A Revolution in Military Affairs?
Changing Technologies and Changing Practices of Warfare

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Throughout the 1990s and early 2000s, the American military establishment feverishly debated the notion of a coming "revolution in military affairs" (RMA) understood as an imminent transformation in the conduct of warfare brought about by new technologies such as precision-guided munitions and information and telecommunication technologies. Its most vocal proponents (Cohen 1996; Owens 2001) predicted a new era of military superiority for the United States if it grasped this epochal opportunity and modernised its armed forces accordingly. The performance of a putatively information-age military in the wars of the twenty-first century has however proven to be much less auspicious, particularly where it has involved confrontation with diffuse and resilient armed insurgencies. Excitable discussions of a revolution in military affairs and an associated military doctrine of network-centric warfare (Cebrowski and Gartska 1998) have accordingly become much more muted in recent years. Yet simultaneously the new figure of the drone aircraft, a weapons system drawing upon RMA technologies, has become the object of insistent debate and frequently seen as heralding the dawn of a new era of robotic warfare (Singer 2009).

That there exists an intimate link between technology and warfare is a claim that can hardly be disputed. Such a relationship is all the more salient when we consider a twentieth century in which was realised an unprecedented mobilisation of industrialised societies for the purpose of waging armed conflict, not least with regard to their scientific and engineering resources. From these efforts have followed the global deployment of motorised forces on land, at sea and in the air, the development of the atomic bomb and the harnessing of the electromagnetic spectrum for lightspeed telecommunications and the extension of perception beyond the natural bounds of the human organism. On the basis of this potent relationship, many commentators have come to the view that technology is *the* central determinant of military power and that one can trace major transformations in the practices of warfare to the emergence of key technological innovations. Already in the 1950s, the historian Michael Roberts contended that the introduction of portable firearms had induced a radical change in military tactics and strategy in the sixteenth century (and thereby occasioned the rise of the modern state), bequeathing the very term of "military revolution" that has since gained common currency (Roberts 1967).

As seductive and compelling as such accounts of the primary causative power of technology may appear, they typically rest on simplistic and selective treatments of the historical record, as several of Roberts's professional colleagues have been keen to underline (Gifford 1995; Black 2008). At a more fundamental level, such perspectives are vitiated by impoverished understandings of technology and the nature of technical change. As reviewers of Geoffrey Parker's expanded version of Robert's original thesis (Parker 1988) put it, technology is all too often treated "as a 'black box,' a primary *explanans* whose nature is itself inexplicable" (Hall and De Vries 1990: 506). The import of such debates is not restricted to the arbitration of historiographical controversies since the ways in which we conceptualise technology and its relation to the conduct of war is essential to any assessment of a contemporary RMA and its possible geopolitical ramifications, and beyond it of the relation between technology and conflict more generally.

This chapter will argue for the necessity of a series of theoretical and methodological moves for the development of a richer comprehension of the role of technology in war. In the first instance, the chapter will propose a conceptual framework that can overcome the limitations of approaches to the RMA that treat technology and society as two distinct domains, putting the analysis of technology and war on a stronger intellectual footing by drawing upon a theory of assemblages that does not insist on such a rigid delineation of technology and society. Having done so, it will outline and seek to problematise three common conceptions of military technology found in both popular and academic accounts of warfare. Finally, the chapter will argue that while technological developments are significantly impacting contemporary military practice - if rarely with the clear, unambiguous effects hoped by their keenest proponents - the RMA can only be adequately grasped by reference to the wider sociotechnical milieu in which they are taking place.

Opening up the Black Box of the War Machine

If we are to overcome the limitations of many existing accounts of technology in war, it is essential to lay a strong theoretical and methodological foundation upon which original analyses can be built. Drawing upon the perspective outlined in the first half of this volume, an essential first step must be an obstinate commitment to resist any firm delineation between society and technology according to which one can simply be read from the other as in various brands of technological determinism or social constructivism. Following Bruno Latour (1999:214), it must be resolutely affirmed that “we are sociotechnical animals and each human interaction is sociotechnical.”

To this end, the present chapter proposes to deploy a theory of assemblages as first elaborated in the work of Gilles Deleuze and Félix Guattari (Deleuze and Guattari 2003) and which recently has been garnering increasing attention in the social sciences, including International Relations (DeLanda 2006; Marcus and Saka 2006; Acuto and Curtis 2013; Bachmann and al. 2014). The concept of the assemblage – a close cousin to ANT’s ‘networks’ - refers to any collection of heterogeneous elements that can be said be display some form of consistency and regularity while remaining open to transformative change through the addition or subtraction of elements or the reorganisation of the relations between those elements. Thus, concrete assemblages can be seen to cut across the various ideational and material domains that are usually analytically delineated, thereby eschewing the search for causal determinisms between them to privilege the systemic interactions and co-dependencies that constitute such assemblages.

