The Persistent Appeal of Chaoplexic Warfare:

Towards an Autonomous S(war)m Machine?

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Throughout the modern era, Western militaries have drawn upon the corpus of contemporaneous scientific understandings of reality and their paradigmatic technological models to inform the organisation of their forces and outline the horizon of their future development. The armed forces successively absorbed the influence of mechanistic, thermodynamic, and cybernetic conceptions and the associated figures of the clock, engine, and computer in their pursuit of mastery on the battlefield. In the closing two decades of the last century, the military mind increasingly came under the sway of a new scientific regime catalysed by the discoveries of chaos theory and complexity science. Organised around the figure of the network, chaoplexic warfare affirms distributed information processing, emergent self-organisation, and decentralised operations as the means to navigate creatively the turmoil of war.

Initially carried to the commanding heights of the US military by the doctrine of network-centric warfare (NCW), chaoplexic warfare survived NCW's fall from grace in Iraq and Afghanistan. It continued to irrigate the subsequent theories and practices of counter-insurgency and counter-terrorism devised during the War on Terror, albeit without yielding any more decisive outcomes against non-state adversaries characterised by their own network forms. With the global security agenda having resolutely shifted to an era of rekindled great power competition in the midst of a new technological wave of artificial intelligence and robotics, chaoplexic conceptions remain the conceptual fount upon which the latest doctrinal

proposals of mosaic warfare, decision-centric warfare, and hyperwar draw. This chapter will review the enduring influence of chaoplexity upon military thought, examining the persistence of its appeal as a future vision of war despite its inconclusive results to date, and analyse the tensions and perils attendant to the incipient realisation of an autonomous s(war)m machine.

The Four Regimes of the Scientific Way of Warfare

As proposed in *The Scientific Way of Warfare* (Bousquet 2022), we can distinguish four moments in the development of military organisation. Each of these corresponds to a broad historical period during which a coherent array of scientific conceptions inform a particular approach to the problems of control and order on the battlefield. Associated with a corresponding technology that doubles as both tool and metaphor, each regime denotes a distinct form of warfare with its specific features and privileged operational principles (Figure 1)

	Key technology	*Scientific concepts*	*Form of warfare*
Mechanism	Clock	Force, matter in motion, linearity, geometry	closer order drill, rigid tactical deployments
Thermodynamics	Engine	Energy, entropy, probability	mass mobilisation, motorisation, industrialisation
Cybernetics	Computer	Information, negentropy, negative feedback, homeostasis	command and control, automation
Chaoplexity	Network	Information, non-linearity positive feedback, self-organisation, emergence	decentralisation, swarming, autonomy

Figure 1: The four regimes of the scientific way of warfare

Situated within the seventeenth and eighteenth centuries, the mechanistic era revolved around the clockwork metaphor, promulgating an understanding of the world as perfectly ordered by a divine mechanism set in motion by its creator. Mechanistic warfare reached its apogee with Frederick the Great's army as the pristine embodiment of a ticking leviathan on the field of battle. Via a process of intense drilling that shaped troops into obedient cogs, an intricate choreography of metronomic firearm volleys and complex tactical deployments was performed on the instruction of the enlightened monarch. With individual soldiers stripped of any capacity for initiative and absent the means for the commander to exert meaningful control after the onset of battle, the mechanistic approach to warfare was devoid of any flexibility and responsiveness to the contingencies of combat. Success rested above all upon meticulous advance planning and the endurance of its moving parts in the face of battlefield attrition.

The industrialisation and motorisation of society correspond to the advent of the thermodynamic age in which science turned to the study of energy, advancing a dynamic, unstable understanding of the universe and the irreversibility of fundamental processes within it. The notion of entropy, in particular, inscribed an immutable tendency towards decay and disorder. Alongside it came a probabilistic approach to scientific problems, undermining the tidy linearity and precise predictability of mechanistic models. Thermodynamic warfare unleashed volcanic forces into war, with rival nation-states mobilising, concentrating, and discharging all available energies in their feverish collisions. From the onset of the French Revolutionary wars to the development of nuclear weaponry, a vertiginous escalation in the intensity of destruction took place. While the development of command economies and total war brought unprecedented levels of central planning to the conduct of war, several armies experimented in this era with tactical decentralisation to navigate the turmoil of the industrial battlefield.

