

# Legal 'Black Holes' in Outer Space: The Regulation of Private Space Companies

Written by Samuel Stockwell

This PDF is auto-generated for reference only. As such, it may contain some conversion errors and/or missing information. For all formal use please refer to the official version on the website, as linked below.

## Legal 'Black Holes' in Outer Space: The Regulation of Private Space Companies

<https://www.e-ir.info/2020/07/20/legal-black-holes-in-outer-space-the-regulation-of-private-space-companies/>

SAMUEL STOCKWELL, JUL 20 2020

On 30<sup>th</sup> April 2020, NASA – the US government's space agency – awarded three private space companies a joint-contract worth \$967m to complete a lunar mission by 2024, in what was celebrated as “the last piece that [America] need[s] in order to get to the moon” by NASA administrator Jim Brindestine (The Telegraph, 2020). Yet, whilst this development was widely covered in the media, less coverage has focused on the extent to which existing international legislation surrounding outer space endeavours appropriately applies to private entities. Indeed, the prospect of a corporate foothold within the extra-terrestrial domain has thrown up both a mixture of optimism and concern regarding the potential benefits of expanding capital projects into space (Adolph, 2006; Dickens & Ormrod, 2007).

By adopting the 1967 UN Outer Space Treaty (OST) as an analytical framework in relation to the rise of the so-called US 'NewSpace' actors, this essay argues that there are significant legal ambiguities regarding the status of private space companies in orbital space. Such loopholes allow the US government to circumvent its own obligations to the OST, whilst simultaneously undermining the notion of space as a 'global commons' through a commodification process. The lack of specificity within the OST surrounding private property rights over extra-terrestrial resources risks the prospect of reinforcing Earth-bound wealth inequalities and US dominance in space, by restricting the potential economic benefits for the broader global citizenry in favour of a narrow class of wealthy American investors. Moreover, the OST's weak clause regarding the regulation of space surveillance risks the incentivisation of a 'global panopticon' network of US satellites. The rise of dual-use technology is blurring the boundaries between military and civilian observations, raising serious ethical concerns over the nature of US space-based data collection. Finally, the increasing number of private satellite constellations is facilitating the possibility of cataclysmic space debris collisions which could exacerbate geopolitical tensions. Such developments are also contributing towards the contamination of the broader space environment in ways that the OST had never envisioned.

### The UN Outer Space Treaty and Rise of the 'NewSpace' Actors

Although ratified into international law in 1967, the UN Outer Space Treaty (OST) is perhaps still the most relevant piece of legislation for analysing state and non-state entity activity in outer space. Designed to prevent both the militarisation of space and national appropriation of celestial bodies at the height of Cold War tensions, the UN OST holds significant influence as a form of customary international law (Hebert, 2014: 6). Ratified by over 100 nations – including major spacefaring nations such as the United States, Russia and China – the treaty is widely accepted as an authoritative document and has formed the basis for all other space treaties that have succeeded it (Kramer, 2017: 129). This is in contrast to more recent legislation such as the 1972 Moon Treaty designed to promote cooperation in Moon exploration and development, which the US and other major space superpowers have refrained from signing (Adolph, 2006: 968-969).

The type of American actors becoming involved in the realm of outer space has undergone significant diversification. Despite working alongside NASA since the 1950s, commercial enterprises were largely confined to the manufacturing of parts utilised in rockets and other equipment for space activities (LaI, 2016: 63-66). However, the continuous sharp decline in NASA's overall budget that has occurred since the Apollo 11 moon landing, and the

# Legal 'Black Holes' in Outer Space: The Regulation of Private Space Companies

Written by Samuel Stockwell

increasing trends towards the privatisation of government functions has drastically altered both the capabilities and the outlooks of private space companies. Indeed, although the space economy is growing overall, global government spending decreased by 1.3% between 2012 and 2013 while commercial-sector growth increased by roughly 7% (Conklin, 2017: 33). Central to the impetus behind this private sector space boom has been the emergence of the so-called 'NewSpace' actors – “a broad range of primarily US-based entrepreneurs... who, for more than 30 years, have aimed to commercialise space” (Valentine, 2012: 1046). Driven by a libertarian outlook of economics, and critical of NASA's historical grip on space exploration, these individuals portray themselves as the pioneers of the 'final frontier' who will save humanity from extinction through privately-funded extra-terrestrial missions (Kearnes & van Dooren, 2017: 182).