Assemblage theory is applicable across all areas of social and political life. Regarding its implications for our understanding of technology, Deleuze and Guattari (2003: 397) argue that

> the principle behind all technology is to demonstrate that a technical element remains abstract, entirely undetermined, as long as one does not relate it to an assemblage it presupposes. It is the machine that is primary in relation to the technical element: not the technical machine, itself a collection of elements, but the social or collective machine, the machinic assemblage that determines what is

> a technical assemblage at a given moment, what is its usage, extension, comprehension, etc.[1]

The above passage makes clear that a technical object is always inserted into broader assemblages that determine its mode of production, the value attributed to it, its distribution in the social field, and its employment, none of which are intrinsic features of the object. While technical objects are typically designed and refined with particular uses in minds, these uses are never exhausted by the intentionality of their creators and objects are always liable to being repurposed as they enter into different assemblages. A simple example would be that of a machete which can just as well be employed for chopping the branches of a tree as for the hacking of human limbs. Such a dual use might perhaps be dismissed as banal given the understood purpose of machetes for the action of *cutting* but more surprising and unforeseen appropriations can also occur. For example, a passenger aircraft normally inserted in a transport assemblage whose function is to carry goods and bodies from one point to another along repeatable paths takes on a radically different character when wielded as a missile hurled against a building. Strictly identical technical objects can therefore dramatically alter their meaning and effectivity in the world when detached from the assemblages that conferred to them their original usages and meanings.

Of course, the technical object is also an assemblage in its own right, composed of heterogeneous parts and specific functional relations between these parts that we must also be attentive to since they exert their own influence on the wider field of social assemblages. A comprehensive understanding of a technical object therefore also requires that its history and genesis be grasped so as to draw out the co-evolution of its parts. Successful technical objects typically undergo a process whereby early designs in which each constitutive internal element serves a single purpose in a linear causal chain progressively develop into more internally coherent schemes in which their parts take on several functions that mutually support the operation of one another and enter into multiple relations of reciprocal causality. As they do

[1] It is important to note that the reference to a "social machine" here is not premised on the notion of a priorly constituted entity of "the social" that would shape at will technology or any other "non-social" realm. Within a theory of assemblages, there is no totality of the social, only social assemblages that already combine bodies, material, machines, discourse, and so on.

so, the forms of technical objects tend to stabilise and their designs can remain fixed for extended periods of time.[2]

This point can be illustrated with reference to the development of firearms. The muzzle-loaded musket widely adopted by the European armies of the eighteenth century employed a flintlock mechanism in which a hammer holding a piece of flint strikes the steel of the flash pan and produces a spark igniting the priming powder that in turn triggers the detonation of the main gunpowder load and causes the weapon to discharge. After each shot, the operator of the musket would then have to reload the weapon from the muzzle end with gunpowder, bullet and wadding, prime the flash pan with some more gunpowder and cock the hammer of the flintlock before taking aim again. In this primitive incarnation, each element of the firearm served a simple purpose in a linear chain with human intervention required to restore the technical object to a functional condition and address all the changes in the state of the object that are by-products of its operation and prevent its immediate reuse.

The flintlock mechanism[3] was eventually replaced by the percussion cap in the mid-nineteenth century, paving the way for the modern breech-loaded cartridge in which bullet, gunpowder, and primer are all combined within a single metallic casing. Starting with the invention of the Maxim gun in 1884, firearm technology then saw the development of semi-automatic or fully automatic designs that use the recoil or a portion of the gases propelling the bullet from the barrel to automatically eject the spent cartridge, load a new cartridge into the breech, and ready the weapon for a new discharge, these operations all performed virtually simultaneously. Although a wide range of semi-automatic and automatic weapons exist, these basic principles of firearm operation have remained practically unchanged for a hundred years, suggesting a high degree of optimisation in the harnessing of the physical laws governing the functioning of such devices.

[2] This analysis is indebted to the French philosopher of technology Gilbert Simondon (1989, 2011). See also Boever and al. (2012). For related ideas from a Social Construction of Technology (SCOT) perspective, see chapter two.

[3] The flintlock mechanism was itself already a more integrated ignition mechanism than the earlier matchlock which lowered a slow-burning match to the flash pan, the lid of which had to be manually lifted by the operator. The flintlock mechanism dispensed with the need for a live match and used a protruding section of the flash pan called the frieze which, upon being struck by the hammer, would provide the spark for ignition as well as lift the lid of the pan and expose the priming powder to the spark, all within a single movement.

It is generally in this state of internal coherence that the technical object is at its most versatile and flexible in its applications, requiring limited intervention into its workings by its users and able to operate relatively autonomously from other technical objects. Such a technical object can therefore be much more easily detached from any given assemblage and reintegrated into a new one than is the case with an unstable technical object still in the midst of its evolutionary genesis, more heavily dependent on the mesh of sociotechnical relations that sustain it, and correspondingly exigent in terms of the conditions necessary for its successful operation. To take examples at the two ends of that spectrum, one could contrast the versatility, ease of use, and widespread diffusion of the AK-47 Kalashnikov rifle (more on which below) with the F-35 fighter jet and its long list of costly operational requirements including bespoke runways, software integration, and specialist training.

When tracking the emergence and evolution of technical objects, it is also important to recognise the extent to which these have become increasingly intertwined with specific understandings of the natural world and its physical properties. Modern technology is intimately tied to the emergence of a scientific worldview pursuing a systematic empirical interrogation of nature from which are derived mathematical laws and regularities that permit the elaboration and optimisation of the contraptions that rely on them. Conversely, technical artefacts allow for the isolation of natural forces necessary for their scientific study. If we are to better understand the workings of technology in our contemporary societies, it is therefore incumbent upon us to trace the articulation of scientific ideas and discourses, materiality of technique, and social practice that might best be referred to as ***technoscience*** (Pickering 1995; Ihde and Selinger 2003). Indeed, it is to this very nexus that we must attend when assessing claims of an overarching revolution in military affairs and determining the role that the information technologies cherished by RMA enthusiasts actually play in the wars of the twenty-first century. For now, however, we must attend to three problematic conceptions that abound within existing accounts of the role of technology in war but which we can now begin to unpick with the help of the conceptual framework just outlaid.

