect (Nicholson et al., 2009; Rummel, 2001).

Dadrian considered latent genocide to be the complex relationship between violence, power struggles by highlighting how military operations, forced relocations, and mass deportations, though often initiated with specific goals in mind, that can unintentionally lead to genocidal outcomes (1975: 205–206). Given the above on interplanetary contamination, latent astrocide could take shape as an unintended outcome of the specific goal of (scientifically) understanding the environmental parameters that enabled life on Earth, considered crucial for our discovery of life elsewhere and to comprehend our own planet (Cottin et al., 2015). That is to say, although space exploration and discovery are in and of themselves non-destructive ends, the means to do so may have severely annihilative outcomes. So, although unintentional, latent astrocide may

² 17 landings on the Moon, consisting of 6 crewed Apollo missions (1969–1972); 11 robotic missions by NASA and the Soviet Union (NASA, 2023; Planetary Society, 2023); 22 landings on Mars, including 11 Mars Lander and Rover missions by NASA (NASA, 2023; Britannica, 2023); 10 landings on Venus all conducted by the Soviet Venera program between 1970 and 1985 (ESA, 2022); 1 landing on Titan, Saturn's largest moon, by NASA's Huygens probe (NASA, 2005); asteroid Eros by NEAR Shoemaker, asteroid Ryugu by Hayabusa2, and asteroid Bennu by OSIRIS-REX (NASA, 2023).

become the most prevalent type of astrocide in the future. In fact, for all we know, we may have already committed astrocide, simply because there was specific extraterrestrial life on the Moon or Mars that we could not detect with our Earthly (technologically enhanced) sensory systems. Meaning, we may very well have already caused extraterrestrial extinction without ever realizing it.

Latent astrocide imitates historical patterns and mechanisms of colonial genocide and ecocide, despite, or perhaps because of, advancements in technology, such as when Columbus and other explorers introduced pathogens to the Western Hemisphere, known as the Columbian Exchange resulting in a drastic population decline of up to 90%, thereby weakening their resistance to the colonizers (Nunn & Qian, 2010). European colonizers, aware of the lethality of their diseases, weaponized them against Indigenous peoples in biological warfare, by intentionally spreading smallpox (Henderson et al., 1999). Even if unintentional, latent astrocide could become intentional once state-corporate space actors harness the power of interplanetary contamination, annihilating extraterrestrial microbes and entire ecosystems in an extraterrestrial biological warfare. Such unpremeditated, latent astrocide could inspire and evolve into intentional optimal astrocide (see subsection 4.3) and intentional biocultural astrocide (see section 4.4).

B) Planetary defense

Planetary defense systems detect, track, assess risks, and mitigate the potential impact of asteroids and comets that threaten Earth in order to prevent (extinction-level) collisions, in which resides the risk of astrocidal outcomes. A rather famous and recent example of planetary defense is NASA's DART (Double Asteroid Redirection Test) mission, which altered an asteroid's trajectory (NASA, 2022) and we could do so in the future when a devastating asteroid is coming our way. Planetary defense is not solely a scientific endeavor but also involves complex governance and policy considerations (Simó-Soler & Peña-Asensio, 2022) and would require a multilateral security regime to address this global challenge effectively (Schmidt, 2023). Careful consideration must be given to planetary defense systems to avoid unintended consequences or misuse (Morrison, 2019). For example, Carnahan et al. (2022) have suggested that asteroid and comet impacts could seed Jupiter's moon Europa and its oceans with life-building materials, altering its ice shell and cryovolcanism. These are similar processes that may apply to Enceladus, one of Saturn's moons (Martin et al., 2023). These building blocks for life, called prebiotic molecules, have been found in samples from the Ryugu asteroid, containing intact amino acids and vitamin B3 (Steigerwald, 2023). It has also been argued that asteroids can carry hydrogen cyanide (HCN), an important prebiotic molecule (Anslow et al., 2023), which may have seeded Earth itself with life (Kaiser et al., 2013).

By seeking to control the course of large and moving celestial bodies, such as NASA's DART Mission that deflected the impact and trajectory of Dimorphos, a minor moon of the asteroid Didymos (NASA, 2022), a culture of galactic control could emerge (Eski, 2023: 81), which is a culture at the galactic level where planetary defense trumps the protection of life-seeding asteroidal impacts. In that sense, Earth's planetary defense may already have the potential to alter or stop the course of asteroids, even destroy them, preventing their potential to seed life on still-lifeless planets. However, planetary defense could, in principle, also be used to seed lifeless planets. Still, we currently intend it solely for our own protection, revealing a self-preserving focus that could, in the future, give us the capacity to determine which planets receive life and which do not, reflecting potential astrocidal intent and consequences.

Moreover, planetary defense could also bring about an intentional form of extraterrestrial *pre*-astrocide of life on other planets, star systems, or even galaxies. In wielding the power to influence celestial bodies and their cosmic paths (Eski, 2023), we become biophysical 'actants,' who, after having reshaped Earth fundamentally (Shearing, 2015: 257), continue to be *prebiotic* actants at a cosmic level with the capacity—and perhaps the will—to prevent extraterrestrial abiogenesis (cf. Andresen, 2023), which is biological terminology for the beginning of life. Off-Earth interdiction of abiogenesis—or perhaps a more provocative term: cosmic contraception—illustrates how we as a

species could (want to) interdict and shape panspermia, which is the cosmic transport of life's building blocks throughout the universe.

4.2 Utilitarian astrocide: astral exploitation of extraterra nullius

The estimated worth of space metals and minerals, and possible outer space economies, is estimated to be USD 2.37 billion in 2025 and expected to reach USD 23.08 billion by 2038 (Mordor Intelligence, 2025). Resembling how colonization brought about a "golden age" for European industry, space mining is also a rapidly growing industry supported by both government-led and private initiatives,³ including NASA's OSIRIS-REx mission, which returned samples from asteroid Bennu, JAXA's Hayabusa and Hayabusa 2 missions (which explored and retrieved material from Itokawa and Ryugu), and ESA's Rosetta mission (which provided key insights into cometary composition) (Steffen, 2022). The corporate sector itself is also advancing asteroid mining capabilities, with TransAstra Corporation developing solar-powered spacecraft, Karman+ targeting platinum-rich asteroids, and Asteroid Mining Corporation (AMC) conducting spectral surveys to identify viable mining sites (Scoles, 2024; Henriquet, 2024). Also governments remain invested in resource extraction beyond Earth, with Japan and the lunar resources company Magna Petra working on helium-3 mining from the Moon, China investing \$18 billion into a magnetic space launcher for lunar helium-3 extraction, and Russia collaborating with China on lunar resource extraction (Turner, 2024; Hussain, 2024; Osburg & Lee, 2022). Luxembourg has positioned itself as a regulatory leader, establishing a space mining law to attract private investment and create a legal framework for extraterrestrial resource extraction (Gilbert, 2024). Other projects include Moon Express, which aims to extract lunar rare earth elements, iSpace's development of lunar landers for resource collection, Off-World Inc.'s robotic mining and construction systems, and Lunar Resources' FarView Project, which plans to use lunar materials to build a radio telescope on the Moon's far side (Mordor Intelligence, 2025; Hutson, 2024). Lastly, there is the planned mission Odin, a covert mission by space mining company AstroForge that aims to mine a suspected M-type asteroid, known for its potential metal-rich composition. This mission has raised concerns among scientists about transparency and the risks of commercial ventures secretly exploring, mining, and dominating space exploration (O'Callaghan, 2023).

