DRONES

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The Brilliant, the Bad and the Beautiful

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emerald PUBLISHING

United Kingdom – North America – Japan – India
Malaysia – China

Emerald Publishing Limited
Howard House, Wagon Lane, Bingley BD16 1WA, UK

First edition 2020

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-83867-988-0 (Print)
ISBN: 978-1-83867-985-9 (Online)
ISBN: 978-1-83867-987-3 (Epub)

ISOQAR certified Management System, awarded to Emerald for adherence to Environmental standard ISO 14001:2004.

Certificate Number 1985
ISO 14001

INVESTOR IN PEOPLE

To Ethan, aim high.

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PREFACE

The inspiration for this book began in the Autumn of 2013, with a dialogue between myself, the experimental arts festival Abandon Normal Devices and the artist technology collective, Marshmallow Laser Feast. Together, we received funding from the UK's National Endowment for Science, Technology and the Arts (NESTA) to explore the creative potential of drones.

The Nesta fund was interested in how digital R&D could be useful for arts organisations, either in designing products, making production efficiencies or creating new insights that could establish new forms of creative practice. Even beginning the project we were not sure which of these we would fulfil, but there was a strong desire to discover insights that could help arts producers figure out how to use drones within their programmes to create new, different and rich audience experiences.

In one of our first meetings, the title *Project Daedalus* came about, after a discussion about the myth of Icarus. In the context of drones, the story of Icarus was particularly prescient, as drones were, then, still highly experimental devices. We were conscious of the risks associated with flying objects in a modern society, both in terms of safety and in terms of the fragility of the technology, which might easily fail at the crucial point of production. We were also conscious of what Icarus has come to symbolise about the act of flight itself, symbolic of humanity's excessive hubris amid a failure

to appreciate the catastrophic consequences that often follow from excessive ambition. As such, we sought refuge in Icarus' father, Daedalus, to characterise the project's values. Daedalus was a craft maker, an artist even, and the creator of Icarus' wings. This was a suitable metaphor for the project, as our goal was to enable flight-based art experiences within the art sector. Yet, we were also informed by Daedalus' cautioning of his son, who told Icarus not to fly too high.

These tethered ambitions were an important operating premise for the project, but we needed to ensure that what we ended up with was much more effective at preventing injury or failure in art productions, than Daedalus was in influencing his son. We wanted to ascertain how we could give practical advice to artists and producers, while also ensuring that we were able to explore the creative limits of the technology. We also wanted to scrutinise the audience experience of such work – without falling into the typical technofetishism that often surrounds innovation. The project would be deeply embedded in the latest technological apparatus and yet we all wanted to interrogate this, question the conventional audiences and consumers of technology and challenge the typical narratives that surround such use. In this respect, the intellectual framework for our research and development was born out of a desire to strip away the technology and focus on the way in which narrative may operate differently through drones – how could they be used for new kinds of storytelling experience?

In the summer of 2014, I took a one-day drone flight course run by Andy Goodwin at Liverpool John Moores University and purchased a couple of micro-drones to practice flying, learn more about the capacity of drones to fly in a semi-autonomous manner, and get to grips with the regulations that surrounded such use. As the project started in October 2014, we were already beginning to see a tidal wave of drone designs and stories emerge in the press. It seemed like not a

week went by when there was not a new Kickstarter being launched, or a new headline related to drones. For both the UK and the USA, their principal regulatory authorities – the Civil Aviation Authority and the Federal Aviation Administration, respectively – were each in the process of discussing how best to regulate drones in civilian contexts, which expanded the intellectual frame around the project considerably.

Suddenly, drones were going mainstream and attracting considerable controversy. These developments expanded my interest in drones beyond the project, particularly since it quickly became apparent that producing drone art involved engaging a whole range of issues outside of the practice itself. There were uncertainties about what people could do legally with drones in society, or even what an arts organisation would have to do to ensure that a drone art production was made safe. There were also questions around the security of drones, the cultural meanings they have, the growing ease with which users could operate them and the manner in which their function was also changing, opening out their use to new kinds of demographic.