Although World War II marked the apotheosis of thermodynamic escalation, it simultaneously constituted the threshold of a new regime. Cybernetics established a science of control and communications organised around the concept of information and embodied in the advances in electromagnetic telecommunication and computational technology. Information became conceptualised as the negation of entropy and thus as an island of order in a dissipating world. Vast command and control architectures were established to secure a Cold War threatening to spiral at any moment into an apocalyptic nuclear conflict, promising centralised authority and stabilising self-regulation through negative information feedback. In the elusive quest for predictability, scientific methodology was applied more systematically than ever to warfare with the comprehensive treatment of tactical and strategic questions by operations research and systems analysis. Yet cybernetic warfare eventually experienced a chastening reversal with the Vietnam War, its sophisticated analytical techniques and military systems floundering when faced with a resourceful asymmetric adversary.

In the midst of the Cold War, scientists were busy extending the informational paradigm and pushing beyond the strictures of early cybernetics. From an exclusive focus on systems characterised by stability and self-regulation, they turned to processes of dynamic change and creative disruption. Through the exploration of non-linear mathematics, chaos theory discovered new inherent limits to scientific prediction, simultaneously revealing a secret order to seemingly random phenomena. At the edge of this intricately patterned effervescence, scientists found life itself in the guise of complex adaptive systems and their collective intelligences. A new understanding of order as the emergent property of distributed interactions between autonomous agents was illuminated and repeatedly identified in nature and society. Buoyed by the proliferation of decentralised telecommunication links and social organisations,

the network established itself as a ubiquitous figure of thought by the final decade of the twentieth century. Yet if the network arrived to change the world, "[it] came not in peace but with swords" (Arquilla 2007, 203). By the early twenty-first century, violent non-state actors had established the power of reticular organisation in humbling hierarchical states and confounding their best efforts at eradicating them. For its part, the US military had been pursuing throughout the 1990s the realisation of a "revolution in military affairs" (RMA) which, by the end of the decade, had become thoroughly infused with chaoplexic thinking. Under the banner of network-centric warfare, armed conflict was reimagined as "a complex, adaptive system where non-linear variables continuously interact" (Gray 2002, 105) and military force is best organised from the bottom-up.

Chaoplexic Warfare Meets the War on Terror

Originally conceived with peer state competitors in mind, NCW was suddenly reoriented towards meeting the challenge of a Global War on Terror launched in the wake of the September 11 attacks. The speed and decisiveness of the successive invasions of Afghanistan and Iraq initially appeared to validate entirely this self-proclaimed new theory of war. The moment of triumph was short-lived. Iraq soon descended into a vortex of civil war that the Coalition appeared powerless to arrest. In response, military leaders undertook a major shift away from the "light footprints" of nimble ground forces supported by air power to visible "boots on the ground" tasked with "winning the hearts and minds" of the local population.

The counterinsurgency moment was, in one sense, a spectacular reversal of NCW. Yet it was simultaneously a reaffirmation of chaoplexic principles that were called upon once again to

make sense of the new challenge and devise an appropriate response to it. A refrain would return throughout: “it takes a network to beat a network, and our network must be better” (Transformation Warfare 2007). This mantra would be shared in equal measure by the special forces-led counterterrorist apparatus that grew in increasing scale and sophistication throughout the same period. Indeed, rather than mutually exclusive, the strategies of counterinsurgency and counterterrorism ran concurrently in both Iraq and Afghanistan, united by a common allegiance to chaoplexity.

The doctrinal expression of the new counterinsurgency (COIN) approach coalesced under the US Army Field Manual 23-4 (2006). The manual advocates a “systems thinking” approach to insurgency, drawing upon “the perspective of the systems sciences that seeks to understand the interconnectedness, complexity, and wholeness of the elements of the systems in relation to one another” (4-3). Contemporary insurgencies are conceived as networked organisations powered by “interconnectedness and information technology” (1-4). They are correspondingly “difficult to destroy” and “tend to heal, adapt, and learn rapidly” (1-17). COIN is therefore an “extremely complex form of warfare” (1-27) that must blend kinetic force with “weapons that do not shoot” that can win over with the local population (1-28). The “human terrain” of the occupied countries is itself essentially composed of “adaptive social networks,” such as tribes, that have to be courted and nudged so as to sever their functional relations to the insurgency (3-5). In this operational environment, decentralised command and control that fosters the “initiative of subordinates” is required to realise “a COIN force that can adapt and react at least as quickly as the insurgents” (1-26). Overall, the final text counts no less than 218 references to “network(s),” 72 mentions of “complex(ity),” and 89 instance of variations on “adaptive” or “adaptation.” Within a couple months of publication, the Bush administration would announce a surge of 20,000 troops tasked with implementing the new doctrine in Iraq.