The goal of utilitarian genocide, as Dadrian explained, is limited to 'economic advantages, demographic considerations, military designs,' where its objectives are predominantly exploitative whereby calculative gains outweigh the inherent desire for atrocity and radical destructiveness (1975: 209). Utilitarian astrocide as harvesting extraterrestrial resources, resembles colonialist genocide (Sartre & Oglesby, 1968) and has annihilative consequences for celestial bodies and any life or building blocks for life on them. Space mining will inadvertently disrupt delicate balances or even render parts of space unusable for future generations, destroying the habitats of any potential life forms (Smith, 2016). Even if we do not directly encounter life, we could be altering environments that are crucial for its existence, or (chemically) polluting extraterrestrial environments, such as the debris left behind on Mars by the Rover mission (Debus, 2005). It makes utilitarian astrocide primarily an environmental harm in and to outer space, driven by and benefitting the powerful few among spacefaring nations and companies (e.g., Hornsey et al., 2022; Lampkin & McClanahan, 2024). Utilitarian astrocide, like latent astrocide, could affect interplanetary ecosystems too, which is not entirely unrealistic when considering that if the Moon were to be fully stripped of its minerals to the point of disintegration, profound consequences for Earth could be the result in the far future. The Moon fulfills a crucial role in stabilizing Earth's axial tilt, and its gravitational pull is responsible for ocean tides, making its absence result in reduced tides that disrupt coastal ecosystems, potentially leading to mass extinctions here (Feehley, 2024).

³ Including Astrobotic Technology Inc., Momentus Space, RHEA Group, Helios Project Ltd., and Origin Space (Mordor Intelligence, 2025).

Even if its effects remain uncertain, utilitarian astrocide is already being legally justified and institutionalized, similar to how utilitarianism-driven European colonialism was once institutionalized in laws regarding *terra nullius*, or “empty lands that are not empty” (Ladd, 2000; Mattei & Nader, 2008; Schultz & Varouxakis, 2005). *Terra nullius* is embedded in legal-philosophical reasoning, as Mattei and Nader criticized, for example, in Locke’s *Two Treatises of Government* (1698) or De Vattel’s *Law of Nations* (1793), providing legal justification for the colonial appropriation of lands and the legal dehumanization of Indigenous people into a ‘race of savages’ (Mattei & Nader, 2008: 102), whose territory could be freely and legally appropriated by the colonizers (id.: 104). In fact, throughout history, science has assisted in such justification and legal dehumanization (Eski, 2023), including criminology, which enabled the Nazi regime in the dehumanization of the Jewish population, eventually codified into the Nuremberg Race Laws (Rafter, 2008).

Much like how laws enabled colonialism, space regulation facilitates the legal exploitation of space, despite the international Outer Space Treaty (OST) prohibiting sovereign claims over celestial bodies. This time national and commercial regulators are meticulously dissecting, neglecting even, the OST to accommodate industrial space mining. This time not by claiming *terra nullius* but by establishing what could be referred to as *extraterra nullius* (Stillwell, 2017: 178). It has led several countries to rapidly legislate space mining laws to attract investment with business-friendly legal frameworks (id.), seemingly driven by *extraterra nullius* principles and reasoning to lay claim to the anticipated abundance of valuable resources in space metals and minerals, such as lunar helium-3.

For example, the 2015 US Commercial Space Launch Competitiveness Act (CSLCA) promotes private space mining, sparking legal debate (Tronchetti, 2016) due to its conflicts with the OST and the accompanying global obligations nations have, including the common heritage principle (Freeland, 2017). Despite this, a 2020 executive order by Trump reinforced the law, and the US encourages other nations to adopt its stance. This has led countries like Luxembourg (LSA, 2017), the UAE (Watson, Farley & Williams, 2023), and Japan (Sure, 2024) to pass laws supporting private space mining. Moreover, space companies may also themselves legitimize and codify impunity preemptively, as Starlink is already doing by stating in its Terms of Service that it recognizes ‘Mars as a free planet and that no Earth-based government has authority or sovereignty over Martian activities’ and that ‘Disputes will be settled through self-governing principles’ (Starlink, 2025 – online source).

In sum, the contemporary legislating of exploitative space laws illustrates how powerful state-corporate space actors are greedily and preemptively legitimizing possible future utilitarian astrocide under *extraterra nullius*, resembling the institutionalization and justification of genocide (Dadrian, 1998) by instrumentalizing it into law through legal fictive constructions today, like those used for colonial genocide in the past (Gurmendi Dunkelberg, 2025).

4.3 Optimal astrocide: terraforming

Oxford Reference describes terraforming as the ‘hypothetical idea of creating an Earthlike environment on another planet,’ where some scientists believe ‘that astronauts could create an oxygenated atmosphere that would make Mars and other planets inhabitable’ (2025 – online source). Terraforming comprises an existential modification of a planet or celestial body to make it (more) habitable for specifically terrestrial life, *in casu*, humans, with applications ranging from Mars to Venus and beyond (Popoviciu, 2023). Arguably, the ethical implications of terraforming and its unintended consequences are significant, and according to some, it is (only) morally permissible if the target planet is lifeless (Schwartz, 2013), reflecting again *extraterra nullius* principles that justify utilitarian astrocide.

Terraforming Mars entails changing Mars’ atmosphere to be Earth-like, for example, by using algae that can produce oxygen, remove carbon dioxide, and survive in extreme environments (Çelekli & Zariç, 2024), which could possibly outcompete or harm potential native Martian

microbial life. Others propose warming the Martian surface so that liquid water can exist, which Mars' thin, cold atmosphere prevents, while artificial aerosols made from local materials could trap heat more effectively than greenhouse gases (Ansari et al., 2024). In a recent paper presented at the 56th Lunar and Planetary Science Conference, Czechowski (2025) suggests that to terraform Mars, key materials like water, CO₂, and nitrogen must be imported, as these are abundant in distant icy bodies in the Kuiper Belt and Oort Cloud. He proposes capturing one or more of these asteroid bodies—possibly destroying them—and using genetically engineered organisms to produce oxygen on Mars. While this could make Mars habitable, it would come at the cost of permanently altering or destroying Mars as an ancient celestial object.

Musk's vision of terraforming Mars is perhaps even farther-reaching and violently radical. In 2019 he tweeted "Nuke Mars!" (Musk on X, 2019 – online source), yet the idea, which involves using nuclear power to release carbon dioxide from Mars' polar ice caps that could potentially thicken the atmosphere and making it more habitable, existed before 2019 (cf. Woo et al., 2022). "Nuking Mars" currently still raises legal and ethical questions under both international and U.S. law (Herron, 2016). In fact, nuclear terraforming, including its nuclear aftermath, could wipe out potential Martian life already existing there, while making it difficult for humans to settle in the near future.

