*Melissa de Zwart**

ACCESSORY TO WAR: THE UNSPOKEN ALLIANCE BETWEEN ASTROPHYSICS AND THE MILITARY

BY NEIL DEGRASSE TYSON AND AVIS LANG
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I Introduction: war and technology

Whilst there has long been an understanding of the importance of technological superiority in the battlespace, recent years have witnessed a growing realisation that the battlespace itself has shifted to the technological domain. New frontiers of grey zone tension include outer space, cyberspace and influence operations.[1] Whilst outer space may have always been susceptible to military operations, cyberspace, in particular the commercial internet and social media, does not at first regard appear to be a natural environment for international tension and hostile operations. Yet examples such as the recent elections in the United States and United Kingdom have revealed covert influence operations which push the boundaries of international laws applicable to hostility and conflict undertaken

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1 Grey zone conflicts arise where there is ambiguity surrounding the nature and legitimacy of activities undertaken by adversaries: Aurel Sari, 'Legal Resilience in an Era of Gray Zone Conflicts and Hybrid Threats' (Working Paper No 2019/1, Exeter Centre for International Law, January 2019) 14.

in cyberspace. They also flag the complexities of new relationships between private operators and governments.[2]

Two recent publications explore the relationship between war and technology from very different perspectives. The first of these books, Neil deGrasse Tyson and Avis Lang's *Accessory to War: The Unspoken Alliance between Astrophysics and the Military* explores the 'curiously complicit' alliance between astrophysicists and the military, reaching back into the earliest days of stargazing and astrology through to current tensions and proposed solutions.[3] At the heart of this discourse is the direct relationship between technology, knowledge and power. The other book, *Routledge Handbook of War, Law and Technology*, provides a much broader overview of the various technologies which now, or in the near future, present a challenge to international peace.[4] However, the multiple authors of this work too are concerned with recognising and celebrating the importance of technological innovation, as well as understanding the legal and ethical challenges of possible uses of new technologies.

Both books consider the importance of the fact that technology and research are vital to military superiority and conversely that investment in technology produces an extensive array of civilian benefits. As deGrasse Tyson and Lang note: 'waging war requires clever thinking and promotes technical innovation'.[5] In this endeavour, scientists, industry and the military are complicit. Although each may act from their own motivations, they have a common interest in the developments and advances in technology that their discoveries may bring, whether that results in new knowledge, profits or military advantage and strategic success.

II Accessory to War: The Unspoken Alliance between Astrophysics and the Military

DeGrasse Tyson and Lang make a compelling case for the bipolar relationship between research astrophysicists and the military, and are clear in their assertion that they are well aware that their cutting edge research 'plugs firmly and fundamentally into the nation's military might'.[6]

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2 Washington Post Editorial Board, 'Facebook is Looking a Lot Like a Government', *The Washington Post* (online, 24 February 2020) <https://www.washingtonpost.com/opinions/facebook-is-looking-a-lot-like-a-government/2020/02/23/2977a204-53f1-11ea-929a-64efa7482a77_story.html>.

3 Neil deGrasse Tyson and Avis Lang, *Accessory to War: The Unspoken Alliance between Astrophysics and the Military* (WW Norton, 2018) xiii–xiv.

4 James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019).

5 DeGrasse Tyson and Lang (n 3) 5.

6 Ibid 17.

The book explores the means and justification for attaining and maintaining the technological edge in the context of space security. The book is divided into two sections: the first part, titled 'Situational Awareness', provides a rich and engaging historical overview of the development of space-related technology with a general exploration of the importance of stargazing in areas as diverse as astrology, navigation, reconnaissance and surveillance, weather prediction and communications. The second part, called 'The Ultimate High Ground', explores the context, impetus and factors surrounding the development of key space technologies and, in particular, the close relationship between military purposes and scientific ingenuity. Interestingly, deGrasse Tyson and Lang emphasise that the influence does not always flow one way. Research scientists and private industry have derived enormous benefits from military research and manufacturing. For example, at the end of World War II

