

The Chief of the Air Staff's Reading List 2020-21



Front cover image:

First RAF P-8A Poseidon on the pan at NAS Jacksonville
after being delivered to the RAF.

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Foreword

This is my inaugural reading list, taking a new approach that reflects the rapidly changing environment in which we operate. This revised and more-regularly updated list will focus on the issues we face today and the challenges of tomorrow: 21st century societal and cultural shifts, space, cyber, sub-threshold warfare and artificial intelligence to name but a few. This list is intended to be a thought-provoking modern collection that will be of interest and information, with topics of relevance to us all. In taking this new approach, I should also re-emphasise the immense importance of historical air power texts which we will continue to promote in a new format that DDefS will introduce in the coming year.

The 2020 list opens with Matthew Syed's *Rebel Ideas*, a remarkable book that challenges us to look at ourselves, how we make decisions and harness diverse ideas. David Kilcullen's *The Dragons and the Snakes: How the Rest Learned to Fight the West* explores how our preoccupation with recent conflicts in the Middle East and Afghanistan, enabled an array of state and non-state actors to adapt and develop, eroding the dominant position of Western powers. It is a sobering exposé of the security challenges facing Western states today.

Justin Bronk's *The Future of NATO Airpower* explores the challenges faced by NATO's air forces, while *Army of None: Autonomous Weapons and the Future of War* brings to life the technological and cultural dilemmas we face with autonomous weapons and their development.

In a year shaped irrevocably by COVID-19, we have included Adam Kucharski's *The Rules of Contagion: Why Things Spread and Why They Stop* using case studies ranging from malaria to malware, computer viruses and viral trends, and also



addressing the challenges emerging through increased exposure to fake news and vast amounts of raw data. *War in Space: Strategy, Spacepower and Geopolitics* by Bleddyn Bowen makes a significant contribution to thinking about the potential for confrontation and conflict in space, something we must all grapple to understand as we establish UK Space Command.

In *The New Rules of War*, McFate posits that 'the West has forgotten how to win wars'. The strength of the book is in the identification of 21st century problems and challenges. The proposed solutions are thought-provoking and, for some, contentious. *Command: The Twenty-First Century General* makes a fascinating contribution to the study of command as it has evolved to reflect the changing character of warfare. This book will challenge you to think about how collective command applies in Joint, cross-government and coalition operations, and the integration of cyber and space.

Military culture can inspire deep loyalty, selflessness and courage that are decisive on the battlefield however it can

also constrain us and potentially condemn us to fight the last or the wrong war. *The Culture of Military Organizations* explores a selection of military organisations and offers a compelling insight into this effect. Finally, for any military reader, *Sandworm* will have broad appeal; covering sub-threshold conflict, cyberspace, and information warfare, it is illuminating as well as an entertaining read.

The books in this list offer a valuable insight into contemporary and emerging challenges as we build our Next Generation Royal Air Force. Future Force concepts. I encourage you to develop yourself personally and professionally through reading some if not all of them.



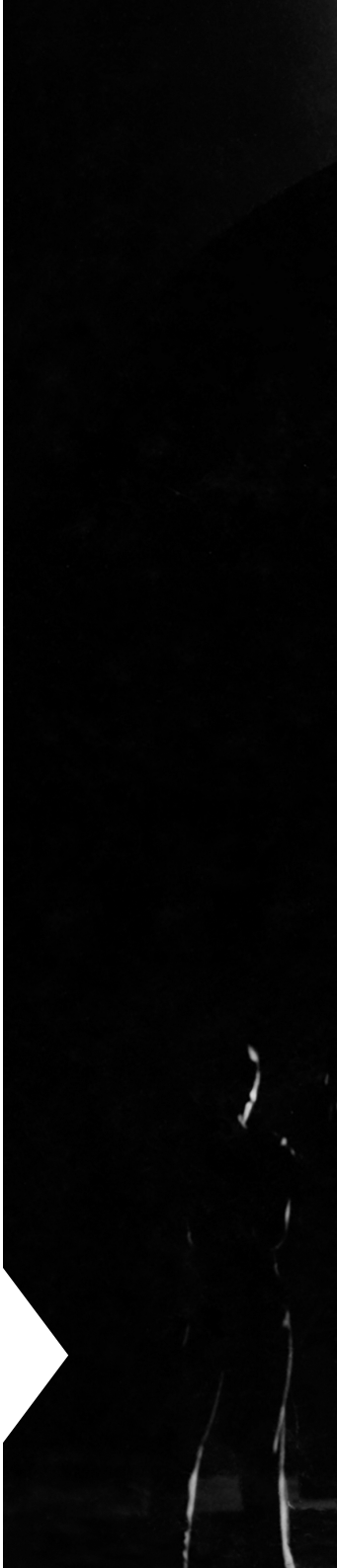
Air Chief Marshal Mike Wigston CBE ADC
The Chief of the Air Staff

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Ground crew on a Bomber Command station return the V-sign to a neighbouring searchlight as they celebrate VE Day, 8 May 1945.

Attribution: © Crown Copyright / Ministry of Defence.
Courtesy of Air Historical Branch (RAF).

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Message from the Director of Defence Studies (RAF)

I hope that you will find the titles within the 20/21 reading list of interest and value. Most of the books are available for loan from unit libraries and in e-book format at the MOD online library (<https://ebookcentralproquest.com/auth/lib/mod/requestAccount.action>) – opening an account is straightforward, simply requiring your personal MOD email address to register. A wealth of books are available for you to enjoy; new titles are made available throughout the year, if you come across a book that you feel is worthy of consideration for CAS' endorsement in next year's list, addressing forward looking and contemporary topics such as artificial intelligence, cyber security, sub-threshold or information warfare, to highlight just a few, please get in touch with me at CAS-ASDefenceStudies@mod.gov.uk.

For all serving regular and reservist RAF personnel, if your reading inspires you to take your study of Air and Space Power, technological advancements, and International Relations and Strategy further, I would actively encourage you to consider applying for a Chief of the Air Staff's Fellowship. Details can be found on the RAF Centre for Air Power Studies website at <https://www.raf.mod.uk/what-we-do/centre-for-air-and-space-power-studies/>.



Group Captain Andrew Hetterley
MPhil MA BA(Hons) RAF

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The Chief of the Air Staff's Reading List is edited and distributed on behalf of the Chief of the Air Staff by the Director of Defence Studies (RAF).

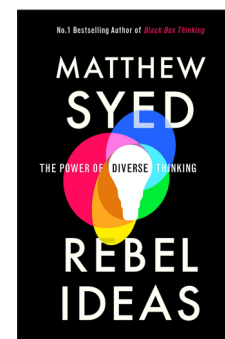
Rebel Ideas: The Power of Diverse Thinking

By Matthew Syed

Publisher: John Murray, 2019

ISBN: 978-1473613928, 320 pages

Reviewed by Warrant Officer Sara Catterall



This is a book about diversity. It is about diversity in all its forms, but with particular emphasis on diversity of thought and how success is about freeing ourselves from the blindspots and biases that affect us all. Written for any with a burgeoning interest in organisational development, for leaders in the RAF it helps us to understand our barriers to inclusion and what this could mean in terms of building a workforce fit for the future and the evolving requirements we must effect, to achieve it.

Matthew Syed is a British journalist and highly successful author on the subject of mindset and high performance organisations. In his previous life he was a table tennis international, and was the English number one for many years. As such, he brings a unique perspective on how every individual, team and organisation has the ability to improve with the right mindset. He goes further, and using a combination of scientific research and engaging individual examples, he also encourages the reader to see the connection between diversity, innovation, and growth.

Syed leads with a hard-hitting example of collective blindness. He suggests that 9/11 was one of the defining intelligence failures of all time and the reason for this was a lack of cognitive diversity in the CIA. Their recruitment system hired exceptional individuals – but homophily or, put simply the tendency to hire in their own image, resulted in a majority employment of white, male, Anglo-Saxon, Protestant Americans, with a similar education,

psychological profile and lived experience. Syed argues this flawed approach led to a consistent validation of the collective view, and in turn, prevented the CIA from comprehending a very real threat to the United States of America on home soil. 'They could not believe that this tall Saudi with a beard, squatting round the campfire, could be a threat to the United States of America' (p. 26). When we compare this with our own drive to increase RAF recruitment statistics for BAME and gender, the book provides compelling evidence in the benefits of embracing difference and the dangers of group think.