Something happened to the drone market in late 2014, which led to 2015 being written about as the year of the drone – at least, in terms of consumer technology – justified in part by the proliferation of highly powerful consumer platforms which gave birth to drone communities all over the world. Soon after, such organisations as the Society of Drone Journalists, the World Drone Convention and the New York City Drone Film Festival were established, along with major institutions with governance responsibilities that were trying to figure out society's response to the widespread proliferation of drones.

These happenings influenced how we thought about the utility of Project Daedalus. We had committed to coming up with a tool kit for drone artists, but how could a tool kit be useful in a context where there is constant change taking place

and where the volume of money invested in the industry's technological ecosystem far exceeded the project's resources? Over the following months, we became engaged with drone stakeholders across a range of sectors and began to set out a vision for what we needed to consider when thinking about how to get the most out of drones. By then, drones had become a topic of widespread public debate, in part due to the growing consumer market, and the expansion of ways in which drones could be used by civilians for filmmaking or scanning environments.

Central to our work was the collaboration between researchers, technologists and artists, which was the foundation for our inquiry. New modes of discovery are possible by embracing a range of disciplines to ask questions about a single subject. Across our project, the pursuit of producing drone art led us into conversations with the Civil Aviation Authority, Liberty UK, Drone Hackers, Drone Racers, the world of international sports media and much more. This book endeavours to do justice to this period of intense research and development around drone technology but it expands well beyond these years. It addresses some of the key questions we had about how drones could be utilised and the issues that the typical hobbyist might have about how to use them, what they can do and what's around the corner for the industry.

The central thread running through the book is the proposition that drones undertake acts of moral, social, and cultural significance, whether these are for good or bad, and the inquiry proceeds principally to explore this territory. In doing so, I ask questions about where drones are taking humanity and what it may be like to live in a world where there is, for instance, a drone highway in the sky, or drone police patrols, instead of ground constabulary.

In this respect, the book contributes to philosophical inquiries into technology, particularly where there are pressing societal needs to identify the moral import of such devices. In doing so, I am careful not to setup a false dichotomy between drones that one may describe as either unequivocally good or bad, since it is apparent that the goodness or badness of any particular application of technology is highly dependent on its context. For instance, a drone system designed to enhance civilian policing may also jeopardise the enjoyment of individual liberties. Alternatively, such applications may be directly derived from the same drone innovations that are used to undertake military interventions. As such, even where there may be societal value in the transfer of technology from one context to another, its worth may be tainted by the fact that it was designed for some other, more troubling use. Drone weapons may also further complicate the morality of conflict, for instance, by removing the combatant from the field of conflict. Here again, moral tensions exist, as one might also argue that such removal attends to a government's responsibility to minimise the potential for harm that its military personnel may encounter from engaging in conflicts, as Strawser (2010) argues.

It is for this reason that the book discusses the 'the brilliant, the bad and the beautiful' – itself a direct reference to Bijker's (1995) *On Bikes, Bakelike and Bulbs* – rather than set up absolute moral distinctions between contexts of application that are either good or bad. In the same way that Bijker's social history of technology clarifies how the world has been changed by such inventions, this book examines the moral implications of drone technologies while acknowledging that these evaluations are continual subject to re-interpretation. Like biology, technology evolves and adapts in new circumstances where different moral judgements may arise.

Analysing matters of design, development and application, the *first chapter* explains how drones have expanded as a vast consumer market in a very short space of time to become one of the defining technologies of the twenty-first century. It tells the story of the drone's emergence as an object of popular desire and how this reflects a certain kind of technotopian allure, which is found more widely in technological consumer culture.

Chapter 2 considers regulatory concerns around drone applications, discussing the greatest risks associated with their widespread use in civilian airspace. It also examines the development of regulations as evidence of an emerging moral pre-occupation with autonomous machines.