## Near-Earth Object and Lunar Resource Mining: US Private Property in Space

Lunar rock samples from the Apollo missions containing rare Earth resources, such as Helium-3 which produces more power and less waste than traditional nuclear reactors on Earth, have since fuelled incentives for extra-terrestrial resource mining (Brearley, 2006: 44-46). This was further facilitated by suggestions that near-earth objects (NEOs) like the so-called 'Anteros asteroid' could comprise of over five trillion dollars' worth of magnesium silicate and aluminium (Kramer, 2017: 131).

Envisaging appropriation concerns that might arise from the future extraction of space assets by spacefaring nations, Article II of the UN OST declared that: “Outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means” (UN, 1967). The emphasis on claims of *national* sovereignty were intimately tied to the Cold War context at the time, where space activities were under the exclusive monopoly of governmental agencies and initiated for goals of military dominance or national prestige (Sachdeva, 2017: 210). However, the privatisation of the space industry that has occurred since the 1980s has meant that the legislation leaves an enormous amount of legal ambiguity and interpretation regarding the regulation of private resource mining in space. As Shaer (2016) demonstrates, the Article II provision fails to address either the exploitation of space for financial gain or the property claims of *commercial* enterprises (Shaer, 2016: 47).

Nevertheless, Article VI of the UN OST asserts that: “States shall be responsible for national space activities whether carried out by governmental or *non-governmental* entities” (UN, 1967; own emphasis). Some scholars have suggested that this clause significantly restrains the activities of private space corporations by incentivising states to regulate their domestic organisations for fear of liability concerns (Abeyratne, 1998: 168). However, the US government recently enacted a piece of legislation which exploited this clause, in order to circumvent its own restrictions and strengthen US economic influence in space. The passage of the 2015 SPACE Act enabled US citizens to privately “possess, own, transport, use, and sell the resources” they obtain in outer space, whilst making careful consideration to deny national sovereign claims over such materials (Leon, 2018: 500).

Yet, regardless of whether it is an American private company or public venture, the US is still satisfying its geopolitical interests; by exclusively siphoning off extra-terrestrial resources for American gain, the nation's soft power is thereby extended at the expense of spacefaring adversaries such as China (Basu & Kurlekar, 2016: 65). Indeed NewSpace actors cleverly played on these strategic concerns prior to the bill's passage, with billionaire space entrepreneur Robert Bigelow asserting that the biggest danger wasn't private enterprises on the Moon, but that “America is asleep and does nothing, while China comes along... surveying and laying claim [to the Moon]” (Klinger, 2017: 222).

The US government's support for private space companies is also likely to lead to the reinforcement of Earth-bound wealth inequalities in space. Many NewSpace actors frame their long-term ambitions in space with strong anthropogenic undertones, by offering the salvation of the human race from impending extinction through off-world colonial developments (Kearnes & Dooren: 2017: 182). Yet, this type of discourse disguises the highly exclusive nature of these missions. Whilst they seem to suggest that there is a stake for ordinary citizens in the vast space frontier, the reality is that these self-described space pioneers are a member of a narrow 'cosmic elite' – “founders of Amazon.com, Microsoft, Pay Pal... and a smattering of games designers and hotel magnates” (Parker, 2009: 91).

# Legal 'Black Holes' in Outer Space: The Regulation of Private Space Companies

Written by Samuel Stockwell

Indeed, private space enterprises have themselves suggested that they have no obligation to share mineral resources extracted in space with the global community (Klinger, 2017: 208). This is reflected in the speeches of individuals such as Nathan Ingraham, a senior editor at the tech site EngadAsteroid mining, who claimed that asteroid mining was "how [America is] going to move into space and develop the next Vegas Strip" (Shaer, 2016: 50). Such comments highlight a form of what Beery (2016) defines as 'scalar politics'. In similar ways to the 'scaling' of unequal international relations that has constituted our relationship with outer space under the guise of the 'global commons' (Beery, 2016: 99), private companies – through their anthropogenic discourse – are scaling existing Earth-bound wealth inequalities and social relations into space by siphoning off extra-terrestrial resources. By constructing their endeavours in ways that appeal to the common good, NewSpace actors are therefore concealing the reality of how commercial resource extraction serves the exclusive interests of their private shareholders at the expense of the vast majority of the global population.

## Private Space Corporations and Orbital Surveillance: Dual-Use Satellite Technology

Starting in 2013, the leaking of classified information by former US National Security Agency employee Edward Snowden revealed the extent to which American intelligence agencies were collaborating with the private sector in mass surveillance operations (Bauman *et al.*, 2014). In what has been described as the 'securitisation' of society, contemporary states have shifted from "politics to policing and from governing to managing" the public, which has often occurred without the consent or knowledge of their citizens (Petit, 2020: 31). While such practices have conventionally been Earth-bound in nature, the space domain provides an entirely radical and strategically beneficial perspective for conducting surveillance through satellites.