While the extent of the contribution made by the troop surge and pivot to COIN remains an object of contention, the security situation in Iraq did improve manifestly over the course of 2007, allowing for a drawdown to be initiated by the end of the following year. All the while, the situation in Afghanistan was rapidly deteriorating, eventually leading to the announcement of its own surge in December 2009. Following its toppling in 2001, the Taliban had evolved into an increasingly decentralised movement and successfully shifted tactics towards the use of improvised explosive devices. General Stanley McChrystal, the commander entrusted with rescuing the Afghan war, observed that the new Taliban "keeps dispersed insurgent cells motivated, strategically wired, and continually informed, all without a rigid – or targetable – chain of command." In sum, "just like their allies in al-Qaeda, this new Taliban is more network than army." This could of course only mean one thing: "to defeat a networked enemy we had to become a network ourselves" (2011, 67). Reviewing the military's response in Iraq and Afghanistan, McChrystal proudly touted the constitution of an "effective" counter-network: "decisions were decentralised and cut laterally across the organisation," "traditional institutional boundaries fell away," the network "constantly self-analysed, revisiting its structure, aims, and processes," and "continually grew the capacity to inform itself" (70).

Although appointed to oversee the deployment of an additional 30,000 troops, the choice of McChrystal belies the popular notion of a wholesale shift to a less kinetic campaign intent on building relations with the local population. In his earlier role, McChrystal had led for five years Joint Special Operations Command (JSOC), the organisation responsible for coordinating the actions of special operations forces from across the US military. During that time, he directed a relentless campaign of kill-or-capture raids against terrorist and insurgent networks in Iraq that only intensified with the surge, a pattern subsequently reproduced in

Afghanistan. It is therefore erroneous to construe the Iraqi and Afghan surges as unalloyed strategic reorientations from counterterrorist manhunt to population-centric counterinsurgency when, in reality, the former was only ratcheted up alongside the new emphasis on public diplomacy and influence operations. Here again, in the most shadowy corner of the War on Terror, we observe chaoplexic principles in action.

As Steve Niva (2013) recounts, JSOC established itself as a truly joint command under McChrystal, systematically breaking down bureaucratic barriers to forge connections between the military's elite units, ranging from the Navy SEALs to the Army's Delta Force and the Air Force's Special Tactics Group. With the support of a Secretary of Defense Donald Rumsfeld intent on outflanking the CIA in the conduct of covert anti-terror operations, McChrystal was able to circumvent the institution's hierarchical strictures and set up a common information-sharing infrastructure. The result was "a networked form of organisation composed of interconnected sets of decentralised and largely autonomous components that combine and work together on the basis of shared information and strategy" (191). Building up its capacity in Iraq between 2003 and 2006, JSOC accelerated its operations under the surge, moving beyond its previous, more limited, decapitation strategy. As McChrystal explained (Filkins 2009): "the aim was to go after the middle of their network – in a regular army, their senior non-commissioned officers. We tried to cause the network to collapse." "Cued to a powerful and decentralised all-source intelligence apparatus," a high-speed tempo of operations could be sustained by exploiting any information obtained through a raid on a given target to rapidly set in motion another targeting cycle (Flynn et al. 2008, 57). As Niva (2013, 192) concludes, through "organisational decentralisation and tactical autonomy," JSOC emerged as "a self-synchronised force experimenting with new forms of network-oriented hunt-and-kill operations."

While these manhunt operations were pursued assiduously, notching high-profile targets as such Abu Musab al-Zarqawi or Osama bin Laden, these did not translate into strategic success. Insurgent and terrorist organisations proved highly resilient and even the intensified efforts to extirpate their networks during the troop surges were only temporarily able to hold back the tide. Nor did COIN sufficient alter the ambient conditions that provided a steady flow of recruits and resources to the insurgents. In Iraq, Sunni factions bid their time until the American withdrawal in late 2011 before resuming their attacks on the Shia-led government. By 2014, the spill-over from the neighbouring civil war in Syria had set the stage for the dramatic capture of major cities by the self-proclaimed Islamic State, an outgrowth of the al-Qaeda in Iraq network led by al-Zarqawi. Coalition efforts to decisively defeat the Taliban were no more fruitful. A signalled commitment to withdrawal led to a similar lull in attacks on international forces that merely served as a prelude to the Afghan government collapsing before even the completion of the final drawdown in summer 2021.