Three Shortcomings in Discussions of Technology and War

The first of the common problems affecting discursive treatments of technology in war is the *disproportionate attention paid to weaponry*. Such bias is easy enough to account for by the intimate relation of weapons to the sharp end activity of war and the particular fascination that firearms, jet aircraft, or nuclear bombs seem to exert on the public at wide. However, it is no less misleading for it, all the more as we consider increasingly industrialised and technologically-intensive armed forces. For one, the focus on eye-catching weaponry generally results in a neglect of other technologies, some of which may at first appear quite mundane but that can credibly be said to have played as important a role as any weapon system in the development of warfare. One might for instance think of the technology of food canning and legitimately query whether the vast static fronts of the First World War could have been sustained for so long without the means for the preservation and transport of inexpensive high-calorie nutrition. Another example can be found in the discovery of penicillin whose anti-bacterial properties saved countless lives and limbs of injured soldiers at risk of infection, restoring many of them to duty and thereby sustaining combat power.[4]

A further problem with a narrow focus on weaponry is that it overlooks the crucial role of logistics in supplying fighting units with the materiel (such as food, fuel, ammunition or medical equipment) they could not operate without.[5] Logistics has long constituted a major part of military operations but has only become more complex and indispensable as armies have become more technologically sophisticated. Indeed, it has been widely observed that the level of resources or personnel allocated to support roles relative to the actual combat forces they enable (the so-called "tooth-to-tail ratio") has steadily increased over time such that the former now outnumber the latter by a scale of as much as ten to one in the most advanced militaries.

A fundamental but often occluded truth comes to the fore when we relax the primacy generally accorded to weaponry in accounts of technology in war and allow for a

[4] Much the same could be said of the assorted techniques of blood transfusion that developed during the Second World War, see Grove (2015). On the long-standing entanglement of armed conflict and medicine, see Larner et. al (2008).

[5] The paucity of general academic accounts of military logistics is revealing in this regard with Van Creveld (2004) and Lynn (1993) standing as rare exceptions. For a more general treatment of logistics that traces its historical entanglement of military operations and business management as well as explore its present role in global manifestations of violence, see Cowan (2014).

consideration of the role of other technical innovations and a tracing of the larger logistical chains in which any given technology is inserted. That is to say, no technical object exists in isolation of the wider sociotechnical systems within which it is produced, distributed, sustained and put to use. Such dependencies are in fact typically all the more dense and fragile the more functionally integrated technical objects are with each other. Accounts that isolate particular technical objects from these dependencies in order to attribute to them a primary causative role are accordingly vulnerable not only to charges of arbitrariness but also of resting on a simplistic understanding of both social and technical change.

Indeed, an even more fundamental problem lies in the persistent *technological determinism* that subtends so many discussions of technology within military affairs. Although such a stance is rarely explicitly theorised or defended, major developments in the conduct of war along with success and failure in particular military exchanges are routinely and uncritically attributed to certain key technologies. As prominent a military strategist as J.F.C. Fuller thus does not hesitate to assert that "tools, or weapons, if only the right ones can be discovered, form 99 per cent of victory" (Fuller 1998: 31). All too often, technologies are treated as *dei ex machina* that seemingly appear from nowhere and induce major transformations in the conditions of war. In such accounts, changes in tactics and organisational arrangements are frequently understood as merely subsequent adjustments to a new technological reality. Where social and cultural variables are considered, they are generally restricted to assessing the extent to which military institutions, so often decried for their supposedly innate conservatism, are able to adapt to this new landscape of war. Thus we find Phillips bemoaning the fact that his fellow military historians are "obsessed with technology as the primary determinate of causation within their discipline" (Phillips 2002: 40).

The limitations of technologically determinist accounts are perhaps best illustrated by reference to a specific example and here the medieval historian Lynn White and his so-called "stirrup thesis" (White 1962) can provide a useful case study to think through the issues at stake. In a collection of essays on medieval technology, White famously develops the claim that the emergence of the feudal order can be traced back to the introduction of the stirrup in horse-riding. White's starting point is that the new technology transformed the practice of war by permitting the effective use of the lance in a charge (since the impact of such a charge would no longer unseat the rider), thereby making the horseman the new dominant unit on the European battlefield in what could retrospectively be construed as a revolution in military affairs. Society consequently turned to the production of mounted knights, whose elevated cost in terms of equipment and training entailed the formation of a class of largely autonomous landed warriors. From this, White claimed, had sprung the feudal period and the different cultural forms that characterised it, such as those associated with ideas of chivalry.