Although many commercial US satellites provide an array of environmental and internet capabilities on Earth, they are also absolutely essential from a national security perspective of maintaining US space superiority (Chatters IV & Crothers, 2009: 257). This is known as the "dual-use" nature of satellites, where civilian and military purposes are blurred into a single observational system and can be adapted for different functions when necessary (Lubojemski, 2019: 128-129). Dual-use satellite technology has been vital for the US military in offering a tactical edge on the battlefield, with 80% of its satellite communications needs being derived from commercial satellites (Hampson, 2017: 7). The reliance on these networks forms a component of the broader US military doctrine of 'space control', part of which aims to secure the transmission of commercial satellite data that will prevent the exposure of sensitive military tactics (Peña & Hudgins, 2002).

Whilst the OST does not contain any clauses specifying the rules or regulations of data monitoring in space, any form of malicious or illegal surveillance can be seen to violate Article XI, which requires states to: "Inform the Secretary-General of the United Nations as well as to the public and international scientific community, to the greatest extent feasible and practical, of the nature, conduct, locations and results of [space] activities" (UN, 1967). Yet, legal scholars have claimed that this clause is significantly weak, since states can withhold vital information about their space activities on the basis that the dissemination of such information is neither 'feasible' nor 'practical' (Chatterjee, 2014: 31-32). The absence of any clear UN guidelines has also meant that American satellite corporations are increasingly capable of refusing to state their intentions, or who their customers are – with the US government being one of these elusive clients.

The 1994 Presidential Decision Decree-23 authorised the US government to require firms to either limit or stop sales of certain satellite images through a process known as 'shutter control'. It is controversial because it designates the US executive branch the ability to limit publicly accessible information in certain circumstances, possibly violating First Amendment rights (Livingston & Robinson, 2003: 12). During the 2001 War in Afghanistan, the US government bought the rights to all orbital images taken over the theatre of operations by GeoEye's Ikonos satellite on the grounds of 'national security' (The Guardian, 2001). However, media groups accused the government deal of preventing them from informing the public about matters of critical importance that in no way implicated national security, including the independent verification of government claims concerning damage to civilian structures and possible casualties (Livingston & Robinson, 2003: 12). These measures therefore undermined the OST's Article XI clause by concealing important information to the public when it was feasibly possible, through the guise of national security discourse. At the same time, it allowed the US government to manipulate media coverage of areas it deems

# Legal 'Black Holes' in Outer Space: The Regulation of Private Space Companies

Written by Samuel Stockwell

to be essential for conditioning public war support in Afghanistan, whilst simultaneously strengthening its space control doctrine.

In many ways this strategy can also be seen as facilitating a 'global panoptical' intelligence network (Backer, 2008). By extending the private-public hybrid structure of surveillance into outer space, businesses and governments have the opportunity to observe millions of global citizens unknowingly at any one point – and with it – immense amounts of data. Given that GeoEye received nearly two million dollars in contract-related fees from the US government for its Ikonos pictures (The New York Times, 2001), this could incentivise the commercial satellite industry to continue to restrict data that might serve the interests of citizens globally. As such, satellite imaging may turn into a form of orbital data-siphoning where companies conducting observations in space could sell off their data to the highest bidder, with a concerning disregard for privacy rights. Indeed, the revelations surrounding Cambridge Analytica and Facebook have underscored the extent to which private entities are monetising off the sensitive information of their consumers unknowingly (Balkin, 2018: 2050-2051).

## Corporate Space Debris, Security Tensions and Environmental Contamination

Space debris can be defined as non-purposeful man-made objects that reside in space; made up of inactive parts from former space operations and fragmentations of spacecraft, there are nearly 30,000 pieces of debris in the Earth's orbit (Pellegrino & Stang, 2016: 25). Despite most debris being centimetres or millimetres in size satellites often travel at the speed of a bullet, meaning that a collision between the two could be catastrophic in terms of environmental, mechanical and financial damage (Black & Butt, 2010: 1).