Envisioning nuclear terraforming to become humankind's savior, Musk appears zealously willing to exchange our survival on another planet—if possible at all—for extraterrestrial life. He is prepared, and could *intend*, to accept the possibility of bringing about a mass Martian extinction of life we are simply not (technologically) capable of sensing at this moment. He and others seem to possess the *mens rea*, vis-à-vis the astrocidal intent, *now*, to one day carry out total annihilation. In Dadrian's words regarding optimal genocide (1975: 210-211), plans to terraform reflect optimal astrocidal intentions that could result in mass, indiscriminate extermination over a sustained period, aiming for the annihilation of a victim planet that is enabled by three factors: the victim planet's extreme vulnerability, the perpetrators' view of its existing state as an urgent existential threat, and the perpetrators' absolute power. Musk and others' intended plans to terraform off-Earth planets whether at a microbial or nuclear level, reflect a narrow, culturally exclusive, and terrestrial and human-centered perspective rooted in colonialist narratives that also drive other modes of space expansion (Vermeulen et al., 2018). These plans, however, go beyond terrestrial colonialism by rationalizing and deeming such destruction necessary for a greater ideal, whether survival, progress, or species expansion. Here, astrocidal intent is not incidental but embedded within contemporary speculative planning and techno-scientific ideology, where planetary transformation becomes an instrumental goal rather than a by-product. Unlike past colonialism on Earth, which often exploited but preserved certain Indigenous structures (even if for extractive reasons), optimal astrocide envisions a blank slate: a complete reformatting of other worlds for human use, with no regard for alien ecologies, proto-life, or future possibilities of being. In sum, by altering and eradicating entire celestial landscapes and stripping them of their cosmic being and identity, while preventing any possibility of future coexistence between terrestrial and potential extraterrestrial life, planets are reduced to human-centric wastelands through terraforming: an act of optimal astrocide, carried out "for all humankind."

4.4 Biocultural astrocide: transhumanism

While existing criminological and genocidal frameworks address physical and cultural harms, biocultural astrocide captures a distinct, emergent form of non-violent, identity-based destruction rooted in space expansionism, where technological and biological transformation enforces assimilation and erasure of non-enhanced individuals in extraterrestrial contexts. This concept extends Dadrian's cultural genocide typology into new, speculative terrains that traditional frameworks do not fully encompass, though we are already witnessing its early manifestations today.

From bio-engineered “space babies” (Asgardia.space, 2023) to other ‘radical solutions [such as] human enhancement, [...] including gene editing of germ line and somatic cells, as a moral duty’ (Szocik, 2020: 122), contemporary scientific and medical experiments are being conducted to increase the chances of human survival in extraterrestrial environments, for example, on Mars (Terhorst & Dowling, 2022). Due to particle radiation from the Sun, other distant stars, and even galaxies (Dobynde et al., 2021), we can only survive for a maximum of four years on Mars, requiring medication or even physiological alterations for protection against the harsh and lethal space environment. Microgravity-induced weightlessness affects the human body, leading to severe bone deterioration (osteoporosis) (Leblanc et al., 2013) and drastic associated mental health issues (Gambacurta et al., 2019; McKie, 2023), which bisphosphonate medication could help mitigate (Rosenthal et al. 2024). A more drastic procedure would involve splicing human DNA with that of tardigrades that are most resilient to radiation and extreme environments, in order to enhance our bodily resilience against solar radiation and other health threats (Hashimoto et al., 2016).

Regardless of their credibility, these initiatives reflect a conviction that we must ‘change human nature if we’re going to survive’ in space, as Johnston, an environmental scientist stated (Knight, 2017 – online source). This belief underscores our intentions as a rapidly self-evolving and self-redesigning species to not only leave our natural biological habitat for space, but in doing so, to evolve beyond it. Paradoxically, in going to space “for all humankind,” we attempt to change ourselves—our Self—into something not-so-human (Eski, 2023: 86–87), where a willingness—an intent—to alter our bodies and very being affects us at a fundamental level. This existential transformation could make it impossible to survive Earth’s atmosphere and gravity (Szocik et al., 2019). Colonizing Mars is then not only about *going somewhere* else but also *becoming something* else altogether. The idea of creating a *Homo superior* with improved cognitive and physical abilities on Mars (Maccarini, 2021) could lead to a divide between enhanced Martians and non-enhanced humans on Earth. The very meaning of humanity could be transformed through processes of this *dehumanization upward*, whereby certain humans are elevated into a new form that simultaneously excludes others (Knoppers & Joly, 2007). This Martianization of the human species may strip away essential human qualities, driven by unchecked technological expansion and corporate power, and could very well result in a genocide of those un-Martianized (Thomas, 2024). That is to say, while already being “left to rot” on an Earth wretched by global warming (Marikar, 2019), Earthlings remain unable to go to Mars.

Following Dadrian’s observations on cultural genocide, biocultural astrocide may constitute a non-violent form of astrocide by a dominant group that enforces assimilation of a victim group through mass conversions, adoption, and cultural suppression rather than through direct violence (Dadrian, 1975: 205), instead leaving non-enhanced individuals vulnerable and powerless on another planet. As such, the biocultural astrocide type extends Dadrian’s cultural genocide type by emphasizing the role of speculative techno-scientific ideologies and bodily transformation as mechanisms of human identity erasure and, eventually, the annihilation of what it means to be human/humanness.

Biocultural astrocide could lead to ‘the deliberate structuring of preemptive assimilation’ of the powerful few who can afford—and *intend* to—become enhanced while they ‘justify resort[ing] to lethal violence’ by keeping the powerless many *not* assimilated which ‘is therefore regarded to be beneficial to the dominant group’ (id.). Biocultural astrocide is then not only perhaps the rawest form of biopolitics (Foucault, 2019), but once among the stars can also be regarded as the deliberate process of identity erasure. It targets our very being at the existential level through self-inflicted assimilation, conversion, or destruction of cultural heritage. This too could lead to the extinction of humanity and of being human, caused, whether directly or indirectly, by space expansionism (Deudney, 2020: 362). As such, biocultural astrocide should not be understood as self-inflicted “death from above”—mass extinction back on Earth (id.), but as “assimilation to above,” willfully and purposefully redesigning humanity *out*—in body and brain—to survive (in) space (Eski, 2023). It is a transformation that reflects a deeper, existential rupture where biological interventions do not occur in a vacuum but are embedded within techno-colonialist ideologies that reshape what it means to be human in space. One kills a planet to make it livable; the other kills

the human to make them adaptable. Thus, unlike terraforming Mars for the human species—an optimal astrocide of a celestial body—Martianizing the human body for Mars can be understood as biocultural astrocide where remaining “human” becomes a victim status.

Building on Dadrian’s insights into ‘problems of nationalism, ethnocentrism and ideology at large [that] signalize the dimensions of a particular type of collective behavior relevant here’ (1975: 203), biocultural astrocide could be stimulated by *planetism* (Cottingham, 1986; Ellyard, 2001; Scodari, 2022). Planetism is described as a future ideological shift where allegiance is given to the planet (Ellyard, 2001), akin to nationalism, but on a planetary scale (Cottingham, 1986). It is imaginable that a future planetary defense system of Mars could dictate that people who fled Earth due to global warming, for example, must purchase and undergo forced biological assimilation to conform to Mars and its inhabitants, solely to control the risk of interplanetary contamination through planetary defense. Perhaps planetism could lead to wars with biocultural astrocide as a consequence: a Holocaust on an interplanetary scale.

5. Discussion and invitation

Using Dadrian’s fivefold typology of genocide, this paper proposed a fourfold prospective typology of astrocide,⁴ understood here as the (often deliberate) annihilation of celestial bodies and extraterrestrial life and ecosystems by powerful space actors. By introducing a prospective typology of astrocide, a first step is taken by criminology to anticipate future astrocidal harms from space exploration by drawing parallels with how genocide studies have analyzed historical atrocities.