White's arguments generated a great deal of controversy among medieval historians and his chronology was subsequently heavily criticised but, for our purposes, it is the more general charge of technological determinism laid at White's feet that interests us most. It is true that the precise origin of the stirrup is not known, and its identification is further complicated by the fact that design and function evolved substantially from earlier single mounting aids to paired riding stirrups connected to a saddle. Reliable representations of horse riders equipped with stirrups can nevertheless be dated back to China in the first centuries of the Common Era and there is some evidence that the earliest forms can be traced as far back as the Assyrians in 850 BCE. What is known with greater certainty is that the stirrup was introduced to Europe by the Avars around 600 CE as they were pushed westwards under pressure from the Turks, eventually leading to a growing European adoption in the eighth and ninth centuries. Crucial to the present discussion of technological determinism is the glaring fact that the stirrup was widely available and put to use in the practice of warfare in many different parts of the world yet only in Europe did it become associated with feudal forms of social organisation.[6]

Albert Dien (1986) has notably shown how the earlier introduction of the stirrup in China and the concomitant rise of cavalry was not accompanied by feudalism there because of the greater strength and reach of the imperial state. Whereas in Europe it was necessary to parcel political authority down to regional levels in order to procure the required mounted units, the advanced Chinese bureaucracy was able to administer the central recruitment of military resources without extensive delegations of power to middlemen. In their discussion of technology, Gilles Deleuze and Félix Guattari (Deleuze and Guattari 2003) also explicitly cite White, acknowledging that the stirrup did constitute a novel type of weapon system through a closer binding of man and horse but simultaneously resisting the attribution of any causal pre-eminence to the technical object since the forms and usage of this new assemblage

[6] On the role of technological diffusion from the East in European development see Hobson (2004).

varied according to the broader social milieu in which it was inserted. “The stirrup,” they tell us,

> occasioned a new figure of the man-horse assemblage, entailing a new type of lance and new weapons, and this man-horse-stirrup constellation is itself variable, and has different effects depending on whether it is bound up with the general conditions of nomadism, or later readapted to the sedentary conditions of feudalism. (2003: 399).

The stirrup did indeed allow for the formation of a novel and effective combat system in cavalry but this effectiveness was only relative to the other contemporary means of war, and the forms of its manifestation were multiple. So while European societies produced mounted knights that would conduct charges for shock effect, Asian nomads privileged mounted archery, using the stirrup to stabilise their aim (Hildinger 2001). Thus the cases of both the Chinese and nomadic appropriations of the stirrup underline that it is only under the specific conditions of European sedentary societies that it can be said to have participated in the development of feudalism.

We should therefore resist the seductive resort to technological developments as the unique, or even principal, causal force from which we can directly derive changes in social arrangements. As we have seen with the stirrup, we cannot draw any simple line from the introduction of a technical object to a particular way of fighting, let alone to wider socio-economic transformations. This is not to say that the specificities of individual technologies are irrelevant or that we can satisfy ourselves with the adoption of the view that technology is merely the second-order emanation of social forces or human intentionality. Such a move would be tantamount to merely lurching from one explanatory pole to another when in fact it is the strict dichotomy between technology and society that must itself be brought into question.

The last shortcoming in both popular and academic accounts of technology and war that we must consider is the tendency to *focus on the latest technical developments* involving contraptions reliant on the most recent scientific discoveries and feats of engineering. The eagerness with which the RMA and drones have been seized upon and invested with portentous significance for the future of war is exemplary of such a bias. Material objects thought of as cruder and less ‘advanced’ in terms of their sophistication and functional complexity are thereby frequently neglected, even where their present impact in the world is considerably greater.

An emphatic example of such a military technology is the AK-47 assault rifle, most commonly known as the Kalashnikov after its Russian inventor. First produced in 1947 and adopted as standard equipment by the Soviet armed forces and most of its Warsaw Pact allies during the Cold War, the Kalashnikov is arguably the most influential weapon active in armed conflicts across the globe (Chivers 2010). Available for less than a hundred dollars in some parts of the world, the AK-47 may lack the accuracy or power of later rifle models but retains enduring appeal for its ruggedness, reliability, and ease of use and maintenance. The weapon of choice of the insurgent, revolutionary, terrorist, and organised criminal as well as still in widespread use by state militaries, the Kalashnikov has acquired a rare iconic status, represented prominently on the national flag of Mozambique, the coat of arms of Zimbabwe and East Timor, and the banners of such armed groups as Hezbollah and the Iranian Revolutionary Guard. In its multiple variants and imitations, it accounts for no less than twenty percent of the estimated 500 million firearms in circulation around the world today. As such, the AK-47 is far and away the most deadly weapon system around, killing more every year than all existing tanks, aircraft and ships combined.

The humble but lethal Kalashnikov draws our attention to the fact that the notion of technology covers not merely the so-called cutting edge of technique (often referred to by the nebulous term of high-tech) but rather the much wider gamut of material objects through which human collectives are assembled and interact with both the natural world and each other. Since a new technology is typically expensive to procure, consequently scarce, prone to malfunction, and reliant on specially trained producers and users, the initial reach of its direct influence is likely to be limited. Generally speaking, the full social impact of a technology is therefore only truly felt at the point of widespread adoption, if it occurs at all.[7] Such an adoption is itself liable to be determined as much, if not more so, by considerations of cost, reliability, and ease of use and maintenance than by its performance in ideal conditions.

[7] Any catalogue of successful and influential technical innovations would unquestionably be dwarfed by the litany of mostly forgotten failures and dead-ends that have followed from not only obviously flawed or impractical designs but also the inability of otherwise functional technical objects to secure a sufficient constituency of users due to unpropitious economic, social or cultural conditions. It is hence not uncommon to see previously unsuccessful technologies rediscovered and prospering several decades after their original conception.