Since the development of the Kessler Syndrome thesis in 1978 – which predicted that space debris may become so dense as to trigger a chain reaction of major collisions – space debris is considered more of a threat to security operations in the near-term than military space activity (Quintana, 2017: 95). Difficulty over determining whether a collision was accidental or a purposeful act further exacerbates this problem, given that "every object in orbit is a threat to everything else in orbit, regardless of its intended function" (Faith, 2012: 86). Such developments have led to the US administration increasingly adopting a securitisation discourse around orbital debris (Bowen, 2014: 47), which may cause concerns as to whether policymakers may react to future American satellite collisions in a militarised manner.

A number of NewSpace actors are likely to complicate these worries even further through recent satellite proposals. Whilst Boeing is proposing a constellation of up to 3,000 satellites, SpaceX has even grander goals of creating a constellation consisting of 4,425 satellites, eventually expanding to 12,000 satellites in the near-future (Kosiak, 2019: 7). Putting this into context, there are currently just around 1,400 active satellites in orbit around the Earth, highlighting the scale of these projects. The collision between a single US privately-owned Iridium satellite and state-owned Russian Cosmos satellite in 2009 underscored not only the sheer amount of debris caused by these collisions – over 1,500 pieces – but also foreshadowed the possible geopolitical tensions that may arise from them (Wang, 2010: 87-88). Given the number of various commercial satellite constellations possibly going into orbit in the near-future, this raises questions over the possibly devastating security hazards they could pose once in orbit or when they eventually become defunct.

Yet the proliferation of these commercial satellite plans also pose significant environmental issues. Article IX of the OST asserts that: "States shall pursue activities of outer space in a manner that avoids any harmful contamination or adverse environmental changes on Earth" (UN, 1967). However, the use of terms like 'harmful' or 'adverse change' underscores the lack of specificity over *what* exactly constitutes environmental damage, or for *whom* it must refrain from harming. There is also a failure to address the explicit problem of space debris since the discourse is primarily concentrated on chemical effluent pollution, undermining attempts to facilitate the removal of floating wreckage (Gupta, 2016: 26).

The inability of the OST to properly promote environmental considerations in space has been mirrored in the NewSpace community, where there has been a woeful lack of ecological consideration: "The hundreds of articles and books on outer space resource development seldom mention that such actions may adversely affect the

# Legal 'Black Holes' in Outer Space: The Regulation of Private Space Companies

Written by Samuel Stockwell

environment in ways that will potentially disadvantage their enterprises and the humans that will be required to implement them" (Kramer, 2017: 136). Such images evoke the types of difficulties that private firms have encountered on Earth reconciling capital with the environment in a way that doesn't damage profit margins (Magdoff & Foster, 2011: 61-66). Yet in doing so, this neglect is only likely to result in the proliferation of extra-terrestrial debris that the UN OST failed to address. Indeed, despite its vastness there is only a narrow region of orbital space that is either useable or beneficial for prolonged human missions (Brearley, 2005: 2), meaning that the increase in space debris from these massive commercial satellite constellations will likely be at the detriment of developing nations who have yet fostered spacefaring capabilities.

Elon Musk's SpaceX company has already caused complications for Earth-bound astrologists. The brightness of his recent 'Starlink' satellite constellation system in comparison to other satellites has been obscuring telescopic images (see Grush, 2020). More concerningly, Starlink may be much more visible during twilight hours which could be problematic in identifying potentially hazardous asteroids in a timely manner (The Verge, 2020). In this sense, whilst private space entrepreneurs are able to increase their profitability from being able to establish constellations, such endeavours are spoiling the scientific work of researchers on Earth that may complicate the monitoring of Earth-based asteroid impacts.

## Conclusion: Space as a Global Commodity

Ultimately, this essay has revealed how the UN OST fails to adequately regulate private space enterprises in outer space within an array of activities. Predominately designed from a state-centric perspective, the increasing entanglement of the state apparatus with the private sector is enabling both actors to satisfy their extra-terrestrial interests through legal ambiguities in a way that the treaty never envisaged possible.

Yet, these processes also expose the ways in which the conceptualisation of outer space by both the drafters of the OST and NewSpace actors is intimately connected to Earth-bound social relations and power structures. Whether it be contestations over resources, surveillance or the environment, the concerns raised mirror those taking place on Earth. A product of its time, the OST was broadly concerned with protecting states from damage caused by one another in a tense international terrestrial atmosphere of possible nuclear annihilation, rather than seeking to protect the space environment as an aspiration "in its own right" (Brearley, 2005: 19). Despite framing themselves as the saviours of an anthropogenic extinction, the emphasis of NewSpace entrepreneurs on profit accumulation in space also emulates the types of criticisms private enterprises have faced on Earth, and risk the extension of existing wealth inequalities into the cosmos. The precedent set by NASA in April 2020 that will likely lead to the further involvement of private firms such as SpaceX in space endeavours will therefore serve to restrict public access to the extra-terrestrial domain – and the benefits that may arise from this. Indeed, the notion of outer space as a 'global commons' is slowly turning into one of a 'global commodity'.