The book is incredibly powerful and encourages the reader to think about the plausibility of diversity, both from an individual and a leadership perspective. It explores the 'why' from a position of continued organisational credibility in a rapidly changing world, and not from the hackneyed political correct societal demands for equality. From leaders, to humans, to family, to team, there are many examples that resonate with our RAF demographic and underpin the need for cultural change, to ensure we can meet the challenges of the future. Syed deals with cognitive diversity in a hierarchical organisation like ours and helps the reader to understand constructive dissent in this context. He discusses echo chambers, describing perfectly those times where we have all been in meetings and where we have been reluctant to air our opinion, at risk of being seen as different to the group or because we are a subordinate to the Chairperson. Syed gives insightful

examples of how this has led to clear organisational failures and despite our approval from the Alpha being inherent human nature, how we can recognise it and in doing so, do something about it. As we carve our #Next Generation Air Force using ASTRA as the guide rope, this book is essential reading for any who want to better understand inclusion but it is much more than that. It sheds the light on how we empower all elements of the RAF Family to innovate and accelerate change; the enlightening view that people from all levels have something to contribute.

If leaders read only one book this year, this should without doubt be it. It is a remarkable book that challenges us to look at ourselves and our leadership styles; how we can improve but essentially contribute to the team ethos and a strong future RAF. Beyond other authors in this genre, such as Simon Sinek or Daniel Kahneman who focus on individual improvement, this book concludes with the argument that as we move into an era of rapid transformation, the problem sets we face will be too complex for an individual but will be faced by the wisdom of a team. The RAF is changing and people are at the heart of this change. Our ASTRA challenge is to adapt at pace, in depth and across all our Service – Syed asserts that diversity of thought and experience, within a psychological safe space, is critical to achieve this. At a time when technological adaption and creativity will be key, this fascinating deep dive gives us the tools to build an effective team, both by better understanding our weaknesses but also the strength of collective intelligence and empowerment. As General Patton said ‘never tell people how to do things. Tell them what to do and they will surprise you with their ingenuity’.

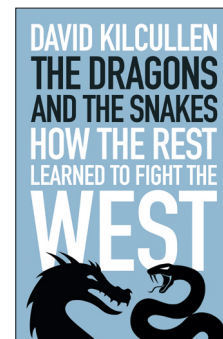
The Dragons and the Snakes: How the Rest Learned to Fight the West

By David Kilcullen

Publisher: London: C Hurst & Co, 2020

ISBN: 978-1787380981, 336 pages

Reviewed by Lieutenant Colonel James Chandler



In 2006, General David Petraeus brought together a group of academics and soldier-scholars to find a new approach to the seemingly intractable conflicts in Afghanistan and Iraq. Together they produced a reinvigorated set of counter-insurgency tactics that the General subsequently put to good effect, initially as commander of the so-called 'surge' in Iraq and thereafter in Afghanistan. Ably assisting him during these missions were special advisers from his original writing team and one such expert was an Australian Army officer called David Kilcullen. Since then, Kilcullen has become an internationally acknowledged expert on strategy, counter-insurgency and international security. Today, he is Professor of International and Political Studies at the University of New South Wales and author of four books, three of which have featured in previous Chief of the Air Staff's Reading Lists: *Accidental Guerrilla* (2010); *Out of the Mountains* (2014) and *Blood Year* (2016). A regular speaker at the UK's Defence Academy, his work has been described as 'disturbingly brilliant'.

His new book is no exception. *The Dragons and the Snakes* is a chilling exposé of the security challenges facing Western states today. At its heart is the proposition that while the USA and her allies became myopically focused on the conflicts in Afghanistan and Iraq, an array of state and non-state actors have adapted and developed to erode the previously dominant global position of Western powers. Kilcullen's argument is that the high-tech, high-precision military model showcased so

successfully in the 1991 Gulf War and 2003 Iraq invasion 'is no longer working' (p. 6). Adversaries have established a position of advantage by learning to render Western conventional military superiority irrelevant and by exploiting the geo-political, economic and security vacuum created during Western focus on the 'War on Terror'. Kilcullen's book is an impressive analysis on how and why this has happened.

The book's title is inspired by President Clinton's first Director of Central Intelligence, James Woolsey, who in 1993 described the post-Cold War world by commenting: 'Yes, we have slain a large dragon [the Soviet Union], but we now live in a jungle filled with a bewildering variety of poisonous snakes'. Kilcullen summarises the decade thereafter as a 'Woolseyan' security environment, where 'threats emanated mostly from weak or failing states and from non-state actors (snakes) rather than capable state adversaries (dragons)' (p. 11). However, after 9/11 and the 2003 Iraq invasion, the West's exclusive focus on just one snake, terrorism, produced two consequences: first, the 'snakes' were forced to learn and adapt, to develop new methods that negated Western military superiority; and second, the 'dragons' were given breathing space to grow and 'the opportunity to watch and learn from our struggles' (p. 18). As a result, non-state threats have become as lethal as the 'dragons' and state adversaries have become as slippery as the 'snakes'.

The main body of *The Dragons and the Snakes* is divided in two. In the first half, Kilcullen uses theories from evolutionary science to explain how the 'snakes' have learned and adapted since 1993. Adopting a Darwinian dialectic, he argues Western counter-terrorism has produced an artificial 'fitness landscape', causing a particularly strong breed of snake to evolve. He illustrates this with reference to the Pakistani Taliban. Kilcullen argues that years of alleged US drone strikes have shaped them from a loose collection of local militias into a unified terrorist group that now poses a significant transnational threat (p. 56). Similarly, Kilcullen explains how the Lebanese group Hezbollah has conducted war-time adaptation in a 'conflict ecosystem' to become more deadly than ever. The Hezbollah 'growth cycle' matured in the Syrian Civil War when it deployed a large expeditionary force to fight alongside Russia in support of the Assad regime. Today, it cleverly combines irregular and conventional methods to operate as a powerful regional actor, 'provoking fears of a coming clash with Israel' (p. 110).

The second half of the book examines two major 'dragons'—Russia and China. Kilcullen explains how Russian adaptation has followed two related pathways. The first is a new strategic approach which Kilcullen dubs 'liminal warfare', from an anthropological term describing people transitioning between two states of being (p. 119). Readers may not thank Kilcullen for introducing yet another term to the already long list describing recent Russian activity – hybrid warfare, grey-zone conflict, Gerasimov Doctrine, *etcetera*. Nevertheless, 'liminal warfare' provides a useful description of Russia's ambiguous activity, between fully overt and truly clandestine, that create conditions of advantage 'before adversaries can react' (p. 119). Complementing this is Russia's second adaptive pathway: 'the most radical military reforms since the creation of the Red Army' (p. 148). These reforms combined the streamlining and

re-equipping of the military with the broadening of its operations to incorporate non-military groups such as cyber militias and organised crime networks. Thus, Russia's evolution has resulted in a resurgent 'dragon' operating with the cunning guile of a slippery 'snake'.

Similarly, China's adaptation has followed comparable pathways. The first is a new strategic approach that adopts a broader interpretation of conflict. This threatens the West with what Kilcullen calls 'conceptual envelopment', where 'non-war' actions such as financial disruption and trade wars are exploited to put adversaries at a strategic disadvantage, making conventional military responses both belated and redundant. This approach, Kilcullen argues, explains why China has purchased real estate overlooking Western naval bases (including Faslane) and the building of artificial islands (or 'unsinkable aircraft carriers') in the South China Sea to dominate these disputed waters (p. 200). Similar to Russia, this conceptual pathway has been complemented by comprehensive military reforms. As a result, China now boasts air and naval forces that emulate the USA's global projection capability and a vast anti-access and aerial denial system (or A2/AD) of anti-ship ballistic missiles and long-range air defences that deter any Western operations in China's sphere of influence.

The Dragons and the Snakes is a compelling analysis of the range of threats facing Western states today. It is essential reading for any military professional seeking to understand the contemporary international security environment. It also raises timely questions regarding military learning and adaptation. After reading *The Dragons and the Snakes*, some may wish to reflect on whether the British military has conducted sufficient learning and adaptation since its bruising experiences in the 'War on Terror'. Are we as 'match fit' for the modern security landscape as our opposite numbers in Russia, China or even Hezbollah?