The harms addressed by astrocide may seem, at first glance, subsumable under existing criminological and genocide studies categories, including state crime, corporate crime, white-collar crime, genocide, ecocide, and colonial violence. Indeed, there exists an expanding typology of “-cides” (Shaw, 2015), including ethnocide (Totten et al., 2002), culturicide (Fenelon, 2014), linguicide (Hassanpour et al., 2012), memoricide (Webster, 2024), religicide (Bennett & White, 2022), democide (Rummel, 1994), politicide (Kimmerling, 2020), classicide (Wu, 2013), elitocide (Jones, 2000), femicide, androicide, juvenicide (Valenzuela, 2022), and geronticide (Brogden, 2001). Ecocide, though not legally codified, increasingly attracts recognition for its impact on Indigenous and planetary ecologies (White, 2015). Concepts like urbicide (Alvarado, 2023) and speciecide (Sollund, 2024) further decenter the human subject. In this context, the proliferation of new harm categories may appear to risk conceptual redundancy, or, as Lam, South, and Brisman (2025: 122) warn regarding the arrival of space criminology, such additions can obscure the entanglement between contemporary space expansionism and elite terrestrial interests.

Yet, astrocide is not simply another “-cide.” It identifies a distinct criminogenic logic rooted in techno-colonial space expansionism, which comprises an irreversible, speculative, and prospective form of annihilative harm (Deudney, 2020; Eski, 2023; Lampkin & White, 2023; Rothe & Collins, 2025). As elaborated on, and unlike genocide or ecocide, astrocide includes the preemptive destruction of environments before life emerges, through terraforming, interplanetary contamination, and resource extraction. It addresses scenarios like panspermia and abiogenesis,

⁴ An earlier draft of this paper included a fifth category, deterrent astrocide, inspired by Dadrian’s (1975) concept of retributive genocide, where violence functions to punish dissent and deter future resistance. However, this logic of retaliation does not translate well to the current space-related context, where no conscious extraterrestrial adversary or resistant subject exists (as far as we can tell). Astrocide, as theorized here, is not reactive but anticipatory and emerging from speculative, techno-colonial ambitions to dominate non-Earth environments. Apparent deterrent acts, such as NASA’s DART mission (NASA, 2022) that was considered as deterrent astrocide, is better categorized as latent astrocide, since they risk preemptively annihilating life-seeding potential without intent to punish. While retributive or deterrent dimensions could hypothetically emerge in future interspecies conflicts, under current conditions astrocide remains a one-directional harm rooted in human expansionism, not reactive violence. Hence, the fourfold typology (latent, utilitarian, optimal, biocultural) remains conceptually appropriate for present conditions.

which remain outside the scope of both green and astro-green criminology. Astrocide thus names a harm that not only obliterates what is but also forecloses what could be.

Moreover, the criminogenic potential of outer space lies not only in space itself, but in humanity's ambition to go there. Genocide remains anthropocentric, whereas astrocide reveals the post-anthropocentric effects of a future-oriented colonizing impulse. Projects of space exploration, framed as "for all humankind," often mask Earth-escapism rooted in ecological anxiety (Kerns, 2021; Ormrod, 2007; Vdovychenko, 2022; IPCC, 2021). In this sense, astrocide may be seen as an unintended extension of ecocide: a techno-political reaction to Earth's degradation that externalizes harm to the cosmos, while escaping from the consequences of the harm done to Earth. Debatably, its intent could be considered to a degree, existentially different from terrestrial genocide and ecocide.

Moreover, rather than conceptually diluting existing frameworks, astrocide should be considered a situated category within nested categories (Bowker & Star, 2000; Foucault, 1970; Hacking, 2007), where it refines rather than duplicates categories like genocide or ecocide. Nested categories function by increasing analytical specificity, which in this case entails moving from harm, to violence, to mass murder, to genocide, to ecocide, and finally to astrocide—each adding unique ontological, legal, or temporal dimensions. This means that astrocide's prospective temporality and extra-terrestrial scope render it irreducible to prior concepts. As Bowker and Star (2000), Foucault (1970), and Hacking (2007) argue, these emergent categories do not merely describe phenomena; they reveal latent epistemic logics and do not replace earlier ones but shift fields of intelligibility as well as moral focus.

In sum, astrocide is not a rephrasing of terrestrial violence in cosmic terms but a considerably necessary expansion of (space) criminological study to encompass planetary futures that confronts how human actions in out space, including terraforming, mining, militarization, privatization, that may erase biogenic potential and destroy unknown ecologies. Astrocide, in fact, presumes terrestrial supremacy while it denies the intrinsic value of non-Earth environments. Recognizing this logic is not speculative but essential, and just as ecocide named the large-scale annihilation of ecosystems, astrocide names the criminogenic consequences of unchecked space expansionism and the annihilation of possible life before it begins.

However, astrocide, as necessary a concept it may be, does have its limitations. First, the prospective nature of typology, while crucial for early intervention, involves inherent uncertainties. Even if it relies on *realistic* speculation and is grounded in current trends and knowledge, this speculation does not fully capture the complexities of future space activities and their intended and unintended consequences. Second, the typology's reliance on Dadrian's typology of genocide, while providing a structured framework, does not fully encapsulate the unique characteristics of astrocide. While Dadrian's typology addresses intentional domination and structural violence, astrocide involves distinct dimensions, such as ecological harm to celestial bodies and the potential for interplanetary contamination, which requires further theoretical development from ecocide, astro-green criminology, and critical space criminology perspectives (cf. Crook, 2024; Eski, 2023; Lampkin, 2020; Rothe & Collins, 2025). Third, the prospective typology could benefit from more in-depth case studies, including detailed analyses of specific space missions or policies, in order to provide empirical grounding and illustrate more concretely the potential astrocidal harm. Given that such an empirical space criminology endeavor has obvious practical limitations, as space travel remains prohibitively expensive, Virtual Reality (VR) could allow for immersive space crime (control) studies (cf. Van Sintemaartensdijk, 2025) and analog astronaut mission simulations (cf. Kaiser, 2025). By embedding astrocide scripts in these VR and analog settings, insights into, for example, group mission behaviors can be revealed, focusing on scenarios such as: what would a space mining crew do if they discovered extraterrestrial life at a mining site?

Would they adhere to their contract with the space mining company and their orders, for example, because of a corporate “*Befehl ist Befehl*”-logic?⁵

To conclude, and if anything, this prospective typology of astrocide is intended as a conceptual provocation and a starting point for conversation. It draws on current knowledge of real, contemporary developments, some of which suggest the emergence of initial astrocidal patterns, and in certain cases, even astrocidal intent. Rather than wait for harm to fully materialize, criminology is invited here to anticipate these trajectories. Given the historically reactive posture of criminological engagement with genocide and ecocide, this framework represents, in a sense, a “third time’s the charm” opportunity that urges the field to respond proactively, rather than risk repeating a future of denial and delay in the face of another catastrophic crime.