On the two main fronts on which the Global War on Terror was waged after September 11, the best efforts of the network-enabled US military as amounted to strategic failures, whatever the tactical successes attained over opponents with vastly inferior resources. Yet, by the early 2010s, the American state was already shifting its attention away from the fight against international terrorism and its regional theatres towards a resurgence of great power competition. The renewed prospect of inter-state war called for a reorienting of the military machine supported by a new raft of advanced technologies and corresponding doctrinal overhauls. Sure enough, chaoplexity would once again serve as a central touchstone for imagining the future of war.

Plus ça change… The Unsurpassed Horizon of Chaoplexic Warfare

Concerned with both the rise of China and Russia's resurgence, the United States has pointedly rearticulated its grand strategic narrative over the past decade, as ratified by the 2018 National Defense Strategy: "inter-state strategic competition, not terrorism, is now the primary concern in US national security" (Mattis 2018, 1). This strategic alignment has been accompanied by a concerted push to winning the race for the next raft of advanced technologies to shape the future of war. At the end of 2014, the Pentagon announced a Third Offset Strategy to restore a competitive military advantage perceived to be eroding dangerously (Hagel 2014). The policy gestured at two previous offset strategies enacted during the Cold War through the development and implementation of key technological innovations. The First Offset involved the acquisition of strategic and tactical nuclear weapons to balance the Soviet Union's superiority in conventional forces in the European theatre during the 1950s. The Second Offset, pursued from the late 1970s after the Soviets attained nuclear parity, sought to exploit breakthroughs in precision weaponry, sensors, and stealth – the very advances that would galvanise the RMA movement. The Third Offset, compelled by the diffusion of Second Offset innovations to rival states, has cast its net widely at a raft of technologies including robotics, machine learning, big data, directed energy, hypersonics, miniaturisation, and additive manufacturing. One primary focus emerges, however, in the words of Deputy Defense Secretary Robert Work: "artificial intelligence and autonomy will lead to a new era of human-machine collaboration" (Payluk and Cole 2016). Yet, as Work insisted, "technology is never, never the final answer," and defence institutions must therefore "incorporate those technologies into new operational and organisational constructs" (Gentile et al. 2021, 35).

Responding to this exhortation, DARPA (2017) introduced a new concept called "Mosaic Warfare" with the stated objective of acquiring "a new asymmetric advantage – one that imposes complexity on adversaries by harnessing the power of dynamic, coordinated, and highly autonomous composable systems." Highlighting the vulnerability and inflexibility of modern forces whose components have to fit each other precisely in the manner of a puzzle, the Pentagon's lead R&D agency outlined the vision of a modular, interoperable, and resilient military whose interchangeable pieces could combine as a constantly shifting mosaic. "The goal is to fight as a network to create a chain of effects – or, more accurately because these effects are not linear, 'effects webs' – to deter and defeat adversaries across multiple scales of conflict intensity." By combining all the elements (be they manned, remotely controlled, or fully autonomous) in a "system of systems," new capabilities and behaviours are expected to emerge, surprising the adversary on the battlefield and confounding any modernisation efforts through their unpredictability. Mosaic warfare promises to deliver operations at "continuous speed" for constant adaptation to the circumstances of battle and support "multi-domain battle" waged simultaneously across the arenas of land, see, air, space, and cyberspace (Grayson 2018).

A related stream of writings invokes a new "decision-centric" approach to warfare that seeks to gain a decision-making advantage on the adversary via a "distributed force design" and a command and control structure "combining human command with AI-enabled machine control" (Clark et al. 2020, vi). Decision-centric warfare is favourably contrasted with network-centric warfare which "focused on improving US military decision-making by centralising it." NCW thus presupposed an "unfettered situational awareness" (iv) delivered to theatre commanders by a secure infostructure, a benefit thought to be foreclosed in future contested environments. Consequently, "network-centric warfare is not well-suited to an adversarial

context" with degraded communications correspondingly depleting combat power (Clark et al. 2021, 19). Finally, "whereas network-centric warfare assumes a high degree of clarity and control, decision-centric warfare embraces the fog and friction inherent in military conflict" (Clark et al. 2020, iv). The proposed new approach thus asserts itself by appealing to the unquestioned virtues of chaoplexity and disparaging NCW despite the latter's own historical, if inconsistent, advocacy of decentralisation.