The Culture of Military Organizations

By Peter R Mansoor and Williamson Murray

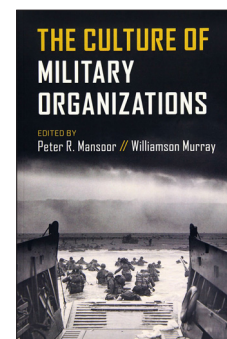
Publisher: Cambridge University Press, 2019

ISBN: 978-1108724487, 484 pages

Reviewed by Air Commodore Fin Monahan

Mansoor and Murray have edited a collection of 14 case studies in a book that explores a most interesting human aspects of warfare: the culture of military organisations. The book demonstrates that military culture can inspire deep loyalty, selflessness and courage that are decisive on the battlefield. However, such is culture's power, it can also insidiously imprison and blind us causing stagnation, inflexibility and, in many cases, condemn us to fight the last, or indeed, the wrong war. However, despite its power, the subject of cultural theory rarely makes more than tangential appearances on academy and staff college courses syllabi. Of note, RAF culture, in particular, has been barely touched upon by the academic community. *The Culture of Military Organizations* brings together case studies that explore a fascinating selection of military organisations giving an insight into this powerful force and is a most worthy choice for this year's Chief of the Air Staff's Reading List.

The first two chapters of the book examine cultural theory providing a framework for the main body. The ensuing case studies then cover a diverse selection of land, maritime and air force organisations from US, British, Soviet, German, Israeli, Iraqi and Japanese militaries. For the air power community, the book includes a case study on the USAF as well as one of the vanishingly rare academic analyses of RAF culture.



An important theme that runs through the book is the relationship between leaders and culture. The case studies covering the Union Army of the Tennessee, the Israeli Defence Force (IDF) and the RAF are all used to demonstrate that leaders of an organisation in its infancy are able to influence culture to a much greater degree than leaders who take over an organisation with an established culture. In the case of the RAF, Trenchard's career long advocacy for developing an 'Air Force Spirit' as a key expression of independence resulted in extensive investment in buildings, a College, a Staff College, uniforms, artefacts and processes and practices that saw the RAF develop a fresh, vibrant and strong culture that was, without doubt, a driving force behind the panache and bravery of The Few. However, Trenchard's powerful personality that drove the positive aspects of RAF culture also resulted in suppression of dissent, institutionalised thinking at the Staff College and selective use of evidence that resulted in groupthink about the application of air power. This led to the RAF developing a 'blind faith in the effectiveness of bombing' that endured well after Trenchard left the Service. Thus, while the staggeringly powerful culture was a positive force of cohesion, Stubbs proposes that it also constrained RAF thinking with the result that the RAF was ill prepared for the unfolding operational environment of the Second World War.

The two case studies by Sinnreich and Murray exploring the British Army from the 1850's until 1945 reveal another

example of strong culture serving to constrain a military organisation. The regimental culture of the British Army encouraged great bravery on the battlefield; Sinnreich wrote that 'British officers of all ranks displayed almost suicidal bravery under fire. To display 'funk,' even when the funk in question was no more than militarily sensible prudence, risked subjecting the offender to penalties ranging from mere contempt to outright ostracism' (p. 167). However, the culture that encouraged such bravery also encouraged a culture of rigid conformity combined with amateurish attitudes to the profession at arms that 'prized games, parades, and hunting' (p. 100) over professional curiosity. Suspicious of swots and scientific officers, the British Army developed an engrained anti-intellectualism that left it chillingly unprepared for the Boer War and also later failed to recognise the value of its own ground breaking experimental tank manoeuvres on Salisbury Plain in the late 1920's and early 1930's.

Contrastingly, the US Navy and Marine Corps case studies, by Kuehn and Millett reveal two organisations with cultures that respected military education and open mindedness. They were, consequently, able to develop the carrier battle group and amphibious warfare concepts to great effect between the wars. Similarly, Pennington's case study highlighted a surprisingly open-minded approach to military thinking in the Red Army allowed the idea of Deep Battle to be developed by Tukhachevsky between the wars, which was, according to Kagan, 'light-years ahead of the armoured warfare of any other state' (p. 242) and demonstrated the ability of a military to innovate when given the opportunity to think and experiment. However, in 1937, Stalin's purges stopped Red Army innovation in its tracks. Tukhachevsky was executed, the term Deep Battle banned and Soviet military thinking was set back 20 years as a culture was killed off from the outside out of fear of a military coup.

Many other themes that demonstrate the power of culture are broached throughout the book and are too numerous to explore here. However, the cultural bias that emerges in a technically focussed service was examined in the naval and air force sections of the book and will be of interest to the air power community. Meanwhile, the theme of 'tribes' was examined in the USMC case study. Tribalism creates a sense of elitism and belonging which is a positive for the tribe members, however, the rivalry between tribes can become a corrosive force. This will resonate with an RAF community in which many clearly identifiable tribes exist based upon trades, branches and platform types.

This book draws together a fascinating collection of highly readable case studies that introduce both the positive and constraining nature of military culture. The case studies demonstrate that many of the organisations examined were not aware that the strong cultures, from which they derived great strength in some areas, were simultaneously and insidiously constraining them in others; they were suffering from cultural blindness. Additionally, the book highlights the central role of a professional military education for stimulating curiosity and establishing an approach that questions the established culture. Using a fascinating selection of diverse case studies, this book has succeeded in highlighting the importance of understanding military culture and is highly recommended.

Army of None: Autonomous Weapons and the Future of War

By Paul Scharre

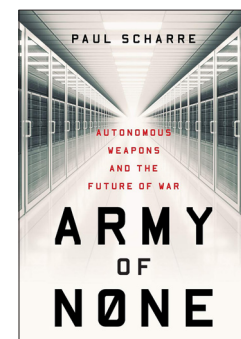
Publisher: WW Norton & Company, 2018

ISBN: 978-03936608984, 446 pages

Reviewed by Air Commodore Mark Phelps

The age of autonomy is upon us, from self-driving cars to automated trading on the world's stock exchanges, applications of machine intelligence are commonplace. Modern weapons are increasingly automated across a range of functions and this is part of a deeper technological trend towards Artificial Intelligence (AI). The introduction of AI enabled weapon systems raises challenges in application beyond the automation of today, towards a future in which AI enabled weapons could decide when to use force and, against whom, without reference to a human operator. Paul Scharre is a former US Army Ranger, policy advisor to the US Secretary of Defence, in which role he led the team drafting the US policy on autonomous weapons. He is currently the Director of the Technology and National Security Programme at the Centre for a New US Security. As both military operator and analyst, Scharre has a uniquely qualified perspective from which to approach the question of autonomy in weapon systems.

For Scharre, 'AI is coming, and it will be used in war, the question that is yet to be answered is how it will be used' (p. 8). Starting with this premise *Army of None* seeks to provide the reader with a view into the development of next generation robotic weapons. Scharre explores the challenges AI will bring into these systems and offers some thoughts on how we might take action now to avoid the unintended consequences that may flow from their use.



Scharre opens with the precautionary tale of Lieutenant Colonel Petrov. Petrov, an officer of the Soviet Air Force, was the duty officer at the Oko nuclear early warning system on 26 September 1983 when the system reported that a nuclear missile had been launched from the United States. Instead of taking the system at face value Petrov questioned the warning and in particular why the United States would launch such a limited attack in the knowledge that the Soviet Union was more than capable of responding. Instead of instigating a chain of events that would have seen the Soviet Union launch a nuclear response, Petrov's actions established that there was a fault in the Soviet early warning system and thereby averted a response that would have likely initiated a nuclear war. In light of this precautionary tale Scharre poses the question; what would a machine response have been?

Army of None consists of 21 chapters, organised into six parts covering the emerging technology through to risk and general acceptance of evolving systems. Part one provides the reader with an understanding of the strengths and weaknesses of the technology as applied in current weapon systems. Adopting a US centric lens, Scharre draws a line between ever increasing automation toward autonomy through the relative complexity of their cognitive processes. Part two looks at future applications of autonomy and the way in which the US defence establishment has been given the discretion to take

advantage of the technology whilst acknowledging the sensitivities that would come with military exploitation.

The next couple of chapters explore the risks associated with deploying autonomous weapons, from the physical harm that an autonomous weapon, or a Fleet or Squadron, could do if malfunctioning or otherwise 'running amok' to the question of whether autonomy in weapons could initiate events leading to war without human deliberation. Scharre draws upon a comparison with automated stock market trading to consider the operationalisation of autonomy in the cyber realm, imagining a future in which a flash war of action and reaction would be possible at such speeds that would make human supervision or intervention all but irrelevant. He cleverly links this into questioning whether autonomous weapons can be used safely. Scharre considers Charles Perrow's normal accident theory which holds that multiple and unexpected failures are built into society's complex and tightly interwoven systems and relates this to the practices of high reliability organisations, to conclude that the complexity of autonomous weapons make accidents inevitable, particularly when operating in confused adversarial contexts such as war. Scharre argues that this fact will only increase as each layer of complexity makes it increasingly difficult for the human operator to predict how the autonomous system will react under all circumstances.