References

- Alvarado, A. (2023). Urbicide, Violence, and Destruction Against Cities by Criminal Organizations. In *Urbicide: The Death of the City* (pp. 603-635). Cham: Springer International Publishing.
- Alvarez, A. (2009). *Genocidal Crimes*. Routledge.
- Andresen, J. (2023). *Extraterrestrial Ethics*. Ethics International Press.
- Ansari, S., Kite, E. S., Ramirez, R., Steele, L. J., & Mohseni, H. (2024). Feasibility of keeping Mars warm with nanoparticles. *Science Advances*, 10(32), eadn4650.
- Anslow, R. J., Bonsor, A., & Rimmer, P. B. (2023). Can comets deliver prebiotic molecules to rocky exoplanets? *Proceedings of the Royal Society*. DOI: 10.1098/rspa.2023.0434.
- Arendt, H. (1963). *Eichmann in Jerusalem: A report on the banality of evil*. New York: Viking Press.
- Asgardia.space. (2023). *The space nation*. From: <https://asgardia.space/>.
- Bennett, G. F., & White, J. (2022). *Religicide: confronting the roots of anti-religious violence*. Simon and Schuster.
- Bennett, K. (2007). Epistemicide! The tale of a predatory discourse. *The Translator*, 13(2), 151-169.
- Bergstrom, S. L., & Rummel, J. D. (2004, March). Planetary defense considerations for future exploration. In *2004 IEEE Aerospace Conference Proceedings* (IEEE Cat. No. 04TH8720) (Vol. 1). IEEE.
- Bianciardi, G. (2022). Is Life on Mars a Danger to Life on Earth? NASA’s Mars Sample Return. *Journal of Astrobiology*, 11, 14-20.
- Bowker, G. C., & Star, S. L. (2000). *Sorting things out: Classification and its consequences*. MIT Press.
- Britannica. (2023). Major milestones in space exploration. From: <https://www.britannica.com/science/space-exploration>.
- Brogden, M. (2001). *Geronticide: Killing the elderly*. Jessica Kingsley Publishers.

⁵ “Befehl ist Befehl” is a German phrase meaning “an order is an order,” historically used to justify obedience to authority, including during the Nazi era. It was rejected as a defense by Nazi officers during the Nuremberg Trials, where following orders did not absolve individuals from responsibility for war crimes (Arendt, 1963).

Burnam-Fink, M. (2015). Creating narrative scenarios: Science fiction prototyping at Emerge. *Futures*, 70, 48-55.

Carnahan, E., Vance, S. D., Cox, R., & Hesse, M. A. (2022). Surface-to-ocean exchange by the sinking of impact generated melt chambers on Europa. *Geophysical Research Letters*, e2022GL100287.

Çelekli, A., & Zariç, Ö. E. (2024). Breathing life into Mars: Terraforming and the pivotal role of algae in atmospheric genesis. *Life Sciences in Space Research*.

Chambliss, W. J. (1989). State-organized crime. *Criminology*, 27, 183.

Cottin, H., Kotler, J. M., Bartik, K., Cleaves, H. J., Cockell, C. S., De Vera, J. P. P., ... & Westall, F. (2017). Astrobiology and the possibility of life on earth and elsewhere. *Space Science Reviews*, 209, 1-42.

Cottingham, J. (1986). Partiality, favouritism and morality. *The Philosophical Quarterly* (1950), 36(144), 357-373.

Crook, D. (2024). *Capitalism, Colonisation and the Ecocide-Genocide Nexus*. London: University of London Press.

Crook, M., Short, D., & South, N. (2018). Ecocide, genocide, capitalism and colonialism: Consequences for Indigenous peoples and global ecosystems environments. *Theoretical Criminology*, 22(3), 298-317.

Czechowski, L. (2025). Energy problems of terraforming Mars. Paper presented at the 6th Lunar and Planetary Science Conference (LPSC), Warsaw, Poland. From: <https://www.hou.usra.edu/meetings/lpsc2025/pdf/1858.pdf>

D'Agostino, R. (2019). Elon Musk: The Popular Mechanics Interview. From: <https://www.popularmechanics.com/space/moon-mars/a26513651/elon-musk-interview-spacex-mars/>.

Dadrian, V. N. (1975). A typology of genocide. *International Review of Modern Sociology*, 5, 201-212.

—— (1998). The historical and legal interconnections between the Armenian Genocide and the Jewish Holocaust: From impunity to retributive justice. *Yale Journal of International Law*, 23(2), 503-560.

Day, L. E., & Vandiver, M. (2000). Criminology and genocide studies: Notes on what might have been and what still could be. *Crime, Law and Social Change*, 34, 43-59.

Debus, A. (2005). Estimation and assessment of Mars contamination. *Advances in Space Research*, 35(9), 1648-1653.

De Berg, H. (2024). *Trump and Hitler: A Comparative Study in Lying*. Springer Nature.

De Vattel, E. (1793). *The Law of Nations*. GGJ and J. Robinson; and Whieldon and Butterworth.

De Waal, A. (1997). *Famine crimes: Politics & the disaster relief industry in Africa*. Indiana University Press.

Deudney, D. (2020). *Dark Skies: Space Expansionism, Planetary Geopolitics, and the Ends of Humanity*. Oxford University Press.

Dobynde, M. I., Shprits, Y. Y., Drozdov, A. Y., Hoffman, J., & Li, J. (2021). Beating 1 sievert: Optimal radiation shielding of astronauts on a mission to Mars. *Space Weather*, 19(9), e2021SW002749.

Driver, E. D. (1968). A critique of typologies in criminology. *The Sociological Quarterly*, 9(3), 356-373.

Egan, T., Kim, S., & Akdere, M. (2023). Advancing scholarly-practice and theory through participatory inquiry and prospective theorizing. *Human Resource Development Quarterly*, 34(4).

Egbert, S., & Mann, M. (2021). Discrimination in predictive policing: The (dangerous) myth of impartiality and the need for STS analysis. In Završnik, A., & Badalič, V. (Eds.), *Automating Crime Prevention, Surveillance, and Military Operations*. Springer, Cham.

Ellyard, P. (2001). Shaping the future of human settlements: Globalisation, and the leadership and management of change. *Tall Buildings and Urban Habitat*, 903, 111–130.

Eski, Y. (2025). Toward a prospective typology of astrocide. Paper delivered at the Crime, Justice & Society Seminar Series of the Edinburgh Law School, University of Edinburgh, April 2, 2025. From: <https://www.law.ed.ac.uk/news-events/events/cjs-seminar-yarin-eski>.

Eski, Y. (2023). *A Criminology of the Human Species: Setting an Unsettling Tone*. Springer.

Eski, Y. (Ed.). (2021). *Genocide and victimology*. Routledge.

European Space Agency (ESA). (2014). Philae's landing on Comet 67P. From: https://www.esa.int/Science_Exploration/Space_Science/Rosetta.

European Space Agency (ESA). (2022). Venera missions to Venus. From: https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration.

Feehley, C. (2024). What would happen if the moon disappeared? From: <https://www.space.com/what-would-happen-if-the-moon-disappeared>.

Fein, H. (2020). Scenarios of genocide: Models of genocide and critical responses. In *Toward the understanding and prevention of genocide* (pp. 3-31). Routledge.

Fenelon, J. V. (2014). *Culturicide, resistance, and survival of the Lakota: (Sioux Nation)*. Routledge.

Foucault, M. (1970). *The Order of Things: An Archaeology of the Human Sciences*. London: Tavistock Publications Ltd.

Freeland, S. (2017). Common heritage, not common law: How international law will regulate proposals to exploit space resources. *QIL: Questions of International Law*, 19-33.

Friedrichs, D. (2010). Toward a prospective criminology of state crime. In W. Chambliss, R. Michalowski, & R. Kramer (Eds.), *State crime in the global age* (pp. 43–57). London: Willan Publishing.

Foucault, M. (2019). *The history of sexuality: 1: The will to knowledge*. Penguin UK.