An equally illuminating case study is provided by the improvised explosive device (IED), a non-standardised bomb assembled from available materials that has become a particularly prized weapon in the arsenal of insurgent groups opposing more conventional armed forces. In the recent wars in Iraq and Afghanistan, IEDs are estimated to have caused around two-thirds of coalition casualties, prompting the Pentagon to expend billions on combating a device produced for as little as thirty dollars.[8] The particularity of the IED as a technical object is that all its incarnations share in common certain key functional components of trigger, detonating fuse, explosive charge, and container but these elements instantiate themselves in each case from a vast array of disparate objects cobbled together and repurposed by the artisan bomb-maker. Explosive charges range from artillery shells and military or industry grade high explosives to homemade explosives concocted from fertilisers and household chemicals while the mechanisms available to either automatically or remotely trigger the detonation include timers, infrared heat sensors, pressure plates, wires, and the radio signals emitted by garage door openers or mobile phones. The IED is thus a highly polymorphous technical object, its endless mutations further spurred by the countermeasures deployed against it. Among the most ingenious of developments we find the removal of any metallic components liable to be picked up by detectors or the adoption of trigger sensors tuned to the very radio frequencies emitted by coalition devices for jamming earlier instances of radio-controlled IEDs.

The IED, in its accelerated and highly improvised manifestation, illustrates a more general mutability of the technical object that co-evolves alongside the wider socio-cultural ensembles within which it is inserted. It furthermore underlines the open-ended functionality of technical objects such that they can always be repurposed and recombined to produce new ensembles beyond the intentions of their original designers. Armed conflict is undoubtedly a particularly potent accelerant for technological evolution, concentrating minds and resources and subject to an intense dynamic of action-reaction between belligerents that singularly spurs innovation. It is therefore not surprising that so many influential technological developments of the last hundred years can be traced back to military efforts, from nuclear energy and the computer to rocketry and satellite geo-positioning. In fact, it is precisely this intimate relation between war and technoscientific innovation that underlies the claims of an

[8] By 2010, the U.S. military had spent over $17 billion dollars on IED counter-measures, excluding the even higher expenditure occasioned by the procurement of reinforced armoured vehicles (Higginbotham 2010).

epochal revolution in military affairs that became ever more insistent at the turn of the twenty-first century and which we can now submit to critical scrutiny.

Technoscientific War in the 'Information Age'

The question of whether a revolution in military affairs is afoot is one that cannot be addressed through the fine-grained analysis of specific technical objects proposed above since it pertains to a very broad thesis of a transformation in the technological basis of war. To the extent that a common technological genus can be identified to the trends encompassed under the label of the RMA, this putative upheaval in the conduct of armed conflict is being attributed to the proliferation of information and communication technologies. From the outset, it must be affirmed that such a general grouping covers so wide an array of concrete technical objects that any claims of predictable and well-delineated effects, above all the assurance of military and geopolitical primacy, should be treated with circumspection.

An analogy can be drawn with the advent of military aviation, surely one of the most significant developments of the last century in opening up a whole new spatial dimension to warfighting (Adey 2010; Van Creveld 2011). While contingent on the application of the internal combustion engine to heavier-than-air aircraft, no simple line can be drawn from the appearance of powered flight to definite military uses that have been shaped as much by political decisions, doctrinal statements, bureaucratic institutions, and tactical schemes as by the available state of aviation technology. Indeed, the various development paths taken by aircraft have been heavily influenced by their intended purposes even if not strictly beholden to them. A plethora of fixed-wing and rotary-wing designs have been produced to fulfil such diverse roles as ground support, air-to-air combat, aerial bombardment, troop transport, reconnaissance and surveillance, or command and control, all of which have been further integrated into wider tactical and strategic schemes such as blitzkrieg, strategic bombing, and air mobility. If mastery of the air is therefore manifestly a major component of military power today, the operational uses to which it has been put are manifold and necessarily related to the conduct of war in its other dimensions. Furthermore, it must be acknowledged that the exercise of airpower has failed to reliably deliver the decisive outcomes its most fervent proponents have imagined for it (Hippler 2013; Pape 1996).

Information and communication technology has similarly (and often in combination with airpower) been embraced in some quarters as a panacea, fuelling enraptured visions of omniscience and omnipotence on the battlefield. Already in 1969, General William Westmoreland, head of command for American military operations in Vietnam, could prophesise the arrival within a decade of the "automated battlefield" in which "an integrated area control system that exploits the advanced technology of communications, sensors, fire direction, and the required automatic data processing" would allow "enemy forces [to] be located, tracked, and targeted almost instantaneously" with "first round kill probabilities approaching certainty" (Westmoreland 1969). Towards the end of the seventies, spurred by Soviet discussions of a "military-technical revolution", elements of the Pentagon led by the influential strategist Andrew Marshall began to theorise technologically-driven changes in the character of warfare that would come to be referred to as the revolution in military affairs (Krepinevich 2002). By the nineties and the emboldening success of the First Gulf War, the notion of an RMA had diffused widely, prompting giddy declarations that new technologies were on the verge of granting military commanders "an omniscient view of the battlefield in real time, by day and night, and in all weather conditions" and allow for the delivery of "the coup de grace in a single blow" (Owens 2000: 14). We can recognise here the insistent recurrence of what Paul Virilio has referred to as "the will to see all, to know all, at every instant, everywhere, the will to universalised illumination: a scientific version of the eye of God which would forever rule out the surprise, the accident, the irruption of the unforeseen" (Virilio 1994: 70).