In chapter five Scharre considers the arguments deployed in the call to ban, or impose a moratorium, on the development of autonomous weapons and the actions that States can take now in a bid to avoid the dire predictions some believe will emerge in a future with autonomous weapons. When debating whether autonomous weapons can conform to the Law of Armed Conflict (LOAC) Scharre points out the subjective nature of much of the law to conclude that whilst the technology is not sufficiently mature to meet all of the

challenges imposed under the LOAC, that is not to say that future developments will not allow it to reach this stage. Questioning the morality of allowing machines to take decisions over the life and death of human beings, Scharre takes issue with a romanticised view of war, in which combatants recognise each others essential human dignity in the act of killing, to argue that the reality of war engages 'no ethical, legal or historical tradition of affording foes the right to die a dignified death [...] autonomous weapons automate the selection of the target but the way of killing has not changed' (p. 288).

The final part of *Army of None* considers the future of autonomous weapons both in human machine teaming and in isolation. Following a discussion of the relative merits and prospects of a ban on the development of autonomous weapons, Scharre concludes that there are many challenges in pursuing a ban, not least the fact that there is no universally accepted definition of what constitutes an autonomous weapon or even if some existing weapon systems have already crossed the Rubicon to autonomy. In the absence of such a unified definition Scharre advocates for the articulation of a positive requirement for human involvement in the application of force as he argues this is what lies at the heart of the debate.

Army of None is an engaging read and I would recommend it to anyone seeking an accessible account of the debate surrounding the current and future use of highly automated and autonomous weapons. Avoiding an overly complicated exploration of the technology, the strength of Scharre's work is his ability to clearly set out the current thinking on, and the challenges associated with, autonomous weapons and their development. Written from a largely US perspective, this is no criticism given that the US is a major power in this field of development and the only one readily susceptible to scrutiny in terms of its development goals and military thinking.

The Rules of Contagion: Why Things Spread and Why They Stop

By Adam Kucharski

Publisher: London: Profile Books, 2020

ISBN: 978-1788160193, 352 pages

Reviewed by Group Captain Andrew Hetterley

Over the past two decades the RAF has been directly involved in several operations combatting outbreaks of disease at home and abroad: COVID-19, Ebola, Foot and Mouth. Increasingly so over the same period, computer viruses and other malware constantly keep us on our guard, both at work and in our everyday lives. Even when we are not challenged by such events, we face a growing deluge of 'viral' videos, trends, challenges and fake news with increasing images of riots and social disharmony commonplace. Whilst these individual events or outbreaks may be streamed in depth elsewhere, where is the medium which covers the prediction and analysis of why some epidemics and trends spread exponentially yet others fizzle out and die? Why are all of us even complicit in such occurrences? Kucharski's work is an interesting and informative text aimed squarely at exploring that question.

The author is an associate professor at the London School of Hygiene & Tropical Medicine. A mathematician, he has worked on teams combatting global outbreaks such as Ebola and Zika. A Ted fellow and winner of the Rosalind Franklin Award Lecture and Wellcome Trust Science Writing Prize, previous works include *The Perfect Bet*; he writes for the *Financial Times*, *Scientific American* and *New Statesman*.

The Rules of Contagion represents Kucharski's most ambitious work to date, interestingly published just as COVID-19 was emerging into the public lexicon. As such



the text is free from any mention of the coronavirus; quite refreshing considering the constant bombardment from media platforms. The author begins by covering the difficult evolution of combining mathematical modelling and medicine during the first serious attempts at eradicating Malaria, progressing to cover historical and modern disease epidemics and pandemics from the Spanish Flu through to contemporary outbreaks of Ebola, Zika, and SARS. Kucharski then examines the spread of social disorder; questioning what causes some events to erupt from one act to a full-blown riot? Can gun or knife crime have an 'R' number and what can analytics do to help bring the figure to zero? Subsequently, he moves the analysis away from medicine and societal strife to examine computer malware, citing occurrences such as Stuxnet and Wannacry. Here he investigates not what the payload or purpose of the virus was but rather why we as humans allowed, or engineered, the viral leap from one machine to another; an aspect of cyber operations that is largely missing from many other books due to more interest in effects and technology. Thereafter he addresses the cascade of spreading internet trends and explores why some posts succeed and 'go viral', such as the Ice Bucket challenge, whilst others don't quite answer the 'share with 9 friends or you don't care' plea. Finally, the book covers the challenges of tracking and tracing outbreaks, warning of increasing social scepticism of the scientific facts vs public perception, a prediction that seems to be playing out in front of us and strengthening daily.

Kucharski has done a great job of taking a difficult subject area, where raw data and endless equations form such an important part of the profession, turning it into an accessible and easily understood work. This is a book that requires no previous knowledge of the topics examined, you neither must be a doctor, sociologist or programmer to get value out of it. Would you like to better understand exactly what 'R' is and how it is calculated? Equally are you curious why some of the numerous social disturbances and riots that have occurred in 2020 rapidly spread around the world yet others are forgotten in a day? Having read this work you will be enriched with knowledge and frustrated with current media analysis of the topics. By extensive use of case studies, many elements of which almost any reader will be at least partially familiar with, Kucharski explains different theories and analytic techniques, illustrating not only where the scientist got it right but where they went wrong and how that evolved the science.

There is no agenda or contentious point of view despite reference to some emotive occurrences, nor does the author seek to endorse or discredit alternate works, in fact he offers a useful basket of further reading to consider. *Contagion* is an educational read for anyone interested in broadening their knowledge across Contagion, Cyber, and Information Advantage. It is not designed to be a boundary pusher or expert level publication; some specialists may find some chapters simplistic in their approach, although the scope would suggest most readers will benefit from taking the time to learn something new. Furthermore, *Contagion* covers gaps in the market over these topics and is complimentary to other texts recommended in recent Chief of the Air Staff's Reading Lists. The elephant in the room of course is COVID-19; is a book on this subject published before the outbreak worthwhile? A resounding yes; since there was no bandwagon or agenda to jump on, this is an objective and neutral analysis free from COVID colouring. A prediction

of a future event during the conclusion is chilling if not unexpected. An updated edition of the book is inevitable, but that should not preclude any reader from picking this up.

This is a highly recommended broadening text which unfortunately now comes with significantly more topical relevance than at initial publication. Worryingly though, the topics covered will be increasingly applicable to any military reader for the remainder of their career and beyond.

War in Space: Strategy, Spacepower, Geopolitics

By Bleddyn E Bowen

Publisher: Edinburgh University Press, 2020

ISBN: 978-1474450485, 288 pages

Reviewed by Wing Commander Gerry Doyle

The author of this book and the reviewer share a connection in that they were both challenged (at different times) by the late Professor Colin Gray to situate space strategy in its wider context. Dr Bowen was asked 'where is the theory of space power, where is the Mahan for the final frontier?' (p. 1); I was asked a similar question about 'where is the Clausewitz for space'? This serious and significant book is Dr Bowen's attempt to address the challenge posed by our common mentor.

Dr Bowen is an author and academic with a growing reputation as a space-power thinker. He completed bachelors, masters and doctoral studies at Aberystwyth University, followed by posts at Kings' College London, and now at Leicester, where he lectures in International Relations. This book is modelled on his PhD thesis; some elements were also exposed in an article in the *Journal of Strategic Studies* in 2017. With such a lineage, it makes little accommodation to the casual reader. This is a book for the serious strategic thinker, probably already acquainted with Mahan and his works. Ideally, he would also have some understanding of Jomini, Clausewitz and perhaps even the French maritime strategist Admiral Raoul Castex.

'War in Space' is thus an attempt to situate space, and the theory surrounding its use for military and security purposes, within the long history of grand strategic theory. It does this by positing that attempts to compare

space strategy with maritime strategy are not misguided, but do require development. Specifically, 'blue-water' maritime theory is held to be an incomplete comparator, and consideration of terrestrial domains' relationships with space are best thought of in terms of coastlines and theories of littoral manoeuvre. The work follows an established tradition (perhaps most familiar to air power students through the work of Colonel Philip Meilinger) within strategic studies of listing numbered propositions and elaborating on them; in the case of this work, seven propositions are outlined in the introduction, then dissected through the remainder of the book. This is done in three main sections, the first of which critiques established space power thinking, the second establishes Dr Bowen's thinking about coastlines, and the third of which relates the theory to contemporary warfare, and in a short concluding chapter, to broader International Relations theory.