Gambacurta, A., Merlini, G., Ruggiero, C., Diedenhofen, G., Battista, N., Bari, M., Balsamo, M., Piccirillo, S., Valentini, G., Mascetti, G., & Maccarrone, M. (2019). Human osteogenic differentiation in space: Proteomic and epigenetic clues to better understand osteoporosis. *Scientific Reports*, 9(1), 8343. <https://doi.org/10.1038/s41598-019-44742-w>

Gilbert, A. (2024). Mining in space is coming. *Milken Review*. <https://www.milkenreview.org/articles/mining-in-space-is-coming>

Green, P. J., & Ward, T. (2000). State crime, human rights, and the limits of criminology. *Social Justice*, 27(1), 101–115.

Gümüşay, A. A., & Reinecke, J. (2024). Imagining desirable futures: A call for prospective theorizing with speculative rigour. *Organization Theory*, 5(1), 26317877241235939. <https://doi.org/10.1177/26317877241235939>

Gurmendi Dunkelberg, A. (2025). How to hide a genocide: Modern/colonial international law and the construction of impunity. *Journal of Genocide Research*, 1–24.
<https://doi.org/10.1080/14623528.2025.xxxxx>

Hacking, I. (2007). Kinds of people: Moving targets. In *Proceedings of the British Academy* (Vol. 151, p. 285). Oxford University Press.

Hagan, J., & Rymond-Richmond, W. (2009). Criminology confronts genocide: Whose side are you on? *Theoretical Criminology*, 13(4), 503–511. <https://doi.org/10.1177/1362480609346057>

Haramia, C. (2025). Respect for the non-living in early-stage space expansion. In *Crime, criminal justice and ethics in outer space* (pp. 305–318). Routledge.

Hashimoto, T., et al. (2016). Extremotolerant tardigrade genome and improved radiotolerance of human cultured cells by tardigrade-unique protein. *Nature Communications*, 7(1), 12808.
<https://doi.org/10.1038/ncomms12808>

Hassanpour, A., Sheyholislami, J., & Skutnabb-Kangas, T. (2012). Introduction. Kurdish: Linguicide, resistance and hope. *International Journal of the Sociology of Language*, 2012(217), 1–18. <https://doi.org/10.1515/ijsl-2012-0001>

Haveman, R., & Smeulers, A. (2008). Criminology in a state of denial: Towards a criminology of international crimes. In *Supranational criminology: Towards criminology of international crimes*. Antwerp: Intersentia.

Henderson, D. A., Inglesby, T. V., Bartlett, J. G., Ascher, M. S., Eitzen, E., Jahrling, P. B., Hauer, J., Layton, M., McDade, J., Osterholm, M. T., O'Toole, T., Parker, G., Perl, T., Russell, P. K., & Tonat, K. (1999). Smallpox as a biological weapon. *JAMA*, 281(22), 2127–2137.
<https://doi.org/10.1001/jama.281.22.2127>

Henriquet, P. (2024). Mining in space: Can we do it? *Polytechnique Insights*.
<https://www.polytechnique-insights.com/en/braincamps/space/extraterrestrial-mining/mining-in-space-can-we-do-it/>

Herron, T. J. (2016). Deep space thinking: What Elon Musk's idea to nuke Mars teaches us about regulating the visionaries and daredevils of outer space. *Columbia Journal of Environmental Law*, 41, 553–580.

Higgins, P., Short, D., & South, N. (2012). Protecting the planet after Rio: The need for a crime of ecocide. *Criminal Justice Matters*, 90(1), 4–5.
<https://doi.org/10.1080/09627251.2012.671146>

Hornsey, M. J., et al. (2022). Protecting the planet or destroying the universe? Understanding reactions to space mining. *Sustainability*, 14(7), 4119. <https://doi.org/10.3390/su14074119>

Hussain, Z. (2024). New Chinese magnetic space launcher that could revolutionize moon mining will work like an Olympic hammer thrower. *New York Post*.
<https://nypost.com/2024/08/19/world-news/chinese-magnetic-space-launcher-to-revolutionize-moon-mining/>

Hutson, M. (2024). The quest to build a telescope on the moon. *The New Yorker*.
<https://www.newyorker.com/science/elements/the-quest-to-build-a-telescope-on-the-moon>

IPCC. (2021). *Climate change 2021: The physical science basis report*.
https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf

James, J. T., & Kahn-Mayberry, N. (2009). Risk of adverse health effects from lunar dust exposure. In *The human research program evidence book* (pp. 317–330).

Johnson, B. D. (2022). *Science fiction prototyping: Designing the future with science fiction*. Springer.

- Johnson, J. E., Conley, C., & Siegel, B. (2015). A path to planetary defense: Requirements for human exploration – A literature review and systems engineering approach.
- Jones, A. (2016). *Genocide: A comprehensive introduction*. Routledge.
- Jones, A. (2000). *Gendercide in Kosovo*. Centro de Investigación y Docencia Económicas.
- Joy, S. (2021). Robert Heinlein's *Stranger in a Strange Land*: A postmodern study. *International Journal of English Literature and Social Sciences*, 6(4), 231–247.
- Kaiser, R. (2025). Connecting the analogue dots: Insights into the future of space crime, criminal justice, and ethics now. In Y. Eski & J. Lampkin (Eds.), *Crime, criminal justice & ethics in outer space: International perspectives*. Routledge.
- Kaiser, R. I., Stockton, A. M., Kim, Y. S., Jensen, E. C., & Mathies, R. A. (2013). On the formation of dipeptides in interstellar model ices. *The Astrophysical Journal*, 765(2), 111.
<https://doi.org/10.1088/0004-637X/765/2/111>
- Kaldellis, A. (2013). *Ethnography after antiquity: Foreign lands and peoples in Byzantine literature*. University of Pennsylvania Press.
- Kerns, J. (2017). Mining materials in outer space. *Machine Design*, 89(5), 9–10.
- Kiernan, B. (2008). *Blood and soil: A world history of genocide and extermination from Sparta to Darfur*. Yale University Press.
- Kimmerling, B. (2020). *Politicide: Ariel Sharon's war against the Palestinians*. Verso Books.
- Knoppers, B. M., & Joly, Y. (2007). Our social genome? *Trends in Biotechnology*, 25(7), 284–288.
- Ladd, J. (2000). Colonialism and the moral philosophers. *Balay: Culture, Law and Colonialism*, 1(1), 115–128.
- Lam, A., South, N., & Brisman, A. (2025). “If there was an observer on Mars, they would probably be amazed that we have survived this long”: Environmental decline, elite escapes, and space colonies. In *Crime, criminal justice and ethics in outer space* (pp. 122–136). Routledge.
- Lampkin, J. A., & McClanahan, B. W. (2024). Astronomical withdrawals: A green criminological examination of extreme energy mining on extraterrestrial objects. *Crime, Law and Social Change*, 81(4), 365–384.
- Lampkin, J., & White, R. (n.d.). *Space criminology*. Springer.
- Lampkin, J. A. (2020). Mapping the terrain of an astro-green criminology: A case for extending the green criminological lens outside of planet Earth. *Astropolitics*, 18(3), 238–259.
- Leblanc, A., et al. (2013). Bisphosphonates as a supplement to exercise to protect bone during long-duration spaceflight. *Osteoporosis International*, 24, 2105–2114.
- Lemkin, R. (2005 [1944]). *Axis rule in occupied Europe: Laws of occupation, analysis of government, proposals for redress*. The Lawbook Exchange, Ltd.
- Liwerant, O. S. (2007). Mass murder: Discussing criminological perspectives. *Journal of International Criminal Justice*, 5(4), 917–939.
- Locke, J. (2013). *Two treatises of government* (1689). In *The anthropology of citizenship: A reader* (pp. 43–46).
- Lopez, J. V., Peixoto, R. S., & Rosado, A. S. (2019). Inevitable future: Space colonization beyond Earth with microbes first. *FEMS Microbiology Ecology*, 95(10), fiz127.