Chapter 3 examines the proposition that drone technologies are a force for good and explores a number of applications that have become prominent within this category. It investigates how drones are being used within a growing number of scientific research programmes and even in such pursuits as journalism to help us better understand the world around us. It focusses on what resides behind the desire to re-characterise drones as objects of desire – and products more generally – and as vehicles for positive social change.

In contrast, *Chapter 4* explores ways in which drones are used for morally contentious applications, while also scrutinising what it is about such uses that is uniquely troubling because they are drones. While our times are characterised by a surge of enthusiasm for the value of drones, so much of the innovation behind their development is achieved because of these destructive ambitions, and for many people, a drone's capacity to undermine human agency through destruction is the most salient anxiety that surrounds their use.

Chapter 5 examines the territory that fits into the realm of aesthetics – neither morally good nor bad, but a new kind of aesthetic sensibility. Framing the conversation around creative applications which encourage us to reflect on our

place in the world, this chapter examines the culture of creative drone innovation and artistic practice. In doing so, it considers how drones have been used in performance, spectacle and theatre.

In concluding, the book identifies the direction of travel for the civilian use of drones, providing a glimpse into some novel applications, trends in consumer interest, developments in new designs and questions that remain unanswered about how drones are regulated in society.

Throughout the book, I refer to a range of cultural texts, which speak to the symbolic connotations of drones, as entities that articulate the aspirations and anxieties of many science fiction writers and filmmakers over the twentieth century. Together, these hybrid narratives reveal why drones are so controversial, but also why they are so compelling, as they tell stories of humanity's future and invite us to consider how, like biology, technology also evolves. Moreover, I explore how humanity's conflicting emotions about these prospects is part of a wider technological anxiety that persists about flying robots and the growing incomprehension of artificially intelligent machines, which we are told may have their own volitions.

In closing, the book establishes that drones are morally significant machines, which are creating a culture of acceptance for artificially intelligent automation. There are few technologies which singularly define a period of time and even fewer which resonate with strong anxieties about technological change, but drones are among such examples. Over the last two decades, I have been intrigued by moments of technological discontinuity, an interest that was sparked by reading Ellul's (1964) *Technological Society* and later, Bijker's (1995) work, and this book seeks to attend to the drone's contribution to this trajectory.

My own inquiries into technology have often led me to consider the growing proximity of biological and digital

technologies, addressing how our comprehension of the human subject is disrupted by the integration of such technologies within our lives, an interest that persists across this book. Yet, drones are in a category of their own, in terms of what they symbolise about technology's future. Their otherworldliness generates deep anxieties about the age of the autonomous machine and what it might mean for humanity to usher in this new relationship with artifice.

Throughout, the book's focus is on drones that fly, but even this is a subset of the entire range of drones that exist. Today, drone designs encompass moving objects that can operate in the air, underwater and on land, even encompassing all three, or a combination of at least two. While there may be especially interesting discussions to be had within this wider range of vehicles, the focus on flying drones speaks to the mass popularisation of the drone industry. It is these kinds of drones that have created the mass interest in drone technology and which describe most of the consumer market. Nevertheless, there are remarkable drones available that mimic the swimming motion of marine life, in a similar way to how some drones mimic avian flight biomechanics. Such vehicles have huge potential to allow us to explore the hidden depths of the ocean, but it is the flying objects that are most fascinating from a societal and cultural perspective, at least, for now.

ACKNOWLEDGEMENTS

Many people have been crucial to the realisation of this book, mostly through having given time to talk with me about the development of drones. Thanks especially to Gabrielle Jenks for kickstarting my collaboration with Abandon Normal Devices and Marshmallow Laser Feast, where the research behind this project began. Conversations with Robin McNicholas, Barney Steel, Seb Hagemeister, Ersinhan Ersin and Nell Whitley were all pivotal in providing the space to think about the implications of drones. Our funding from Nesta's Digital R&D for the Arts, supported by the Arts and Humanities Research Council, Arts Council England, and Nesta, was a crucial infrastructure for thinking more critically about the relationship between research, art practice and technology.