Since they form the core of the book, it is worth dissecting the Seven Propositions in more detail: the first four critique the 'bluewater' analogy to space power thinking. Proposition I surmises that 'space warfare is waged for the command of space'; in Dr Bowen's eyes this leads to a distinction between space control and space denial. Proposition II states that 'spacepower is uniquely infrastructural and connected to Earth'. Proposition III notes that 'the command of space does not equate to the command of Earth' and Proposition IV that 'the command



of space manipulates celestial lines of communication'. Taken together, his analysis is that they underline both the usefulness of the bluewater analogy and also its limitations; in particular, the 'infrastructural' aspects of space power are unique to space, and ideas about blockade and attrition versus the quest for decisive engagement do not translate completely to space.

Proposition V is introduced in isolation (a whole chapter underpins its explanation). It states that 'Earth orbit is a cosmic coastline suited for strategic manoeuvres'. Based on the observation that much of space is inherently local to the Earth's surface, and can therefore be influenced by capabilities on that surface such as jammers, other littoral analogies are expounded, including the potential for 'astro-economic' warfare.

Proposition VI notes that 'spacepower exists within a geocentric mindset'. It roots evaluation of spacepower in what it can deliver on Earth, and primarily on land. It also notes the inexorable growth of the 'space economy' and the cultural perspectives that access to space services can and will make. The first point highlights the analysis of Mahan's thinking that pervades the book. The naval battles that Mahan analyzed can be divided into imperial struggles over colonies distant from their home countries, and campaigns fought in direct support of continental disputes; this distinction puts a premium on selection of appropriate analogies and drawing the correct lessons from them.

Finally, Proposition VII states that 'space power is dispersed and imposes dispersion on the Earth'. The first part of this refers to the fact that satellites in orbit are unable to mass and concentrate in the way that terrestrial forces can; the second is essentially the corollary that space effects can be ubiquitous if a constellation of satellites is well-designed, and that this leads to dispersal of terrestrial assets.

The last substantive chapter of the book attempts to illustrate the application of the propositions by imagining a future conflict between the Peoples' Republic of China and the United States of America over the fate of Taiwan. It is not possible to summarise the author's chronology for this conflict easily, because the narrative, the analysis of factors leading up to it, the application of the propositions to the conflict and the resulting deductions are interleaved continuously. However, his intent is clear; to provide a plausible setting for a conflict between space-enabled great powers.

Dr Bowen's work is a significant contribution to the application of grand strategic principles to conflict in space, and some elements of it are noteworthy for their originality. The distinction between blue-water and littoral maritime strategies is clearly laid out, though an apparent objection to it, namely that coastal waters are territorial, while space is determinedly governed by global commons principles is in this reviewer's estimation under-analysed. The recognition of the historical context that underpinned Mahan's writings, particularly the distinction between conflict in direct support of continental conflict and that fought in support of colonial exploitation is salutary, and the exploration of the implications of space commerce in proximity to conflict. But it is necessary to outline some limitations of the work in order recommend it to specific readers.

Firstly, Dr Bowen assumes familiarity with the space environment, the implications of the physical laws governing spaceflight, including launch activity, and implicitly with international law as it applies to space. He makes no claims to the contrary, so this is not a criticism, but someone coming to this work without such grounding will struggle. Equally, and again without misleading anyone, he assumes a fairly deep grounding in the historical strategists he cites. In both cases, the

thorough bibliography will provide some signposts, but, for example, where he engages with existing space thinkers such as Oberg, Lupton and Dolman (p. 64-65), he does so in abbreviated terms that presuppose familiarity with their arguments. This is perhaps the place where the book's origins as a PhD thesis show through, and equally where a more substantive engagement with their arguments and why and where the author disagrees with them would be welcome.

Next, it must be pointed out that the work does not instruct anyone in how to apply the propositions it is built around; the campaign planner seeking to incorporate and exploit space capability in their plans must look elsewhere (though in a similar way, *On War* is not a staff officers' handbook on how to complete an estimate). But in this respect, the China-Taiwan-USA chapter seems a missed opportunity. If it had begun with a linear narrative of what is imagined to happen, then followed with an analysis rooted in the propositions, it would be much clearer how the propositions could have, or might have, influenced the participants.

Prospective readers must and will form their own opinions on Bowen's propositions, and anyone willing to do the requisite background reading will find the effort justified. Those engaged in postgraduate research on the strategic implications of space power will surely have to engage with this work, and someone coming new to the field will find much to provoke, stimulate and enlighten them. It stands as a testament to Dr Bowen's scholarship, as a *tour d'horizon* of the space power thinking as currently understood and as a major attempt to advance the theoretical underpinnings of it. With these minor qualifications, it is warmly recommended as a work that will endure.

The New Rules of War: How America Can Win Against Russia, China, and Other Threats

By Sean McFate

Publisher: New York, William Morrow, 2019

ISBN: 978-0062843586, 336 pages

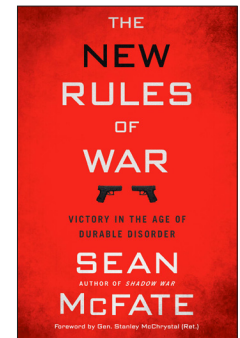
Reviewed by Dr Steven Paget

The New Rules of War is a provocative and confronting read. Sean McFate declares at the beginning of the book that the 'American military has experienced nothing but loss' since the Second World War and observes that 'the West has forgotten how to win wars' (p. 1 and p. 2). McFate is clear in his belief that the difficulties experienced by Western militaries stem from a focus on conventional war, an idea that he exerts is 'dead' (p. 6). In response, McFate outlines a series of new rules of war that will enable the US to win in an age of 'durable disorder', which he believes will replace the rules-based order. McFate proposes ten key rules: 'conventional war is dead', 'technology will not save us', 'there is no such thing as war or peace – both co-exist, always', 'hearts and minds do not matter', 'the best weapons do not fire bullets', 'mercenaries will return', 'new types of world powers will rule', 'there will be wars without states', 'shadow wars will dominate' and 'victory is fungible'.

The author is well-qualified to write the book given his professional experience and academic credentials. McFate is a practitioner-scholar, having served in the 82nd Airborne Division and worked as a private contractor. He also has a PhD in International Relations from the London School of Economics and is currently a Professor of Strategy at the National Defense University and the School of Foreign Service at Georgetown University. McFate views this background as advantageous, noting: 'Academics who learn war in libraries can only learn so

much. Practitioners who mistake their war stories for macro insights are no better. There are exceptions, of course, but the best war futurists are scholar-practitioners' (p. 20). His writing style is clear, direct and largely avoids military jargon. In fact, the author expressly points out: 'Buzzwords have replaced ideas, as authorities bicker over hybrid warfare, nonlinear war, active measures, and conflict in the "gray zone"' (p. 179). McFate's writing is underpinned by his professional experience and academic knowledge, but some readers may be deterred by its polemical nature.

In arguing against the perceived conventional orthodoxy, McFate is forthright in his views, describing preparing for conventional war as 'unicorn hunting' (p. 42), asserting that the F-35 'proves the adage that a camel is a horse designed by a committee' (p. 44) and contending that nation-building fails as 'countries are not machines that can be built' (p. 150). McFate makes a strong and convincing argument in many areas, not least in advocating the prioritisation of people, pointing out that 'grey matter is more important than silicon' (pp. 54-55). He also makes a clear and persuasive case for the importance of 'weaponizing influence' (p. 109). The prevalence of mercenary forces, the risks presented by failing states, the existence of conflict in the gap between traditionally-defined war and peace and the significance of shadow wars make for interesting case studies and demonstrate the breadth of the book.



Other proposals such as the creation of a foreign legion, involving the US recruiting, training, sustaining and commanding forces that are sourced globally to provide 'long-term boots on the ground' are grounded in logic, but have the potential to be contentious (p. 100). Some of McFate's views may make for uncomfortable reading, including his opinion that 'COIN isn't for the kind hearted' as it was 'never meant to build democracies', but rather 'enslave people' (p. 90 and p. 95) and his view that 'the laws of war have devolved into a punchline' (p. 208). To reinforce his argument, however, the author backs up his assertions with a range of case studies from around the globe.