- LSA. (2017). *Loi du 20 juillet 2017 sur l'exploration et l'utilisation des ressources de l'espace*. https://space-agency.public.lu/en/agency/legal-framework/law_space_resources_english_translation.html
- Maccarini, A. M. (2021). The social meanings of perfection: Human self-understanding in a post-human society. In *What is essential to being human?* (pp. 197–213). Routledge.
- Marikar, S. (2018). The rich are planning to leave this wretched planet. *The New York Times*. <https://www.nytimes.com/2018/06/09/style/axiom-space-travel.html>
- Martin, E. S., et al. (2023). Measurements of regolith thicknesses on Enceladus: Uncovering the record of plume activity. *Icarus*, 392, 115369.
- Mattei, U., & Nader, L. (2008). *Plunder: When the rule of law is illegal*. John Wiley & Sons.
- Matthews, R. A. (2010). The construction of “So what?” criminology: A realist analysis. *Crime, Law and Social Change*, 54, 125–140.
- McGarry, R., & Walklate, S. (2019). *A criminology of war?* Bristol University Press.
- McKie, R. (2023). How far should we go with gene editing in pursuit of the “perfect” human? *The Guardian*. <https://www.theguardian.com/science/2023/feb/05/how-far-should-we-go-with-gene-editing-in-pursuit-of-the-perfect-human>
- Merrie, A., Keys, P., Metian, M., & Österblom, H. (2018). Radical ocean futures—Scenario development using science fiction prototyping. *Futures*, 95, 22–32.
- Mordor Intelligence. (2024). *Space mining market size & share analysis: Growth trends & forecasts (2025–2038)*. <https://www.mordorintelligence.com/industry-reports/space-mining-market-industry/companies>
- Morrison, D. (2019). Overview of active planetary defense methods. In *Planetary defense: Global collaboration for defending Earth from asteroids and comets* (pp. 113–121).
- Moses, A. D. (2010). Raphael Lemkin, culture, and the concept of genocide.
- Mubin, O., et al. (2016). Towards an agenda for sci-fi inspired HCI research. In *Proceedings of the 13th International Conference on Advances in Computer Entertainment Technology (ACE 2016)*, 9–12 November 2016, Osaka, Japan (pp. 9–12). <https://doi.org/10.1145/3001773.3001786>
- Muñoz, P., & Dimov, D. (2023). Facing the future through entrepreneurship theory: A prospective inquiry framework. *Journal of Business Venturing*, 38(4), 106303.
- Musk, E. (2019). X post: “Nuke Mars!” <https://x.com/elonmusk/status/1162218267932446724>
- NASA. (2024). *Artemis program: Returning to the Moon*. <https://www.nasa.gov/specials/artemis>
- NASA. (2023). *Mars landings and exploration history*. <https://mars.nasa.gov/missions>
- NASA. (2022). NASA confirms DART mission impact changed asteroid’s motion in space. <https://www.nasa.gov/press-release/nasa-confirms-dart-mission-impact-changed-asteroid-s-motion-in-space>
- NASA. (2005). Huygens probe lands on Titan. <https://science.nasa.gov/mission/cassini/spacecraft/huygens-probe>
- Nicholson, W. L., Schuerger, A. C., & Race, M. S. (2009). Migrating microbes and planetary defense. *Trends in Microbiology*, 17(9), 389–392.
- Nunn, N., & Qian, N. (2010). The Columbian exchange: A history of disease, food, and ideas. *Journal of Economic Perspectives*, 24(2), 163–188.

O'Callaghan, J. (2023). The first secret asteroid mission won't be the last. *The New York Times*.
<https://www.nytimes.com/2023/12/27/science/secret-asteroid-mission-astroforge.html>

Osburg, J., & Lee, M. (2022). Governance in space: Mining the Moon and beyond. *RAND Corporation*. <https://www.rand.org/pubs/commentary/2022/11/governance-in-space-mining-the-moon-and-beyond.html>

Oxford Reference. (2025). Terraforming.
<https://www.oxfordreference.com/display/10.1093/oi/authority.20110803103157183>

Pavez, I., Godwin, L., & Spreitzer, G. (2021). Generative scholarship through prospective theorizing: Appreciating the roots and legacy of organization development and change to build a bright future. *The Journal of Applied Behavioral Science*, 57(4), 459–470.

Pearce, F., & Tombs, S. (1990). Ideology, hegemony, and empiricism: Compliance theories of regulation. *The British Journal of Criminology*, 30(4), 423–443.

Pemberton, S. (2014). State crime in the global age; State crime: Current perspectives. *State Crime Journal*, 3, 132–135.

Planetary Society. (2023). Every Moon mission. <https://www.planetary.org/space-missions/every-moon-mission>

Popoviciu, D. R. (2023). *New worlds: Colonizing planets, moons and beyond*. Bentham Books.

Popper, A. (2015). Transforming business through science fiction prototyping. *Computer*, 48(01), 70–72.

Pruitt, W. R. (2021). *An introduction to the criminology of genocide*. Springer Nature.

Rafter, N. (2008). Criminology's darkest hour: Biocriminology in Nazi Germany. *Australian & New Zealand Journal of Criminology*, 41(2), 287–306.

Rafter, N. (2016). *The crime of all crimes: Toward a criminology of genocide*. NYU Press.

Randolph, R. O., & McKay, C. P. (2014). Protecting and expanding the richness and diversity of life, an ethic for astrobiology research and space exploration. *International Journal of Astrobiology*, 13(1), 28–34.

Rosenthal, R., Schneider, V. S., Jones, J. A., & Sibonga, J. D. (2024). The case for bisphosphonate use in astronauts flying long-duration missions. *Cells*, 13(16), 1337.

Rothe, D. L., & Collins, V. E. (2023). Planetary geopolitics, space weaponization and environmental harms. *The British Journal of Criminology*, 63(6), 1523–1538.

Rothe, D. L., & Collins, V. E. (2025). *Space expansionism and criminology: The emerging terrain of crime, harm, and violence*. Taylor & Francis.

Rothe, D. L., & Friedrichs, D. O. (2018). Crimes of the powerful: An agenda for a twenty-first-century criminology. In *Routledge handbook of critical criminology* (pp. 180–189). Routledge.

Rummel, J. D. (2001). Planetary exploration in the time of astrobiology: Protecting against biological contamination. *Proceedings of the National Academy of Sciences*, 98(5), 2128–2131.

Rummel, R. J. (1994). The new concept of democide. In *The widening circle of genocide* (Vol. 3, pp. 1).

Sarliève, M. (2020). Ecocide: Past, present, and future challenges. In *Life on land* (pp. 233–243). Springer International Publishing.

Sartre, J. P., & Oglesby, C. (1968). *On genocide* (pp. 57–85). Beacon Press.