As well, I am grateful to the many conversations I have had about drones with Serge Wich, Liam Young, Gerry Corbett, Andy Goodwin, Ruth McCullough and Anna Frew. Thanks also to the various organisations who gave me space to speak about this subject over the years, notably BlueDot Festival, British Film Institute, British Science Festival, Cheltenham Science Festival, Institute of Ideas, Manchester Science Festival, Royal College of Art, SciFoo, TEDx Warwick, Manchester Airport, Sheffield Documentary Festival and Sport Accord. Much of the research and the ideas within these chapters began and was developed through giving these talks.

Finally, I am always, particularly grateful to my colleagues and students at the University of Salford, Manchester, UK. The freedom to think across subjects, disciplines, and sectors, bringing industry and academic expertise together in considering questions about our future is critical to all of my work and Salford is a place that celebrates all of these values. Particular thanks to Sheila Pankhurst, Robert Young, Jean Boubli, Judith Smith and our creative technicians at Media City, overseen by Jan Bradley and Tamsin Middleton, who have made it possible for me to share my research into drones with the public since its inception.

1

ORIGINS

Given the volume of debate about drones over the last decade, it is tempting to believe that they are a twenty-first century phenomenon. However, their origins can be traced back to the late nineteenth century and the beginnings of the aviation industry, when pilotless balloons were used in military operations. At that time, the word drone was not used to describe anything resembling the drones that we see all over the world today. Yet, the historical roots of the term drone tell a number of stories that have an impact on how we make sense of the drone today. Its etymology derives principally from an environmental context, where the word drone describes a male bee whose sole function is to impregnate the queen bee. Indeed, the association between bees and mechanical drones designed for military missions is found in the naming of the British remote-controlled plane, called the Queen Bee, which was used in anti-aircraft gunnery training in the 1930s.

First flown in 1935, the Queen Bee had a range of 483 metres, a maximum speed of 167 kilometres per hour and a wingspan of 8.94 metres. It was so successful that the US military subsequently emulated the design, referring to their own plane as a *drone*, in homage to the British plane. This reference

conveyed the sentiment that, not only were all the US planes symbolically under the influence of the original Queen Bee, but they were also unmanned aerial vehicles (UAV) requiring a controller to determine their behaviours (Callaghan, 2014; Hilton, 2018; Zimmer, 2013). This early reference to flying insects has led drones to be characterised by actions that are determined by other forces, a kind of mindlessness where its movements are prescribed by a higher authority, which takes decisions on its behalf. In this respect, the drone is devoid of any intelligence or self-determination and functions as a surrogate for humanity's presence in circumstances where people would prefer not to go.

Yet, the origins of the word drone are also found in a completely different and unrelated cultural context: musical composition, where drone music is characterised by a kind of repetitive and systemic sound, a reaction to what Dennis (1974) describes as a 'fragmentation of post-war serial music'. Such music is typified by the work of La Monte Young in the 1960s and later John Cale and the Velvet Underground.

These two completely separate origins were unified in 2014, when pioneering drone filmmaker Liam Young and drone musical pioneer John Cale created a performance at the London Barbican titled *TLoop ≫60Hz: Transmissions from the Drone Orchestra* (Cale & Young, 2014), during which Young piloted his drones as integral parts of Cale's musical set (Beaumont, 2014). In this example, we find our starting point for this book, as a way into understanding the contemporary, cultural fascination with drones.

In recent years, drones have attracted widespread discussion with reactions equally amazed and appalled by their exploits. A big part of this tension has to do with the state of our technological culture today and much of this book accounts for the wider technocultural context in which drones exist. The twenty-first century is a time of remarkable technological developments, where automation, artificial

intelligence (AI) and the prospects of humanity becoming redundant are intertwined narratives within the cultural discourse about drones. Furthermore, the emergence of new technologies is played out in highly public ways, inviting speculation on humanity's future to a degree never experienced before. Where once, public debate about the future may have been limited to the public square or, later, the professional media, today's public arena consists of billions of messages shared across social networks.