McFate's use of historical examples strengthens his argument throughout much of the book, but his assertions are too brief and lack nuance in places. He describes the Battle of the Somme, for example, as 'stealing 1.2 million lives and achieving nothing', but omits to mention the significance of trying to relieve pressure on the French at Verdun and the argument put forward increasingly by historians that the British Army learned from the experience and would prove a more effective force in the future (p. 250). Equally, some of McFate's contemporary analysis, such as his assertion that the migrant crisis resulting from events in Syria was responsible for 'instigating Brexit', is overstated as it overlooks wider events (p. 105). This overstatement may have been intended to provide emphasis and does not detract from the overall argument, but the presentation of evidence could have been stronger in some sections.

The real strength of the book is in the identification of problems and challenges. The proposed solutions are open to contestation and will, undoubtedly, be debated by other war futurists. A constructive dialogue can only be beneficial for western militaries given the experience of the past few decades. *The New Rules of War* ought, as a

result, to be read by military professionals, defence and security academics and anyone with an interest in the subject. McFate's use of the example of Brigadier General William 'Billy' Mitchell is apt as he is aware that some of his arguments are likely to meet resistance. The reader does not always have to agree with McFate's argument or be persuaded by his proposed solutions, but they do need to be prepared to address them and engage in the necessary conversations that they spark. This is, overall, an important book that should be read and debated widely. If, as McFate contends, 'the West has forgotten how to win wars', proposed solutions require serious consideration – even if only to present alternatives.

Command: the Twenty-First Century General

By Anthony King

Publisher: Cambridge University Press, 2019

ISBN: 978-1108700276, 504 pages

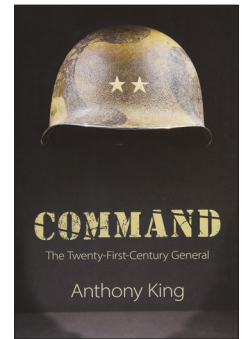
Reviewed by Air Commodore (Retd) Al Byford

The peculiar nature of military operations – in particular, the delivery of lethal force on behalf of the state, where by definition those involved may kill or be killed – means command in the armed forces is very different from, for example, the responsibilities and challenges of directing a large civilian company. Consequently, the study of command looms large in the education of every military professional and is underpinned by an extensive body of literature. However, the majority of the historiography is devoted to individual studies of ‘great’ commanders, whilst substantive, systematic analyses of the practice and processes of command itself are surprisingly rare. The exceptions are three widely referenced works featuring on the syllabi of most military staff courses: Eliot Cohen’s *Supreme Command*, dealing with political rather than military leadership at the grand strategic level; Marten van Creveld’s *Command in War*, which emphasises the ‘command regime’ (the organisation of command); and John Keegan’s *The Mask of Command*, which compares and contrasts four figures exemplifying different points on the spectrum of command in different historical contexts.

There is certainly scope, then, for Anthony King’s recent (2019) book *Command: the Twenty-First Century General*. Professor King is a widely published and respected academic who currently holds the Chair in War Studies at the University of Warwick. A frequent consultant to the military, his practical experience of working with

Headquarters International Security Assistance Force (ISAF) during the Afghanistan conflict is clearly reflected in this work. As a sociologist, his primary research interest has been on small-unit cohesion, so a study of the evolution of the practice of command is something of a departure. However, King argues that as his research has matured, the linkages with his previous work, in terms of the development of military teamwork (albeit at a different level), have become more evident. The air force reader should note this book focuses explicitly on the command of armies rather than navies or air forces and is firmly located at divisional (two-star) level. The author’s rationale is that most wars are fought and won on land, so this approach allows for valid comparisons to be made at a universally accepted and commonly understood level, both over time (beginning with the First World War) and internationally.

The core of the book comprises a series of chapters considering how individual commanders have practised command, and these are illuminating in themselves. UK readers will be most interested in General Nick Carter’s ‘epiphany’ when commanding ISAF’s Regional Command South in Kandahar in 2009–10. He realised the brigade was no longer tenable as the primary construct for operational command, and only the division is capable of coordinating the panoply of different capabilities, inputs and outcomes now required of a contemporary operation. As Chief of the General Staff and now Chief of Defence



Staff, his (and thus the British Army's) efforts to rediscover the divisional level of command have shaped military thinking and conceptual development in the land domain for at least the last half-decade.

Following his survey of individual command experiences, King advances two central, but closely related, arguments. The first is that command in the twenty-first century is now fundamentally a decision-making process. The second is this has in turn driven a distinct shift from individualistic command to 'collective command', where commanders, their deputies, subordinates and staff are 'bound together in dense, professionalised, decision-making communities'. If a commander insists on making every decision, King believes, there is a risk the process becomes slower without becoming better, due to the increasing complexity of modern warfare. Once the challenge was to integrate infantry, artillery and cavalry. Then armour and air power had to be incorporated, and now space, cyber and information operations are also involved. Additionally, international partners and coalitions bring accompanying political sensitivities, including an almost absolute intolerance of civilian casualties. In this context, King argues, it is impossible for a single decision-maker to exercise executive authority across all of these points of interaction without imposing unacceptable delays.

King acknowledges the shift he perceives to collective command is disputed, General David Petraeus affirming: 'There is one commander. He is the guy. Everyone else is in support of him'. The notion is also challenged conceptually. In his own generally supportive review of King's work, Sir Lawrence Freedman points out that distributing authority has always been an aspect of military command to some extent and at different levels. Certainly, King himself recognises the role of the commander as executive authority, personally accepting legal and moral

responsibility for the actions ordered to assure legitimacy and accountability. Yet he suggests resistance to the idea of collective command stems not so much from these sorts of constraints, but is cultural: a preference for 'revered personal martial qualities' rather than 'the more mundane mechanics of command itself.'

The key issue is whereas King sees command overwhelmingly as a decision-making exercise, others, such as Freedman, still view it principally as a process of authority. However, King argues that in an era of complex, joint, hybrid and heterogeneous operations, generals simply cannot command in a traditional way. They can no longer 'just order their subordinates into action', but must now constantly make decisions. These may involve defining complex situations, identifying possible courses of actions, and encouraging the support of superiors, peers and partners through manipulation, negotiation and influence. Therefore, in a riposte to Freedman's book review King claims 'twenty-first century decision-making has now superseded twentieth century command'.

This book undoubtedly makes an important contribution to the study of command as it has evolved in response to the changing character of warfare. Whilst there are obvious limitations in extrapolating a general theory of command from just one level – the division – in one domain, there is much to stimulate thought and provoke debate. The emphasis on decision-making rather than on the exercise of authority is contentious, and the air and space reader will have to consider how (and even if) collective command applies in these domains in the way that King suggests it does in the land domain. The formation of No.11 Group – at a corresponding two-star level of command – suggests an alternative approach to the coordination and control of multi-domain operations by the RAF. Nonetheless, in future

operations air and space capabilities will almost certainly be integrated with land capabilities through the division, so the understanding provided by this book of how command is organised and exercised at this level is essential. I commend it wholeheartedly.

The Future of NATO Air Power: RUSI Whitehall Papers 94

By Justin Bronk

Publisher: Routledge, 2020

ISBN: 978-0367468231, 152 pages

Reviewed by Air Vice-Marshal (Retd) Prof Tony Mason

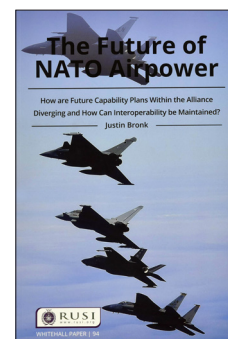
The author, based at the prestigious Royal United Services Institute for Defence and Security Studies, has established an international reputation for comprehensive scholarship and penetrating analysis of international air power.

Scope

This compact but disturbing study examines and explains the growing divergence between the United States and the rest of the NATO Alliance in air power capability and potential.

Three sections comprise essential reading for any individual engaged in the study, planning, procurement or policy of Alliance air power. They are the Introduction; Chapter One, which examines the political and strategic environment; and Conclusion, which identifies Challenges and Opportunities. They identify many of the problems and some of the solutions, in the current and future application of air power by the Alliance.

Chapters 2, 3 and 4 examine the Air Forces of the USA, of the Medium European Powers and of 'The Smaller NATO Air Forces'. They contain a wealth of thoroughly researched, largely technical detail, primarily focused on manned aircraft and associated systems. These three Chapters may be regarded largely as sources for the author's analysis, conclusions and recommendations. Unfortunately, study of the footnotes is inhibited by the lack of an index.