- Schabas, W. A. (2010). Commentary on Paul Boghossian, "The concept of genocide." *Journal of Genocide Research*, 12(1-2), 91-99.
- Schmidt, N. (2024). Planetary defense governance: Thirty years of development and the multilateral future. *Acta Astronautica*, 214, 343-355.
- Schultz, B., & Varouxakis, G. (Eds.). (2005). *Utilitarianism and empire*. Lexington Books.
- Schwartz, J. S. (2013). On the moral permissibility of terraforming. *Ethics & the Environment*, 18(1), 1-31.
- Schwarz, J. O. (2014). The narrative turn in developing foresight: Assessing how cultural products can assist organisations in detecting trends. *Technological Forecasting and Social Change*, 90, 510-513.
- Scodari, C. (2022). Unfamiliar races in untimely places: Anti-essentialism and the science fiction television series *The Expanse*. *The Journal of Popular Culture*, 55(4), 842-866.
- Scoles, S. (2024). In the race for space metals, companies hope to cash in. *Undark*.
<https://undark.org/2024/05/08/asteroid-mining-space-metals/>
- Shaw, M. (2015). *What is genocide?* John Wiley & Sons.
- Shearing, C. (2015). Criminology and the Anthropocene. *Criminology & Criminal Justice*, 15(3), 255-269.
- Sheehey, B. (2019). Algorithmic paranoia: The temporal governmentality of predictive policing. *Ethics and Information Technology*, 21, 49-58.
- Simó-Soler, E., & Peña-Asensio, E. (2022). Planetary defense is not only about science. *Advancing IDEA in Planetary Science*, 2679.
- Simpson, S., Weber, D., & McMahon, J. (2024). Towards a critical space theory: The instrumental politics of space exploitation. *European Journal of Political Theory*. Advance online publication.
<https://doi.org/10.1177/14748851241279679>
- Slapper, G., & Tombs, S. (1999). *Corporate crime*. Longman.
- Small, M. (2025). Musk, Mars, and Ur-Fascism. *Bella Caledonia*.
<https://bellacaledonia.org.uk/2025/01/21/musk-mars-and-ur-fascism/>
- Smeulers, A., & Grünfeld, F. (2011). Genocide. In *International crimes and other gross human rights violations* (pp. 159-200). Brill Nijhoff.
- Smith, N. (2016). Space rocks: A perspective on largely unregulated asteroid mining. *Geo. Mason Journal of International Commercial Law*, 8, 402.
- Sollund, R. (2024). Anthropocentrism, speciesism and specicide. In *Criminological connections, directions, horizons* (pp. 116-132). Routledge.
- South, N. (2009). Ecocide, conflict and climate change: Challenges for criminology and the research agenda in the 21st century. Public Information Department, UNICRI.
- Spry, J. A. (2022). Current status and future perspectives in planetary defense. *Nature Microbiology*, 7(4), 475-477.
- Starlink. (2025). Starlink terms of service – Article 11.
<https://www.starlink.com/legal/documents/DOC-1020-91087-64>
- Steffen, O. (2022). Explore to exploit: A data-centred approach to space mining regulation. *Space Policy*, 59, 101459.

- Steigerwald, W. (2023). First look at Ryugu asteroid sample reveals it is organic-rich. NASA. <https://www.nasa.gov/solar-system/first-look-at-ryugu-asteroid-sample-reveals-it-is-organic-rich/>
- Szocik, K. (2020). Is human enhancement in space a moral duty? Missions to Mars, advanced AI and genome editing in space. *Cambridge Quarterly of Healthcare Ethics*, 29(1), 122–130.
- Szocik, K., Campa, R., Rappaport, M. B., & Corbally, C. (2019). Changing the paradigm on human enhancements: The special case of modifications to counter bone loss for manned Mars missions. *Space Policy*, 48, 68–75.
- Takemura, N. (2019). Astro-green criminology: A new perspective against space capitalism. *Research Bulletin*, 40, 7–16.
- Taylorian, B. R. (2021). *The institutional dictionary of Astronism*. Astral Publishing. <https://cloak.uclan.ac.uk/47036/>
- Terhorst, A., & Dowling, J. A. (2022). Terrestrial analogue research to support human performance on Mars: A review and bibliographic analysis. *Space: Science & Technology*, 1–18.
- Thomas, A. (2024). Systemic dehumanization. In *The politics and ethics of transhumanism* (pp. 159–194). Bristol University Press.
- Tombs, S., & Whyte, D. (2003). Unmasking the crimes of the powerful. *Critical Criminology*, 11(3), 217–236.
- Totten, S., Bartrop, P. R., & Jacobs, S. L. (2008). *Dictionary of genocide* (Vol. 1). Greenwood Press.
- Totten, S., Parsons, W., & Hitchcock, R. (2002). Confronting genocide and ethnocide of Indigenous peoples. In A. Hinton (Ed.), *Annihilating difference: The anthropology of genocide* (pp. 54–91).
- Tronchetti, F. (2016). Title IV space resource exploration and utilization of the US Commercial Space Launch Competitiveness Act: A legal and political assessment. *Air and Space Law*.
- Turner, M. (2024). Japan moves in on hidden \$4 trillion energy source on the Moon as space race against US and China escalates. *The Scottish Sun*. <https://www.thescottishsun.co.uk/tech/14005012/japan-moon-mining-helium-3-us-china-space-race/>
- Van Sintemaartensdijk, I. (2025). Imagining space crime: Using virtual reality to advance our understanding of space crime. In Y. Eski & J. Lampkin (Eds.), *Crime, criminal justice & ethics in outer space: International perspectives*. Routledge.
- Valenzuela, J. M. (2022). Iuvenis sacer: The systematic murder of young people in Latin America. In *Young people in complex and unequal societies* (pp. 252–272). Brill.
- Vermeulen, A. C. J., Nevejan, C., & Brazier, F. (2018). Seeker: Co-creating diversified futures. In *Studio time: Future thinking in art and design* (pp. 172–182). Black Dog Press.
- Vdovychenko, N. (2022). Elon Musk's SpaceX: How the 'space race' to Mars adopted The Californian Ideology. *DiggIt Magazin*. <https://diggitmagazine.com/articles/elon-musk-spacex>
- Walters, R. (2003). *Deviant knowledge*. Willan.
- Watson, Farley & Williams. (2023). Key features of the new United Arab Emirates regulations on space activities. <https://www.wfw.com/articles/key-features-of-the-new-united-arab-emirates-regulations-on-space-activities/>
- Webster, S. (2024). Revisiting memoricide: The everyday killing of memory. *Memory Studies*, 17(6), 1408–1428.

White, R. (2017). Criminological perspectives on climate change, violence and ecocide. *Current Climate Change Reports*, 3, 243–251.

White, R. (2015). Climate change, ecocide and crimes of the powerful. In *The Routledge international handbook of the crimes of the powerful* (pp. 211–222). Routledge.

Witze, A. (2023). Special delivery! Biggest-ever haul of asteroid dust and rock returns to Earth. *Nature*. <https://www.nature.com/articles/d41586-023-02954-2>

Woo, T. H., Baek, C. H., & Jang, K. B. (2022). Analysis of terraforming on Mars using nuclear power for the beginning of space colonization. *Nuclear Technology and Radiation Protection*, 37(3), 253–257.

Woolford, A. (2006). Making genocide unthinkable: Three guidelines for a critical criminology of genocide. *Critical Criminology*, 14(1), 87–106.

Wu, H. (2013). Classicide in Communist China. In *The Routledge handbook of international crime and justice studies*.

Young, J. (2011). *The criminological imagination*. Polity Press.

Zedner, L. (2007). Pre-crime and post-criminology? *Theoretical Criminology*, 11(2), 261–281.