As suggested by Virilio, such dreams of power may be ancient but their modern incarnation is to be understood by reference to a contemporary scientific worldview, and in particular to an informational episteme that has been recasting our understanding of nature, society, and human subjectivity as processes of informational exchange. Although prior antecedents can be traced (Mindell 2003), the crucible of this worldview most clearly lies in the Second World War in which the first computers were assembled and the modern foundations of the information sciences were laid (Galison 1994; Hayles 1999). Receiving further impetus from the intense superpower rivalry of the Cold War that saw computation and networking technologies increasing deployed throughout the military (Edwards 1997; Bousquet 2008a), this informational paradigm has firmly established itself as the technoscientific regime of our time. Notions of the rise of an information society qualitatively distinct from its predecessors have accordingly become common currency within both popular and academic discourse (Bell 1973; Toffler 1980; Hardt and Negri 2000) with Manuel Castells's pronouncement that "networks constitute the new social morphology of our societies" (Castells 2000: 500) succinctly expressing the contemporary credo.

The American military enthusiastically embraced this view in the 1990s, producing a doctrine of "network-centric warfare" (NCW) that purported to achieve "information superiority" and "full spectrum dominance" (Alberts and al. 2002). Taking inspiration from the non-linear sciences of chaos and complexity, this latest version of the RMA argued for a decentralisation of command that would grant the various constituents of the armed forces a capability for self-organisation and unparalleled operational flexibility (Bousquet 2008b, 2009). By the onset of the War on Terror, the Secretary of Defense Donald Rumsfeld was keenly promoting an agenda of "transformation" requiring a "leap into the information age" and the establishment of a new "set of interconnections" that would allow small, nimble forces to outperform more numerous non-networked opponents (Rumsfeld 2001, 2002).

Yet the translation from grandiose rhetoric to prosaic reality proved itself to be considerably more challenging. Initial successes in Afghanistan and Iraq at the turn of the century gave way to protracted and indecisive campaigns in which much of the supposed technological superiority of Western militaries was negated by determined insurgencies that made use of commercially available technologies such as mobile phones and the Internet to organise but never relied on them exclusively (Shachtman 2007). The aura of network-centric warfare dimmed accordingly, its terminology quietly dropped in the latter half of the 2000s (Guha 2016).[9]

This is not to say that information and communication technologies are not significantly altering the landscape of armed conflict, or even that elements of the RMA vision have not been realised. The present ability to survey the battlespace and persistently track entities within it is truly unprecedented. The precision with which munitions can be delivered to any

[9] The drawn-out conflicts in Afghanistan and Iraq occasioned a revival of counter-insurgency doctrine (COIN) that denoted a shift away from NCW's emphasis on high-tempo operations and kinetic force to the management of populations and winning of "hearts and minds." Crucially, however, COIN continued to make extensive use of information and communication technologies, notably in the production of biometric databases of local populations and the computer modelling of societal dynamics (Ansorge 2015).

point of the globe to devastating effect is increasing all the time.[10] The digitisation and networking of armed forces is continuing apace, driving both automation and an increasingly tight cybernetic integration of humans and machines (Coker 2013; Holmqvist 2013; Wilcox 2015). All these developments are significant and certainly merit thorough analysis, but the claims of military superiority and strategic pre-eminence attached to them remain to date unsubstantiated.

The RMA is not best understood, however, as a thesis on the future development of war whose validity is to be assessed. For the reasons outlined above, it is too broad and general a thesis to withstand any sustained probing and we are better served by a more careful and detailed analysis of specific sociotechnical systems. Information and communication technologies are contributing to altering the ways in which wars are being fought but these changes remain too variegated and uncertain for them to be encapsulated under a single movement, let alone one that can be conveniently steered to the benefit of a single party, particularly when such technologies are so widely accessible and relatively inexpensive.

We can, however, benefit from an appreciation of the ideological function that talk of an RMA serves within wider socio-cultural imperatives. In this respect, Jeremy Black's assessment remains particularly insightful:

> Belief in the RMA [is] symptomatic of a set of cultural and political assumptions that tell us more about modern Western society than they do about any objective assessment of military options […] The RMA acts as a nexus for a range of developments and beliefs, including an unwillingness to accept conscription, a very low threshold for casualties, an assertion of Western superiority, and the ideology of machinism (Black 2003: 97).

In other words, technology is seen as the means by which the United States and its allies can continue to exert military influence globally while avoiding both the human casualties and compulsory enlistment such a policy might otherwise entail and which have become deeply unpopular with their populations since the Vietnam War. Indeed, Western policy-makers have become increasingly sensitive to both the wider public's reduced tolerance of casualties (the so-called "body-bag syndrome") and the resistance that mandatory conscription would

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[10] According to one estimate, "in 1944 it took 108 B-17s dropping 648 bombs to destroy a target. In Vietnam similar targets required 176 bombs. Today, a single PGM [Precision Guided Munition] can destroy the target" (Rip and Hasik 2002: 213).

likely encounter today. In this regard, the recent turn to drones for the prosecution of the Global War on Terror is merely the latest expression of the aspiration to a technicist fix for this bind, appearing to provide yet another means to "project power without projecting vulnerability" (Chamayou 2015: 12).[11]

This ideological investment in the power of technological contraptions to resolve the inherent tensions within the geopolitical designs outlined above may well be precisely that which condemns the RMA and its avatars to repeated failures to live up to their inflated promises. The more Western states attempt to pursue "riskless wars" (Shaw 2005) through the application of technology, the more they render themselves susceptible to, and indeed invite, the strategic response of their adversaries to make conflict as costly in human lives as possible, including for the civilian populations these states purport to secure. In the words of General Stanley McChrystal, former Commander of Coalition forces in Afghanistan (Rose 2013):

> To the United States, a drone strike seems to have very little risk and very little pain. At the receiving end, it feels like war. Americans have got to understand that. If we were to use our technological capabilities carelessly […] then we should not be upset when someone responds with their equivalent, which is a suicide bomb in Central Park, because that's what they can respond with.