In surveying at length the comparative strengths of the Alliance's two major potential adversaries, the author argues persuasively that while, as a whole, it maintains an edge in airborne manned and unmanned systems, it faces considerable advances in Russian and Chinese surface-to-air missile systems. They will challenge Western air supremacy and are already being widely exported.

Divergence

Justin Bronk observes the strategic focus of the US shifting from Europe to the Pacific and from confrontation with Russia to increasing concern about Chinese political, economic and military potential. At the same time, US aviation-related technology is being deployed within a command and control (C2) network of systems, known as the Advanced Battle Management System (ABMS), which includes artificial intelligence, real-time command and control, automation, manned and unmanned aircraft, space-based enablers, hypersonic missiles and directed energy weapons. In Florida, a Joint UK-Australian-Canadian data centre (which includes US Government and contractor specialists) became operational in 2019. It provides mission information to the existing suite of sensors carried by the F-35.

Bronk acknowledges that the US has always been the dominant partner in the Alliance, but the air forces of European NATO members have suffered from delayed modernisation plans, inflexible C2 organisation,

reduced numbers, and inadequate weapon stocks. Moreover, they are uncertain about the residual threat from Russia. He explains how the weaknesses are aggravated by operations in recent years in 'Discretionary conflicts' in largely permissive environments in the Middle East and North Africa. They have made air power a major factor in counter-terrorism and counter-insurgency, but to the detriment of training for high intensity operations. In addition, the use of air power as a high tempo regular force-multiplier over extended periods, but with smaller numbers available, has induced problems of aircrew retention and airframe fatigue.

Alliance Options

Allies who 'credibly' wish to join a US-led warfighting coalition will need to operate with the highly automated ABMS C2 system. But the current 'red card' process to enforce national caveats and rules of engagement will not be compatible with the system. Bronk argues persuasively that non-US air forces will either have to adopt US automation and mission command or 'pursue an entirely different path without large scale interoperability with US forces'. In the event, European initiatives have become associated with both options.

The author describes the two European projects which seek to incorporate new generation combat aircraft into their own 'system of systems' rather than seeking self-sufficiency in individual platforms. The UK leads a consortium in the 'Tempest' project which will seek to integrate and test new technologies, Unmanned Combat Air Vehicle (UCAV) capabilities and stand-off weapons, initially on Typhoon.

Other press releases have indicated an intention for the UK to fight in the realms of space and cyber. A new tri-Service Information Systems and Services HQ was established in 2019, to conduct planning and generate

battle-winning information services, manned by 2,000 military and civilian security personnel from air, land, sea, space and cyber specialisations.

The second European initiative, *The Future Combat Air System/Système de combat aérien futur* is led by France and Germany and offers a similar ability to incorporate manned and unmanned combat aircraft in a contested environment.

Bronk emphasises the need for major European projects to give greater prominence to European developed networks, resilient C2, survivable ISTAR and munition and spares stockpiling. Smaller allies could either specialise in enablers or continue to operate combat aircraft within a 'viable alternative airpower ecosystem' developed through Tempest, FCAS/SCAF or a combination of the two. The author's alternative would, however, imply a force tailored to European geography and threats. That would seem inconsistent with at least British and French wider world aspirations. Nor can he draw any conclusions from the tangled state of BREXIT future security negotiations.

The Human Element

Inherent in Bronk's study is, however, a much more serious challenge to all NATO air forces: the place of *people* in the application of air power in the next generation. He touches *en passant* on issues of human interface with the many facets of modern aviation technology, but nowhere explores the fundamental problems underlying them all.

Since the publication of '*The Future of NATO Airpower*', the RAF has announced a 20-year *Astra* programme, shifting focus from a traditional air combat role to a multi-domain approach, in a bid to win the information war. On March 6th 2020, the RAF in-house publication

RAF News contained an authoritative summary of the recently launched programme, which was designed to supersede the RAF's *Thinking to Win* campaign of 2016. It could have been entitled '*From Thinking to Win to Thinking the Unthinkable*'. It contained the suggestion that for the first time in history, '*We should see a Chief of the Air Staff who is not a pilot... we are reshaping a force so everyone understands they can be the chief.... We used to fight on land, then sea and then in the air. Now we have the space and cyber realms.... Cognitive diversity is vital. In the old days it was what the pilot said that mattered as the air domain was their preserve.... We must not preserve a narrow band of thinking... we do have glass ceilings in some career branches We need to incorporate the views of everybody... we want to select the best person for the job*'.

At the same time, reliable reports from the USAF Academy at Colorado Springs indicate that almost 50% of cadets are now electing to graduate in specialisations such as artificial intelligence, computer and information systems rather than pilot, and the annual proportion is increasing steadily. The tendency is accompanied by reduced career commitment stimulated by the attractions of challenging and highly regarded cognate opportunities in the civilian sector.

The Next Study

Contemporary British MOD advertising reflects the recruiting and retention difficulties of the armed services. There is a very obvious opportunity now for the RUSI to examine human resource questions about NATO air power, including motivation, incentives, status, competition, identity, career opportunities, unmanned interface and inter/joint-Service relations.

In sum, Justin Bronk has produced a definitive study which deserves to be accompanied by a complementary

examination of the human issues which are at least as likely to determine the impact of air power within and beyond the Alliance.

Sandworm: A New Era of Cyberwar and the Hunt for the Kremlin's Most Dangerous Hackers

By Andy Greenberg

Publisher: Doubleday, 2019

ISBN: 978-0385544405, 348 pages

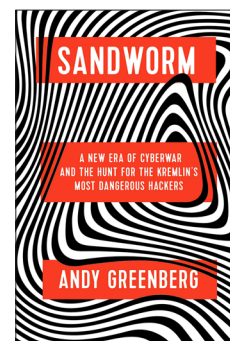
Reviewed by Wing Commander Paul Withers

In June 2017 the headquarters of Maersk, the world's largest shipping company, was hit by the start of the most devastating and costly cyber-attack the world has seen so far. The attack went on to cause important elements of the global logistics system to grind to a halt, impacted hospitals and industry worldwide, and crippled all online systems across Ukraine. *Sandworm* is the name cyber researchers gave to those responsible for unleashing this attack and many others. In writing this excellent book, Andy Greenberg pieces together a complex puzzle to identify and locate *Sandworm*, shine a light on 'Russia's reckless willingness to wage this new form of cyberwar around the world' (p. xiii), and more broadly expose what he argues is a global arms race in cyberspace. However, this book covers far more than cyber-attacks, it is also a fascinating insight into information warfare and exposes the world's worrying lack of critical infrastructure resilience.

Andy Greenberg is an award-winning investigative journalist and senior writer for *Wired* magazine. His reporting covers information freedom, privacy, security, and hacker culture. His work for *Wired*, and in particular his reporting on Ukraine, has been widely recognised and his writing style is both engaging and accessible. Greenberg takes a forensic approach when following the evidence trail, gaining first-hand accounts from a range of cybersecurity experts. Each chapter starts with a human story, descriptive and sometimes

shocking accounts of the attacks attributed to *Sandworm*, which gives the reader empathy with those intimately involved in the detection, mitigation and attribution of the series of cyber-attacks.

Part one of the book starts in 2014 with a US cyber intelligence company, *iSight* discovering and analysing what is known as a 'zero day', a previously unknown security flaw in software. On analysing the malicious software, or malware code, the researchers identified clues that gave some insight into its origin. First, there were pointers towards it having originated from Russia. Second, the code contained the tag 'arrakis02'. An *iSight* analyst who was also a science-fiction enthusiast realised that this was a reference to the planet Arrakis in Frank Herbert's classic 1965 sci-fi novel *Dune*. In the novel, a vast desert in Arrakis was inhabited by 'thousand-foot-long sandworms' (p. 15). By analysing other known examples of malware and cross-checking for *Dune* references, it became clear to *iSight* that whilst this particular code was relatively new, the *Dune* link uncovered activity by the same actor stretching back years. *iSight* then exercised their prerogative as the firm that had ostensibly uncovered a new malicious cyber actor and chose a name for the group: *Sandworm*. This is akin to a palaeontologist naming a new dinosaur species. Subsequent chapters of part one move around the world and eventually end up in Ukraine, where Greenberg establishes the historical and cultural context of the country's conflict with Russia, leading up to



Christmas 2015 when Ukraine was struck by a significant cyber-attack on its power grid.