A central assumption within decision-centric warfare is that state competitors have identified network access as a key vulnerability and can be expected, in any future conflict, to target it with the full gamut of available kinetic, electromagnetic, and cyber weapons. As such, the new thinking promotes a "context-centric" infrastructure supported by decentralised wireless networks rather than a single overarching network that might serve as a single point of failure. Depending on the available communication links, the command and control architecture will reshape itself, enabling discrete operations to be carried without the requirement for system-wide information-sharing. A related construct refers to an "Internet of Battle Things" (Kott et al. 2016) that conceives of future conflictual spaces as saturated by pervasive computing, communication, and sensing through the ubiquitous connectivity of AI-equipped entities, with data networks managing and reconfiguring themselves autonomously as a function of needs and availability.

This concern with minimising critical reliance on unhindered data links is one of the drivers in the concerted push towards autonomous weapons, along with the promise of greater speed and agility in the battlespace. In particular, the development of swarm robotics involving large numbers of small, low-cost, autonomous robots has revived concepts of "fire-ant warfare" warfare first proposed in the 1990s (Libicki 1994). One widely cited report (Scharre 2014, 20)

envisions the fielding of “billions of tiny, insect-like drones” and rehearses the familiar chaoplexic litany of emergent behaviour, collective intelligence, adaptation, and self-healing networks. Yet another publication (Ryan 2018, 12) highlights how “the new [sic] and interdisciplinary research areas of AI, complex adaptive systems, and swarm optimisation indicates the potential for self-organised robot swarms to be used in future conflict.”

In addition to a reliance on autonomous platforms, the vision of decision-centric warfare rests upon the future articulation of AI with human cognition. Machine learning algorithms are expected to assist local commanders with a range of force element combinations and tactics to achieve their goals, allowing for courses of action that would not have been otherwise conceived and will not be anticipated by the enemy. Over time, past performance will allow commanders to accept machine recommendations without scrutiny, accelerating even further the decision-making process and imposing insoluble dilemmas to the adversary (Clark et al. 2020). In the longer term, an informational fusion of human and machine through brain-computer interfaces is anticipated. The development of “direct neural enhancements of the human brain for two-way data transfer” supporting a “read/write capability between humans and machines” thus holds the potential to “revolutionise tactical warfighter communications, speed the transfer of knowledge throughout the chain of command, and ultimately dispel the ‘fog’ of war” (Emanuel et al. 2019, v).

The allure of AI has brought forth familiar dreams of martial omnipotence through technological supremacy. A four-star Marine Corps general and an AI entrepreneur have outlined their shared vision (Allen and Husain 2017) of a future “hyperwar” defined by “the unparalleled speed enabled by automating decision-making and the concurrency of action that will become possible by leveraging artificial intelligence and machine cognition.” Postulating

a revolution in artificial intelligence that will "fundamentally change the human condition" and thereby the "profoundly human undertaking" that is war, they foresee AI being "deployed at scales sufficient to essentially enable an infinite supply of tactical, operational, and strategic decision-making." By "collapsing the decision action cycle to fractions of a second," hyperwar will be "a type of conflict where human decision-making is almost entirely absent." Directing "swarms of complex, autonomous systems" operating in both the kinetic and cyber realms, the AI-augmented strategic commander will attain "a qualitatively unsurpassed level of situational awareness and understanding." The upshot will be nothing less that the capacity to "consistently dominate [and] overmatch the enemy's capacity to respond."

In all this, the main operative concept remains, as ever, that of information, binding ever more tightly the constituents of the war machine. As with previous incarnations of chaoplexic warfare, it remains uncertain whether the present proposals for the adoption of AI and robotic systems can achieve the desired decentralisation and emergent adaptation. Simonetti and Tripodi (2020, 127) express the concern that the new technologies and the corresponding acceleration in the tempo of the battlespace "may overcentralise command and control functions at the political or strategic level" and effectively prohibit the meaningful conduct of mission-oriented operations. With reaction times that preclude meaningful human tactical input, the levels of war could become dramatically compressed with the upper echelons drawn to exert their authority as low down the chain of command as the tempo of battle and prerogatives of AI permit. Yet, from another perspective (Payne 2021, 192), the AI swarm might just as conceivably institute a "supercharged" form of mission command in which the speed and opacity of its distributed deliberations systematically exclude any hierarchical intercession.