> private industry attracted many scientists whose skills were no longer required for war work. Former adversaries became allies, and vice versa. The Iron Curtain descended, and Cold War projects multiplied. Postwar research in the radio band swiftly ramped up as astronomers outfitted their observatories with wartime radar surplus, often bought at fire-sale prices or simply rescued from being thrown down a mineshaft.[7]

This symbiotic relationship continues in space exploration today, with extensive partnerships being developed between military and private space actors.[8]

DeGrasse Tyson and Lang amass and cite from a massive range of scientific, technical, historical and even literary sources, drawing together the overarching themes and preoccupations of human endeavour and rivalry which resulted in the capacity to explore and exploit outer space. It is a fascinating read for a general audience whilst providing sufficient insight and detail to those more interested in space security and global politics. DeGrasse Tyson and Lang present ample vignettes and case studies of the political history of space to keep even the casual enthusiast engaged and keep explanations short and relevant. For example, discussing the question of legality of overflight of nations on Earth by satellites in orbit, they explain:

> Some analysts maintain that the Eisenhower administration, intentionally or inadvertently, either allowed the Soviet Union to go first or was hugely relieved when it did so, because the historic flight of the first world-circling satellite effectively resolved the fraught issue of 'freedom of space': whether flights through the airspace above the territory of another country violated that country's sovereignty. Insistence on 'vertical sovereignty' and prohibitions against overflights would mean that a country deemed military satellite reconnaissance illegal. But now, having launched the first satellite, the 'Soviets had unwittingly placed themselves

7 Ibid 191.

8 Debra Werner, 'Military Turns to Private Sector for Rapid Space Innovation', *SpaceNews* (online, 9 October 2019) <https://spacenews.com/warfare-satellite-innovation-2019/>.

> in a position where they could hardly argue the illegality of the trespass of their own Sputnik'. Thenceforth, in principle, anyone could go anywhere in space.[9]

They go on to navigate carefully the early days of Cold War space rivalry and the background to the 1967 *Outer Space Treaty*,[10] right up to the present day tensions over proposed instruments such as the draft *Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects* ('*PPWT*') proposed by Russia and China to the UN Conference on Disarmament in 2008 and 2014.[11] They also examine current national articulations of the need for space superiority, a claim essentially based in technological superiority.[12] They also provide an overview of the key provisions of the *Outer Space Treaty*.

In the chapter titled 'Space Power', deGrasse Tyson and Lang address the emergence of new powers in the space domain alongside the decline in the United States' dominance in space, precipitated by decreased investment in space research. Importantly, deGrasse Tyson and Lang directly address the assertion that space is 'a warfighting domain just like air, land and sea'.[13] The complex issue of the characterisation of space as both the 'province of all mankind' as per art 1 of the *Outer Space Treaty* and as a domain to be used for both peaceful and military and strategic purposes is confronted directly with realism and facts. Space is an inherently dual-use domain.[14] For example, rendezvous and proximity operations of satellites promise new opportunities for refuelling and repair of spacecraft that may otherwise become space junk. However, like much of the space domain, this technology also carries within it both the potential for productive peaceful use, and

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9 DeGrasse Tyson and Lang (n 3) 268–9 n 79, citing Everett C Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (Frank Cass, 2002) 107–9; William Burrows, *This New Ocean: The Story of the First Space Age* (Random House, 1998) 187; Curtis Peebles, *High Frontier: The US Air Force and the Military Space Program* (Air Force History and Museums Program, 1997) 10; Walter McDougall, *The Heavens and the Earth: A Political History of the Space Age* (Johns Hopkins University Press, rev ed, 1997) 123–4, 134.

10 *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, opened for signature 27 January 1967, 610 UNTS 205 (entered into force 10 October 1967) ('*Outer Space Treaty*').

11 Conference on Disarmament, *Draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects*, UN Doc CD/1839 (29 February, 2008) ('*PPWT*'); deGrasse Tyson and Lang (n 3) 294–5.