War is a clash of wills, Clausewitz wrote almost two hundred years ago (1976: 13). To expect wars to be fought only on the terms dictated by a single side is quite simply to wish away the agency of such an opposing will. There is little to suggest that any technology is likely to fulfil such a yearning any time soon, however much faith in this vision satisfies the ideological requirements of Western societies.

More so than in any other sphere of social existence, the brute physicality of war confronts us with the pervasive role that material objects occupy in the life (and death) of human collectives. But while the rapid and dramatic changes in the practices of warfare experienced in the modern era can be directly correlated to the evolutions of technique, we should be wary of simplified linear accounts that all too hastily read developments on the battlefield as incipient to the character of specific technical objects. It is only when these are related back

[11] Drone strikes offer the added benefit that the physical elimination of individuals designated as threats to Western security does away with the seemingly insuperable problem created by the capture and detention of "unlawful combatants".

to the wider sociotechnical assemblages in which they are embedded that we can begin to draw out the complex interdependencies and co-constitutive interactions that make up the war machine. Such an intellectual endeavour can contribute to developing more sober and nuanced appreciations of the transformative potential of technological developments than those which have animated RMA enthusiasts and at times intoxicated policy-makers. And as remote a prospect as it might seem today, it may also be one of the necessary preliminaries to the war machine's eventual disassembly.

Bibliography

Acuto, Michele and Simon Curtis (eds) (2014) *Reassembling International Theory: Assemblage Thinking and International Relations* (London: Palgrave).

Adey, Peter (2010) *Aerial Life: Spaces, Mobilities, Affects* (Oxford: Wiley-Blackwell).

Alberts, David S., John J. Gartska and Frederick P. Stein (2002) *Network Centric Warfare: Developing and Leveraging Information Superiority* (Washington, DC: CCRP Publications).

Ansorge, Josef (2015) *Identify and Sort: How Digital Power Changed World Politics* (London: Hurst).

Bachmann, Jan, Colleen Bell and Caroline Holmqvist (eds) (2014) *War, Police and Assemblages of Intervention* (London: Routledge).

Bell, Daniel (1973) *The Coming of a Post-Industrial Society* (Harmondsworth: Penguin).

Black, Jeremy (2003) *New Century War: Past, Present, Future* (London: Continuum).

Black, Jeremy (2008) 'Was there a Military Revolution in Early Modern Europe?' *History Today* 58(7): 34-41.

Boever, Arne De, Alex Murray, Jon Roffe and Ashley Woodward (eds) (2012) *Gilbert Simondon: Being and Technology* (Edinburgh: Edinburgh University Press).

Bousquet, Antoine (2008a) 'Cyberneticizing the American War Machine: Science and Computers in the Cold War' *Cold War History* 8(1): 77-102.

Bousquet, Antoine (2008b) 'Chaoplexic Warfare or the Future of Military Organization' *International Affairs* 84(5): 915-929.

Bousquet, Antoine (2009) *The Scientific Way of Warfare: Order and Chaos in the Battlefields of Modernity* (London: Hurst).

Bousquet, Antoine (2014) 'Welcome to the Machine: Rethinking Technology and Society through Assemblage Theory' in Acuto, Michele and Simon Curtis (eds), *Reassembling International Theory: Assemblage Thinking and International Relations* (London: Palgrave).

Castells, Manuel (2000) *The Rise of the Network Society* (Oxford: Blackwell).

Cebrowksi, Arthur K. and John J. Gartska (1998) 'Network-Centric Warfare: Its Origin and Future' *Proceedings* 124(1): 28-35.

Chamayou, Grégoire (2015) *A Theory of the* Drone (New York, NY: The New Press).

Chivers C. J. (2010) *The Gun: The Story of the AK-47* (New York, NY: Simon and Schuster).

Clausewitz, Carl von (1976) *On War* (Princeton, NJ: Princeton University Press).

Cohen, Eliot A. (1996) 'A Revolution in Warfare' *Foreign Affairs* 75: 37-54.

Coker, Christopher (2013) *Warrior Geeks: How 21st Century Technology is Changing the Way We Fight and Think About War* (London: Hurst and Company).

Cowan, Deborah (2014) *The Deadly Life of Logistics: Mapping Violence in Global Trade* (Minneapolis, MT: University of Minnesota Press).

DeLanda, Manuel (2006) *A New Philosophy of Society: Assemblage Theory and Social Complexity* (London and New York: Continuum).

Deleuze, Gilles and Félix Guattari (2003) *A Thousand Plateaus: Capitalism and Schizophrenia* (London and New York: Continuum).

Dien, Albert E. (1986) 'The Stirrup and its Effect on Chinese Military History' *Ars Orientalis* 16: 33-56.