Greenberg uses the second part of the book to recount some of the most significant events in the relatively short history of cyberspace. These 'flashback' chapters provide important context for what is to come. He begins with the 2007 *Aurora* experiment, where US researchers were able to hack a large diesel generator remotely over the Internet, resulting in the machine physically shaking itself to pieces. He continues with a fascinating overview of cyber history by describing some of the most notable cyber-attack campaigns that have impacted the world.

Thereafter, Greenberg moves the narrative from location to location, weaving together an intricate web of cyber incidents and associated clues pointing towards attribution. Greenberg highlights the global significance of the power grid attacks in Ukraine and despite analysts very clearly demonstrating that Western Europe and the US were vulnerable to the same type of attack, the international reaction was muted at best. Specialists in Industrial Control System security suggested that the US Government 'had done little more than sweep the incident under the rug' (p. 111). Greenberg also opens the aperture on broader Russian-attributed attacks, including the interference in the US democratic process by the *Fancy Bear* cyber actor. For each successive attack, he paints a vivid and expanding picture of the various malicious groups incrementally pushing further and further and testing to see how the West responds.

As the story starts to reach its climax, he revisits the attack on Maersk, before exploring how the attackers benefitted from the compromise of a range of cyber-attack tools, that reportedly belonged to the US National Security Agency. The leak, from a group calling itself the *Shadow Brokers*, made public a significant flaw in the Microsoft Windows

Operating System. In June 2017, the malware known as *NotPetya* hit the world.

Although targeted at Ukraine, *NotPetya* spread world-wide within hours not just crippling Maersk, but hitting pharmaceutical, construction, manufacturing and wider logistics sectors. Greenberg devotes an entire chapter to calculating the cost of the *NotPetya* malware. Some of the larger companies affected suffered losses in the tens of millions of US\$, with the White House assessing overall costs at \$10 Billion worldwide.

Greenberg devotes several chapters to understanding and analysing the complex evidence supporting attribution. He sheds light into the murky world of Russian Military Intelligence, the GRU, progressively building a compelling link between *Sandworm* and the Russian state. He explores Russia's development of concepts of 'information confrontation', observed in the West as a key facet of the 'Gerasimov Doctrine'. This leads Greenberg to conclude 'I couldn't help but see how Gerasimov's ideas explained *Sandworm's* actions, too' (p. 240).

This meticulously researched book is highly recommended and *Sandworm* will have broad appeal. For the general military reader, it offers important insight into information warfare, in particular how technical exploits delivered through cyberspace form part of the broader Russian approach to 'sub-threshold' conflict. It provides specific detail on one aspect of the conflict in Ukraine, exposing how actions in cyberspace have been woven into the wider conflict. For those interested in cyber security and cyber resilience it offers a series of highly significant case studies, particularly in its lessons on attribution, response and recovery. For commanders it should raise important questions on the resilience of their missions in the face of cyber-attack. It should prompt them to carefully consider

what is important to them in cyberspace, how they would continue to operate and how they might recover. Above all, this is an engaging and interesting book which makes a significant contribution to our understanding of aspects of information warfare. The evidence Greenberg offers is compelling and readers should find the book both enthralling and alarming.

Contents: The Chief of the Air Staff's Reading List 2019-20

The Royal Air Force: The First One Hundred Years

By John Buckley and Paul Beaver

Publisher: Oxford University Press

Flying to Victory: Raymond Collishaw and the Western Desert Campaign, 1940-1941

By Mike Bechthold

Publisher: University of Oklahoma Press

Churchill: Walking with Destiny

By Andrew Roberts

Publisher: Allen Lane

Bolts From The Blue

By Sir Richard Johns

Publisher: Grub Street Publishing

Leaders: Myth and Reality

By General Stanley McChrystal (US Army, Retired), with Jeff Eggers and Jason Mangone

Publisher: Portfolio Penguin

On Grand Strategy

By John Lewis Gaddis

Publisher: Allen Lane

Blunder: Britain's War in Iraq

By Patrick Porter

Publisher: Oxford University Press

The Secret World: A History of Intelligence

By Christopher Andrew

Publisher: Allen Lane

Small Wars, Big Data: The Information Revolution in Modern Conflict

By Eli Berman, Joseph H. Felter and Jacob N Shapiro

Publisher: Princeton University Press

LikeWar: The Weaponization of Social Media

By P.W. Singer and Emerson T. Brooking

Publisher: Eamon Dolan/Houghton Mifflin Harcourt Publishing

Contents: The Chief of the Air Staff's Reading List 2018

Routledge Handbook of Air Power

By John Andreas Olsen

Publisher: Routledge

The Birth of the RAF, 1918

By Professor Richard Overy

Publisher: Allen Lane

Over the Horizon: Time, Uncertainty and the Rise of Great Powers

By David M. Edelstein

Publisher: Cornell University Press

Aerial Warfare: The Battle for the Skies

By Frank Ledwidge

Publisher: Oxford University Press

The Vietnam War

By Ken Burns and Lynn Novick

Broadcaster: Public Broadcasting Service (PBS)

The Future of War: A History

By Sir Lawrence Freedman

Publisher: Allen Lane

The Cybersecurity Dilemma: Hacking, Trust and Fear Between Nations

By Ben Buchanan

Publisher: Hurst and Company

Shoot, Don't Shoot: Minimising Risk of Catastrophic Error Through High Consequence Decision-Making

By Dirk Maclean

Publisher: Air Power Development Centre (Australia)

War in 140 Characters: How Social Media is Reshaping Conflict in the Twenty-First Century

By David Patrikarakos

Publisher: Basic Books

Air Force Blue: The RAF in World War Two

By Patrick Bishop

Publisher: William Collins

Contents: The Chief of the Air Staff's Reading List 2018

The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force

By Sir Walter Alexander Raleigh and Henry Albert Jones

Publisher: Oxford Clarendon Press

Sagittarius Rising: Reminiscences of Flying in the Great War

By Cecil Arthur Lewis

Publisher: Peter Davies

Bomber Harris: His Life and Times

By Henry Probert

Publisher: Greenhill Books

First Light

By Geoffrey Wellum

Publisher: Viking, London

Strategic Air Offensive Against Germany 1939-1945

By Charles Webster and Noble Frankland

Publisher: HMSO

With Prejudice: The War Memoirs of Marshal of the Royal Air Force Lord Tedder

By Arthur William Tedder

Publisher: Cassell

The Right of the Line: The Royal Air Force in the European War 1939-1945

By John Terraine

Publisher: Hodder & Staughton

The Central Blue: Recollections and Reflections

By Sir John Cotesworth Slessor

Publisher: Cassell

The Impact of Air Power: National Security and World Politics

By Eugene M Emme (Editor)

Publisher: Van Nostrand Co.

The Air Campaign: Planning For Combat

By John A. Warden III

Publisher: National Defense University Press

Contents: The Chief of the Air Staff's Reading List 2017

The Fix: How Nations Survive and Thrive in a World in Decline

By Jonathan Tepperman

Publisher: Bloomsbury Publishing

Defense of the West: NATO, the European Union and the Transatlantic Bargain

By Stanley R Sloan

Publisher: Manchester University Press

All the Kremlin's Men: Inside the Court of Vladimir Putin

By Mikhail Zygar

Publisher: Public Affairs

ISIS: A History

By Fawaz A Gerges

Publisher: Princeton University Press

Understanding Modern Warfare

By David Jordan, James D Kiras, David J Lonsdale, Ian Speller, Christopher Tuck and C Dale Walton

Publisher: Cambridge University Press

Airpower Applied: U.S., NATO, and Israeli Combat Experience

By John Andreas Olsen (Editor)

Publisher: Naval Institute Press

Precision and Purpose: Airpower in the Libyan Civil War

By Karl Mueller (Editor)

Publisher: RAND Corporation

The Air Force Way of War: U.S. Tactics and Training after Vietnam

By Brian D Laslie

Publisher: University Press of Kentucky

Space Warfare in the 21st Century: Arming the Heavens

By Joan Johnson-Freese

Publisher: Routledge

Team of Teams: New Rules of Engagement for a Complex World

By Stanley McChrystal, David Silverman, Tatum Collins, Chris Fussell

Publisher: Portfolio Penguin

Notes

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

The views expressed by the reviewers in this list are theirs and theirs alone.

Inclusion of a particular book within the reading list should not be taken to mean that the Royal Air Force or the Ministry of Defence endorses the contents. Manuscripts with challenging and even contrarian views will be included in order to stimulate thinking, discussion and debate.

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