12 DeGrasse Tyson and Lang (n 3) 350–77.

13 Ibid 325, citing Marcia Smith, 'Top Air Force Officials: Space Now Is a Warfighting Domain', *SpacePolicyOnline.com* (online, 17 May 2017) <https://spacepolicyonline.com/news/top-air-force-officials-space-now-is-a-warfighting-domain/>.

14 Melissa de Zwart, 'Outer Space' in William Boothby (ed), *New Technologies and the Law in War and Peace* (Cambridge University Press, 2018) 339. See also deGrasse Tyson and Lang (n 3) 159, 298.

use as a space weapon.[15] Much of the uncertainty arises from lack of transparency or certainty regarding what function the satellite is actually performing, something which is virtually impossible to discern from observation.[16]

DeGrasse Tyson and Lang certainly share their love of space with the reader and leave us with a sense of awe and optimism: that investment in science and discovery, whatever the source of funding, has led to advancement and knowledge for all of humankind. In the final chapter, 'A Time to Heal', they explore current threats to the space environment from space junk to space war, highlighting the disparity in national budgets spent on science and those spent on military projects. However, their final message is one of hope, that all of this human ingenuity, used to solve great problems and to explore the universe, can be brought to bear for the benefit of humankind. Ultimately they flag that this is one of the amazing aspects of space: its ability to inspire and engage human endeavour.

III Routledge Handbook of Law, War and Technology

The main weakness of the *Routledge Handbook of Law, War and Technology* is that, whilst it was published in 2019, it is based on a symposium and project originally commenced in 2013. As with everything concerning cutting edge technology, this means that there have been many changes and developments since that time. Some of the issues flagged have become far more prominent, including the topics of space and the global impact of information operations on elections worldwide, which receive fairly cursory attention. The original contributions to the 2013 symposium were peer reviewed to identify where there were gaps in the coverage of new technologies and additional chapters were commissioned to redress them.

The book is divided into six sections: 'Law, War and Technology'; 'Cyberwarfare'; 'Autonomy, Robotics and Drones'; 'Synthetic Biology'; 'New Frontiers'; and 'International Perspectives'. As the introduction to the book explores, some of these new technologies 'so profoundly' challenge the recognised categories of warfare that we are forced not only to determine if the existing principles of the law of armed conflict, also known as international humanitarian law, can be applied to the deployment of such technologies in an offensive manner, but even whether the effects of their use can in fact be recognised as war.[17] One of the obvious examples of this is information

15 Theresa Hitchens, 'The Stellar Dance: US, Russia Satellites Make Potentially Risky Close Approaches', *Breaking Defense* (online, 10 April 2019) <https://breakingdefense.com/2019/04/the-stellar-dance-us-russia-satellites-make-potentially-risky-close-approaches/>.

16 Brian Weeden, 'Dancing in the Dark Redux: Recent Russian Rendezvous and Proximity Operations in Space', *The Space Review* (online, 5 October 2015) <https://www.thespacereview.com/article/2839/1>.

17 Rachel Kerr, 'Introduction: Technological Innovation, Non-Obvious Warfare and Challenges to International Law' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 1, 2.

warfare or its more subtle manifestation, influence operations. Multiple complications ensue: is it clear who is the proponent of such acts? And how can their effects be predicted? Thus the book explores and challenges our preconceptions regarding the nature of war and how it can be recognised and subjected to international law. Clearly there is also significant scope in a book of this nature to explore the ethical issues created by the concepts of dual-use technology and the desire to create technology which improves society, yet is susceptible also to causing great harm. However the main focus of the majority of the chapters is rather on the identification and categorisation of the technology and its potential uses.