Consequently, drones have become symbolic of a range of societal aspirations and anxieties about technology, a singular technological concept into which diverse aspects of societal interests and functions are located. Other such technological platforms include the mobile phone, the television, the computer, the internet and the automobile. However, the drone is a concept which has unique, diverse properties that speak to a number of crucial dimensions of humanity's ambivalence over its relationship with technology and how it feels about its technological future. Drones are not just single purpose machines. Rather, they are capable of all kinds of actions, from making sports, to making wars and to making film, which is why this book spans the brilliant, the bad and the beautiful. Drones are not just one thing, with a single purpose. They are empty vessels into which humanity may pour all of its desires and all purposes. In this sense, they are radical and revolutionary devices.

In terms of actual flying machines, Hall and Coyne (2014) outline how the development of drones occurred alongside the rise of aviation more broadly and this trajectory remains present today, as drones become a bigger part of military strategies. Indeed, humanity's pursuit of flight is also interwoven with wider ideas about its place in the world. As people have managed to transcend the limits of their evolutionary functions and occupy the skies, so too have they

been able to entertain the idea that humans are special and unbound by nature. While these ideas grossly exaggerate humanity's location in Earth's ecosystem, they are views that persist in our society, as humanity's relentless pursuit of discovery reveals.

Drones owe a lot of their popularisation also to contexts which are anything but positive indications of humanity's worth, associated mostly with destruction and surveillance, the use of which scholars have questioned as having only a thin layer of legal legitimacy. In this respect, drones have become championed as technologies of violence and power. In their simplest form, drones allow an operator – or pilot – to occupy the sky in ways that are beyond the capacity of most individuals and, perhaps, through such power, to wreak unprecedented degrees of havoc.

To this end, there is considerable controversy about using the word *drone* within the industry. It is a term that some would prefer to fall out of favour altogether, due to these destructive associations. However, Chapman (2014) provides a thoughtful reflection on the term drone, noting that its popular use is a compelling reason to keep it in play. Chapman (2014) notes further that the

> *push to distance ourselves from the word drone is primarily coming from one segment of the industry: the military suppliers and defence contractors who are now scrambling to move into the commercial market. (p. iv)*

Yet, to cease using the word drone would be to permit the erosion of this historical reality, which tells the story of the drone industry. Indeed, these relationships also remain a large part of the economic and intellectual infrastructure that surrounds drone innovation today.

Yet, a major shift in public consciousness around drones occurred in December 2013, when Amazon unveiled its plan to radically transform the way it sends out packages to customers, by using drones. At that time, their promotional concept film Amazon *Prime Air* (2015) portrayed a factory in which a drone is loaded with a parcel and is seen flying out to a household. As the film's camera tracks the drone's flight, it then descends onto the pathway of a family's front porch, which they greet happily in anticipation of receiving their goods.

Since then, Amazon has pursued its desire to bring about civilian drone delivery, steadily nurturing the idea that the proliferation of drone services is an inevitable part of humanity's future. Soon after the release of this film, Amazon was accompanied by other commercial giants seeking to do the same. In fact, in April 2019, Amazon was beaten by Google's drone company, Wing Aviation, in conducting the first drone deliveries. A subsidiary of Google's Alphabet Inc parent company, Wing Aviation has been testing drone delivery in Australia since 2014 and is also operating in Finland. Wing Aviation is the first company in the USA to receive a licence to operate as a drone delivery company. Upon receiving its licence, Google explained how:

> *For communities across the country, this presents new opportunities. Goods like medicine or food can now be delivered faster by drone, giving families, shift workers, and other busy consumers more time to do the things that matter. Air delivery also provides greater autonomy to those who need assistance with mobility. Also, our all-electric drones will reduce traffic on our roads and pollution and carbon emissions in our skies. (Wing Aviation, 2019)*

In its Wing Aviation website, it outlines the proposition to customers:

> *What would you like delivered by Wing to your door in less than 10 minutes?*
>
> - *Over-the-counter medicine (such as painkillers)*
> - *Breakfast – I'm in a rush to get to work*
> - *Groceries (toothpaste, washing powder etc.)*
> - *Lunch – I'm too busy at work to grab a bite to eat*
> - *Dinner – there's nothing in my fridge*
> - *'Emergency' essentials (such as diapers, an ice scraper for frozen car windows).*

One of the values of drone delivery systems is that they permit people to send out parcels to any location, whether or not they have a recognised address. Using global positioning system (GPS) data, the package can be programmed to fly just about anywhere, provided the drone has enough battery power to return back to base. The implications of such systems are vast. Societies need no longer be organised around such ideas as a physical address and, much like a phone, the user becomes the node in the network, the point of delivery, characterised by a hidden numerical code, rather than a semantic reference point. Thus, the realisation of drone delivery is a further erosion of our sense of identity and its being replaced by a set of binary codes. In the drone-fuelled future, our locations need not be described by street names, cities or postcodes. Instead, we will have a continually updating GPS location to describe where we are, and all the important places in our lives, transforming how we think of places and the spaces we occupy.

The expansion of drone applications into civilian environments is inextricable from the growth of commercial

consumer drone companies, notably Da-Jiang Innovation Technology Co (DJI) and Parrot, two of the leading commercial drone retailers. Their products have become available across a range of retail outlets, which have positioned drones into mainstream conversations. A good example of this is the Apple store, itself a brand which has captured the imagination of digital consumers, not least because mobile phones are quickly becoming control platforms for drones.

As consumer drone use became tied to photography and filmmaking, Apple's alignment spoke to their wider pursuit of what has become known as the prosumer market – where consumers want products that allow them to produce media content of their own, like videos and photographs (Hughes, 2016), rather than simply consume the content of others. In this way, consumer drones emerged as a component of our increasingly digital lives, where everything we do interfaces with our mobile devices in some way. Drones became a crucial lifestyle accessory of that mobile ecosystem.

These examples indicate how the public discourse on drones is changing along with the economic investments around it. A critical part of this history is the various economies and political lobbying that surrounds the development of the drone infrastructure. For example, in August 2015, Amazon created attention by lobbying for drones to be given exclusive access to the altitude of 200–400 feet. This plan conjured up images that are found in countless science fiction stories, where a certain level of the sky above our heads functions as a parallel road network. Since then, Amazon undertook its first drone delivery test flights on 7 December 2016 and has now, like Google, undertaken extensive testing of its delivery system.

These trajectories take the world one step closer to a future of flying vehicles which ferry people around; a prospect that is especially appealing, as the world's roads become

ever more congested. However, the means by which this dual layer of vehicular transportation would be powered is still unclear. Moreover, the idea of an additional layer of movement above our heads is not new. Indeed, twentieth century monorails were one such system and subways are a similar concept, albeit underground. What would distinguish a drone highway is the absence of people from the space, but it would still rely on a rule bound, semi-autonomous form of organisation, so as not to create complete chaos.

These possibilities draw humanity even closer to a world that has been imagined by science fiction writers and filmmakers for decades, where, a future of flying machines and artificially intelligent robots would walk – or fly – among us. Indeed, in 1997, the second *Back to the Future* film takes its protagonist Marty McFly to the year 2015, a world where his archenemy has become omnipotent and where hoverboards and flying cars are just another part of the landscape. In this world, these extraordinary technologies have become mundane in the way that describes the trajectory of many mainstreamed technologies, which may be a critical part of their becoming a ubiquitous and seamless part of our everyday lives. At one point in that imagined future, the movie takes us to suburban America to witness how this radical future will affect the lives of the common people. For a fleeting second, we see a flying robot, a drone, taking a dog for a walk. In the future imagined within this film, we are shown how we will send our beloved pets out for walk with robots, rather than take them ourselves. And there may be good reasons to believe this scenario.

Twenty years later, not only did the year 2015 actually deliver the world's first hoverboard, but it has also shown the world's dog-walking drone. In 2014, a film released on Vimeo by Jeff Myers shows a dog waking from its sleep and then being led by a drone around a quiet suburban street in broad