## References:

- Abeyratne, R. (1998) 'The Commonality Principle in Social Obligations of States with Regard to the Exploitation of Outer Space', in *International Journal of Politics, Culture, and Society* (Vol. 12, No: 1, 165-185).
- Adolph, J. (2006) 'The Recent Boom in Private Space Development and the Necessity of an International Framework Embracing Private Property Rights to Encourage Investment', in *The International Lawyer* (Vol. 40, No: 4, 961-985).
- Backer, L. (2008) 'Global Panopticism: States, Corporations, and the Governance Effects of Monitoring Regimes', in *Indiana Journal of Global Legal Studies* (Vol. 15, No: 1, 101-148).
- Balkin, J. (2018) 'Free Speech is a Triangle', in *Columbia Law Review* (Vol. 118, No: 7, 2011-2056).
- Basu, A. & Kurlekar, A. (2016) 'Highway to the Danger Zone: United States Legislative Framework Regulating the Commercial Space Sector', in *Astropolitics* (Vol. 14, No: 1, 44-70).

# Legal 'Black Holes' in Outer Space: The Regulation of Private Space Companies

Written by Samuel Stockwell

- Bauman, Z. & Bigo, D. & Esteves, P. & Guild, E. & Jabri, V. & Lyon, D. & Walker, R. B. J. (2014) 'After Snowden: Rethinking the Impact of Surveillance', in *International Political Sociology* (Vol. 8, No: 2, 121-144).
- Beery, J. (2016) 'Unearthing global natures: Outer space and scalar politics', in *Political Geography* (Vol. 55, 92-101).
- Black, S. & Butt, Y. (2010) 'The Growing Threat of Space Debris', in *Bulletin of the Atomic Scientists* (Vol. 66, No: 2, 1-8).
- Bowen, B. (2014) 'Cascading Crises: Orbital Debris and the Widening of Space Security', in *Astropolitics* (Vol. 12, No: 1, 46-68).
- Brearely, A. (2005) 'Faster than a Speeding Bullet: Orbital Debris', in *Astropolitics* (Vol. 3, No: 1, 1-34).
- Brearely, A. (2006) 'Mining the Moon: Owning the Night Sky?', in *Astropolitics* (Vol. 4, No: 1, 43-67).
- Campbell, D. (2001) 'US buys up all satellite war images', article from *The Guardian* (<https://www.theguardian.com/world/2001/oct/17/physicalsciences.afghanistan>, accessed 07/04/20).
- Chatterjee, P. (2014) 'Legality of Anti-Satellites Under the Space Law Regime', in *Astropolitics* (Vol. 12, No: 1, 27-45).
- Chatters IV, E. & Crothers, B. (2009) 'Space Surveillance Network Report', in *AU-18 Space Primer Report*, ed. by Air Command and Staff College and Space Research Electives Seminars (Alabama: Air University Press).
- Conklin, K. (2017) 'Deterrence in the Age of Asteroid Mining: Nuclear Strategy and the Commercialization of Space', in *Project on Nuclear Issues: A Collection of Papers from the 2017 Conference Series and Nuclear Scholars Initiative*, ed. by M. Cancian, S. Abbott, M. Armbruster, L. Brandt, K. Conklin, D. Davies, D. Etim, A. Gillens, J. Graham, C. Green, S. Herzog, I. Jenkins, N. Powell, W. Rumbaugh, D. Salisbury, A. Sanders-Zakre & H. Toivanen (Washington DC: Centre for Strategic and International Studies).
- Dickens, P. & Ormrod, J. (2007) *Cosmic Society: Towards a Sociology of the Universe* (Abingdon: Routledge).
- Faith, G. (2012) 'The Future of Space: Trouble on the Final Frontier', in *World Affairs* (Vol. 175, No: 3, 82-87).
- Gordon, M. (2001) 'A Nation Challenged: Public Information; Pentagon Corners Output Of Special Afghan Images', article from *The New York Times* (<https://www.nytimes.com/2001/10/19/world/nation-challenged-public-information-pentagon-corners-output-special-afghan.html>, accessed 07/04/20).
- Grush, L. (2020) 'The true impact of SpaceX's Starlink constellation on astronomy is coming into focus', article from *The Verge* (<https://www.theverge.com/2020/3/24/21190273/spacex-starlink-satellite-internet-constellation-astronomy-coating>, accessed 28/03/20).
- Gupta, V. (2016) 'Critique of the International Law on Protection of the Outer Space Environment', in *Astropolitics* (Vol. 14, No: 1, 20-43).
- Hampson, J. (2017) *The Future of Space Commercialization* (Washington DC: The Niskanen Center).
- Hebert, K. (2014) 'Regulation of Space Weapons: Ensuring Stability and Continued Use of Outer Space', in *Astropolitics* (Vol. 12, No: 1, 1-26).
- Kearnes, M. & van Dooren, T. (2017) 'Rethinking the Final Frontier: Cosmo-Logics and an Ethic of Interstellar