The chapters in the first section of the book provide vital context for the discussion and analysis in the individual chapters that follow. In their chapter 'Obvious and Non-Obvious: the Changing Character of Warfare', Ernst Dijxhoorn and James Gow discuss the increasing importance of legitimacy as the key issue in contemporary warfare, identifying that the 'key to war is the struggle for the will of "the people"'[18] who 'consume, and base their judgement on, a constant stream of information and commentary'.[19] Noting that this information can be sourced from a vast number of providers and platforms, on a rapidly accelerating timeframe, information (or its sinister counterpart, disinformation) itself becomes a weapon, drawing state, non-state, private and commercial actors into the evolving sphere of hybrid warfare.

The section dealing with cyberwarfare raises the key issue of whether a cyber attack may constitute an armed attack and the vexing problem of attribution, as well as some more nuanced considerations.[20] Sir David Omand explores the damage done to intelligence work by the Snowden revelations.[21] He considers the entry into popular discourse of concepts and terminology such as 'mass surveillance' and 'bulk data', and the reaction of consumers to the spectres raised by this language. The fear of a consumer backlash

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18 Ernst Dijxhoorn and James Gow, 'Obvious and Non-Obvious: The Changing Character of Warfare' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 13, 18.

19 Ibid 19.

20 Elaine Korzak and James Gow, 'Computer Network Attacks under the *Jus ad Bellum* and the *Jus in Bello*: "Armed" — Effects and Consequences' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 65; Elaine Korzak and James Gow, 'Computer Network Attacks under the *Jus ad Bellum* and the *Jus in Bello*: Distinction, Proportionality, Ambiguity and Attribution' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 76; Marco Roscini, 'Proportionality in Cyber Targeting' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 88.

21 The 'Snowden revelations' related to the mass, warrantless surveillance of United States citizens by the United States Government, as well as the collection of data by the United Kingdom's Government Communications Headquarters and the role of tech companies such as Apple, Google, Microsoft, Facebook and Skype in the collection of user data. Disclosures of information on these matters were made by former defence contractor Edward Snowden to *The Guardian* in 2013. Snowden still lives in exile in Russia. For a timeline of the various disclosures: see Lawfare Institute, 'Snowden Revelations', *Lawfare* (Blog Post, 8 June 2020) <https://www.lawfareblog.com/snowden-revelations>.

consequently resulted in the reassurance by platform and device providers that their data would be 'safe' behind their encryption tools.[22] This section concludes with Gow's exploration of the key weakness of cybersecurity: the human factor.[23]

The next section deals with autonomy, robotics and drones. It focuses significantly less on the robots and more on the role of the human operator in decision-making. Providing an interesting departure from a fixation on killer robots, the five chapters in this section take a step back to look at how far a human can be held responsible for decisions being made by autonomous computer systems.[24]

Considering that the writing of this review occurs in the context of the COVID-19 pandemic and related theories regarding the origins of the disease, the next section of the book dealing with the existence and uses of synthetic biology appears significantly relevant. The chapters in this section explore the complexity of developing bioweapons and their indiscriminate effect, as well as flagging the potential for the development and use of such weapons to increase.[25] One of the key issues raised by the authors in this section is the extent to which research in this area should be allowed to proceed. The authors raise the question regarding the effectiveness of a complete ban on research on bioweapons, creating a knowledge gap which not only counters principles of academic freedom,[26] but potentially weakens the ability to recognise, verify and counter a bioweapon attack.[27]

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22 Sir David Omand, 'Digital Intelligence and Armed Conflict after Snowden' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 101, 114–15.

23 James Gow, 'The Ambiguities of Cyber Security: Offence and the Human Factor' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 118.

24 Thrishantha Nanayakkara, 'Autonomy of Humans and Robots' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 131; Jack McDonald, 'Autonomous Agents and Command Responsibility' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 141; Kenneth Anderson and Matthew C Waxman, 'Legal-Policy Challenges of Armed Drones and Autonomous Weapons Systems' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 154; Maziar Homayounnejad and Richard E Overill, 'The "Robots Don't Rape" Controversy' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 169; Tony Gillespie, 'Humanity and Lethal Robots: An Engineering Perspective' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 182.