Edwards, Paul. N. (1997) *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, MA: MIT Press).

Fuller, J.F.C. (1998) *Armament and History* (New York: Da Capo Press).

Galison, Peter (1994) 'The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision' *Critical Inquiry* (21)1: 228-266.

Grove, Jairus (2015) 'Blood' in Mark B. Salter, *Making Things International 1: Circuits and Motion* (Minneapolis, MT: University of Minnesota Press).

Guha, Manabrata (2016) *The Rise and Fall of Network-Centric Warfare* (London: Routledge).

Hall, Bert S. and Kelly R. De Vries (1990) 'Essay Review – The "Military Revolution" Revisited' *Technology and Culture* 31(3): 500-507.

Hardt, Michael and Toni Negri (2000) *Empire* (Cambridge, MA: Harvard University Press).

Hayles, N. Katherine (1999) *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago, IL: University of Chicago Press).

Higginbotham, Adam (2010) 'U.S. Military Learns to Fight Deadliest Weapons' *Wired* 18(8).

Hildinger, Erik (2001) *Warriors of the Steppe: Military History of Central Asia, 500 BC to 1700 AD* (Cambridge, MA: Da Capo Press).

Hippler, Thomas (2013) *Bombing the People: Giulio Douhet and the Foundations of Air-Power Strategy, 1884-1939* (Cambridge: Cambridge University Press).

Hobson, John M. (2004) The Eastern Origins of Western Civilization (Cambridge: Cambridge University Press).

Holmqvist, Caroline (2013) ‘Undoing War: War Ontologies and the Materiality of Drone Warfare’ *Millennium: Journal of International Studies* 41(2) 535-552.

Idhe, Don and Evan Selinger (2003) *Chasing Technoscience: Matrix for Materiality* (Bloomington, IN: Indiana University Press).

Krepinevich, Andrew F. (2002) *The Military-Technical Revolution: A Preliminary Assessment* (Washington, DC: Center for Strategic and Budgetary Assessments).

Larner, Melissa, James Peto and Nadine Käthe Monem (eds) (2008) *War and Medicine* (London: Black Dog Publishing).

Latour, Bruno (1999) *Pandora’s Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press).

Lynn, John A. (1993) *Feeding Mars: Logistics in Western Warfare from the Middle Ages to the Present* (Oxford: Westview Press).

Marcus, George E. and Erkan Saka (2006) ‘Assemblage’ *Theory, Culture and* Society 23(2-3): 101-106.

Mindell, David A. (2003) *Between Human and Machine: Feedback, Control, and Computing Before Cybernetics* (Baltimore: MD, John Hopkins University Press).

Owens, Bill (2001) *Lifting the Fog of War* (Baltimore, MD: Johns Hopkins University Press).

Pape, Robert (1996) *Bombing to Win: Air Power and Coercion in War* (Ithaca, NY: Cornell University Press).

Parker, Geoffrey (1988) *The Military Revolution: Military Innovation and the Rise of the West, 1500-1800* (Cambridge: Cambridge University Press).

Phillips, Gervase (2002) ‘The Obsolescence of the Arme Blanche and Technological Determinism in British Military History’ *War In History* 9(1): 39 -59.

Pickering, Andrew (1995) *The Mangle of Practice: Time, Agency, and Science* (Chicago, IL: University of Chicago Press).

Rip, Michael Russell and James M. Hasik (2002) *The Precision Revolution: GPS and the Future of Aerial Warfare* (Annapolis, MD: Naval Institute Press).

Roberts, Michael (1967) ‘The Military Revolution, 1560-1660’ in *Essays in Swedish History* (London: Camelot Press).

Rogers, Clifford J. (ed) (1995) *The Military Revolution Debate* (Boulder, CO: Westview Press).

Rose, Gideon (2013) ‘Generation Kill: A Conversation with Stanley McChrystal’ *Foreign Affairs* 92(2): 2–8.

Rumsfeld, Donald H. (2001) Town Hall Meeting, Washington, DC (9 Aug. 2001).

Rumsfeld, Donald H. (2002) ‘Transforming the Military’ *Foreign Affairs* (May/June).

Shachtman, Noah (2007) ‘How Technology Almost Lost the War’ *Wired* 15(12).

Shaw, Martin (2005) *The New Western Way of War: Risk-Transfer War and its Crisis in Iraq* (Cambridge: Polity Press).

Simondon, Gilbert (1989) *Du Mode d’Existence des Objets Techniques* (Paris: Editions Aubier).

Simondon, Gilbert (2011) ‘The Essence of Technicity’ *Deleuze Studies* 5(3): 406-424.

Singer, Peter W. (2009), *Wired for War* (New York: Penguin).

Toffler, Alvin (1980) *The Third Wave* (London: Collins).

Van Creveld, Martin (2004) *Supplying War: Logistics from Wallenstein to Patton* (Cambridge: Cambridge University Press).

Van Creveld, Martin (2011), *The Age of Airpower* (New York, NY: PublicAffairs).

Virilio, Paul (1994) *The Vision Machine* (Bloomington, IN: Indiana University Press).

Westmoreland, William (1969) Address to the Association of the US Army (14 Oct. 1969).

White, Lynn H. (1962) *Medieval Technology and Social Change* (Oxford: Oxford University Press).

Wilcox, Lauren B. (2015) *Bodies of Violence: Theorizing Embodied Subjects in International Relations* (Oxford: Oxford University Press).