# Legal 'Black Holes' in Outer Space: The Regulation of Private Space Companies

Written by Samuel Stockwell

Flourishing', in *GeoHumanities* (Vol. 3, No: 1, 178-197).

Klinger, J. (2017) *Rare Earth Frontiers: From Terrestrial Subsoils to Lunar Landscapes* (Ithaca: Cornell University Press).

Kosiak, S. (2019) *Small Satellites in the Emerging Space Environment Implications for U.S. National Security-Related Space Plans and Programs* (Washington DC: Center for a New American Security).

Kramer, W. (2017) 'In dreams begin responsibilities – environmental impact assessment and outer space development', in *Environmental Practice* (Vol. 19, No: 3, 128-138).

Lal, B. (2016) 'Reshaping Space Policies to Meet Global Trends', in *Issues in Science and Technology* (Vol. 32, No: 4, 63-74).

Leon, A. (2018) 'Mining for Meaning: An Examination of the Legality of Property Rights in Space Resources', in *Virginia Law Review* (Vol. 104, No: 3, 497-546).

Livingston, S. & Robinson, W.L. (2003) 'Mapping fears: the use of commercial high-resolution satellite imagery in international affairs', in *Astropolitics* (Vol. 1, No: 2, 3-25).

Lubojemski, A. (2019) 'Satellites and the Security Dilemma', in *Astropolitics* (Vol. 17, No: 2, 127-140).

Magdoff, F. & Foster, J.B. (2011) *What Every Environmentalist Needs to Know About Capitalism* (New York: Monthly Review Press).

Parker, M. (2009) 'Capitalists in Space', in *The Sociological Review* (Vol. 57, No: s1, 83-97).

Pellegrino, M. & Stang, G. (2016) *Space security for Europe* (Paris: European Union Institute for Security Studies).

Peña, C. & Hudgins, E. (2002) *Should the United States "Weaponize" Space? Military and Commercial Implications* (Washington DC: Cato Institute).

Petit, P. (2020) '“Everywhere Surveillance”: Global Surveillance Regimes as Techno-Securitization', in *Science as Culture* (Vol. 29, No: 1, 30-56).

Quintana, E. (2017) 'The New Space Age', in *The RUSI Journal* (Vol. 162, No: 3, 88-109).

Rudgard, O. (2020) 'Jeff Bezos and Elon Musk win Nasa contracts for 2024 moon mission', article from *The Telegraph* (<https://www.telegraph.co.uk/news/2020/04/30/jeff-bezos-elon-musk-win-nasa-contracts-2024-moon-mission/>, accessed 28/06/20).

Sachdeva, G. (2018) 'Commercial Mining of Celestial Resources: Case Study of U.S. Space Laws', in *Astropolitics* (Vol. 16, No: 3, 202-215).

Shaer, M. (2016) 'The Miner's Guide to the Galaxy', in *Foreign Policy* (No: 218, 44-51).

UN Office of Outerspace Affairs (1967) 'Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies', article from *United Nations Office of Outerspace Affairs Website* (<http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html>, accessed 25/03/20)

Valentine, D. (2012) 'Exit Strategy: Profit, Cosmology, and the Future of Humans in Space', in *Anthropological Quarterly* (Vol. 85, No: 4, 1045-1067).

# **Legal 'Black Holes' in Outer Space: The Regulation of Private Space Companies**

Written by Samuel Stockwell

Wang, T. (2010) 'Analysis of Debris from the Collision of the Cosmos 2251 and the Iridium 33 Satellites', in *Science & Global Security* (Vol. 18, No: 2, 87-118).

*Written at: King's College London*

*Written for: Tim Stevens*

*Date written: April 2020*