25 Matteo Bencic Habian, 'A Threat Assessment of Biological Weapons: Past, Present and Future' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 237.

26 Guglielmo Verdirame and Matteo Bencic Habian, 'The Synthetic Biology Dilemma: Dual-Use and the Limits of Academic Freedom' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 251, 258.

27 Filippa Lentzos and Cecilie Hellestveit, 'Synthetic Biology and the Categorical Ban on Bioweapons' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 215, 226–7; Habian (n 25).

The following section is headed 'New Frontiers' and deals with outer space, biometrics and future war crimes. Bleddyn Bowen's chapter 'Space Oddities: Law, War and the Proliferation of Spacepower' provides a refreshing approach to the characterisation of space, asserting that contrary to rhetoric of peaceful purposes and the concept of a space sanctuary, space has always been militarised, noting:

> Given the integration of spacepower into our daily lives and military capabilities, and not only in the Western world, it is time to view outer space and astropolitics beyond the inhibitive lenses of the 'militarisation' and 'weaponisation' of space.[28]

Rather, space should be regarded as an extension of Earth politics and contest.[29] The following chapter identifies the consequences of the growth of the commercial space sector.[30]

Further chapters cover fascinating issues of 'Biometrics and Human Security', highlighting the potential risks and benefits of using biometric data in tracking refugees.[31] Subsequent chapters canvass views towards future war crimes, specifically involving cyberwarfare, autonomy and synthetic biology,[32] and digital evidence.[33]

The final section features an eclectic selection of topics which can all be broadly held together under the title of 'International Perspectives'. Clearly outer space was an add-on to the book as attitudes to space are not canvassed in this section. The first part of the section is a chapter providing key insights into Russian information warfare, examining the strengths and vulnerabilities of Russian versus Western attitudes to information warfare. [34] The final four chapters in this section round out

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28 Bleddyn Bowen, 'Space Oddities: Law, War and the Proliferation of Spacepower' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 265, 276.

29 Ibid.

30 Pawel Frankowski, 'Outer Space and Private Companies: Consequences for Global Security' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 280.

31 James Gow and Georg Gassauer, 'Biometrics and Human Security' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 293.

32 James Gow and Ernst Dijxhoorn, 'Future War Crimes and the Military (1): Cyber Warfare', in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 305; James Gow and Ernst Dijxhoorn, 'Future War Crimes and the Military (2): Autonomy and Synthetic Biology' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 317.

33 Maziar Homayounnejad, Richard E Overill and James Gow, 'Future War Crimes and Prosecution: Gathering Digital Evidence' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 329.

34 Oscar Jonsson, 'Russian Information Warfare and its Challenges to International Law' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 339.

Islamic ethics and law with respect to unconventional warfare,[35] French attitudes and responses to cyber attack[36] and the complexity of the application of international law to cyber attacks, given the vast difference in norms and attitudes in the United States, United Kingdom, Russia and China.[37]

IV Conclusions

Each of these books makes a strong contribution to understanding the technological environment and background to current grey zone and hybrid conflicts. They each attempt to meld technological concepts and the application of legal principles, as well as social contexts. They both provide excellent background reading for an understanding of the current complex issues affecting national security. However, one may feel slightly more optimistic after reading deGrasse Tyson and Lang's tome, as at the end of it all, the optimism of the astrophysicist wins out against the struggles and despair of international rivalries.

35 Ariane Tabatabai, 'Unconventional Warfare and Technological Innovation in Islam: Ethics and Legality' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 354.

36 Anne-Marie le Gloannec and Fleur Richard-Tixier, 'Cyber Security, Cyber-Deterrence and International Law: The Case of France' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 366.

37 Elaine Korzak, 'The US, the UK, Russia and China (1): Regulating Cyber Attacks Under International Law — Developments at the United Nations' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 375; Elaine Korzak, 'The US, the UK, Russia and China (2): Regulating Cyber Attacks under International Law — the Potential for Dedicated Norms' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 381.