War at the Edge of Control… and Beyond

As of today, the ideal of chaoplexic warfare remains the unsurpassed horizon of military thought, its incantatory power seemingly undimmed by the repeated setbacks incurred in its previous applications. Since they began permeating military thinking in the 1980s, chaoplexic conceptions have become an exhortation tirelessly repeated through the overlapping waves of maneuver warfare, network-centric operations, counterterrorism, COIN, and mosaic warfare, each iteration promising anew to realise their promise. Yet chaoplexic warfare must at this point appear to the jaded eye as a revolution perpetually deferred. The perennial calls for the decentralisation of military operations only serve to underline the fact that it is never achieved. As for the supposed dominance that the turn to chaoplexity was to deliver, it has proven stubbornly elusive.

A first explanation for this eternal return can be sought in the innate tension between a state military's inherently hierarchical character and chaoplexic warfare's project of radical decentralisation. Quite simply, so long as armed forces act as an instrument at the behest of a state authority, they must necessarily adhere in some fundamental measure to the hierarchical principles that are the very essence of the state form. Civilian control, strategic planning, and bureaucratic accountability are all merely different expressions of the war machine's capture by the state apparatus (Deleuze and Guattari 2003). As such, any decentralising moves must eventually conflict with chains of command and legal responsibilities. This obviously explains why non-state actors, while almost never purely horizontal organisations, have been the truest practitioners of chaoplexic warfare. Unhampered by the constraints of legality, popular accountability, or even strategic coherence, transnational jihadism has constituted a fissiparous

yet enduring war machine that has proven both atrociously creative and endlessly resilient in the face of concerted state efforts at eradicating it. In this sense, chaoplexic warfare constitutes a horizon forever out of reach for state militaries. Indeed, we should certainly dread the prospect of any military so fully emancipated from state control as to no longer have any purpose apart from itself.

Military thinkers are not unaware of this tension, at the very least intuitively, and the most sophisticated analysts among them have endeavoured to find in it a virtue. Arquilla and Ronfeldt (2000, 49 & 86) thus assert that, while decentralisation should be vigorously encouraged, it is necessary to maintain "central strategic control" and pursue "hybrids of hierarchies and networks." Whether or not a middle passage can ever be successfully negotiated, the opposition between hierarchies and networks is set to remain a constitutive tension in military thought and practice for the foreseeable future, with the exhortations to be more chaoplexic unlikely to be silenced.

A second, more straightforward, reason may also account for the disappointing outcomes generated by two decades of war under the sign of chaoplexity. There is no doubt that the US military has developed information-enabled capabilities at the tactical and operational levels that can execute combined arms operations with a speed, precision, and power that has no match today. Over the course of the War on Terror, it adapted repeatedly, overhauling its doctrine in response to the challenges it faced. And yet neither tactical virtuosity nor institutional learning could salvage a flawed strategy. The lightning invasions of Afghanistan and Iraq were followed by a dawning realisation that, as many had warned at the outset, the subsequent occupations would be a much taller order. Naïve assumptions, held by at least some within the political and military leadership, about the pacified democratic societies that would

spontaneously emerge after the toppling of the incumbent regimes were mercilessly dispelled by the intractable realities of insurgency, international terrorism, and civil war. Despite the turn to counterinsurgency and the supposed priority placed on "winning hearts and minds," the presence of occupying forces and recurrent civilian casualties continued to generate armed opposition faster than it could be decimated. Even the narrow goal of securing some geopolitical advantage upon departure from Afghanistan and Iraq could not be attained by the exertions of the most powerful army in history. While the inquest into the failings of the two major American wars conducted in the early twenty-first century is now a matter for historians, many will have already drawn the conclusion that they were either so injudicious in their conception or so compromised in their initial execution as to have been beyond rescue.

This in turn raises a more fundamental consideration about the nature of power and control in the chaoplexic age. The vibrant transmutability of reticular organisation is observable everywhere in our ever more interconnected world, pulling in remote locations and disparate entities into tangled causal complexes via the continuous flows of information crisscrossing the planet. While opportunities to profit from the rippling perturbations of these dynamic complexes abound, these are necessarily contingent and transient – and the perils are no less plentiful. It therefore speaks of a particular hubris to believe that the embrace of the network form will deliver the certainty and mastery necessary to shape the world in one's image. Nothing in the non-linear sciences offers such guarantees.

In seeking to appropriate the network form and its attendant powers, militaries have repeatedly come up against the limits that their institutional frameworks and mindsets impose on any attempts to radically decentralise their operations. Piecemeal implementations of mission command have resulted, here and there, in highly effective tactical deployments in which

substantial autonomy has been granted to their individual agents. The generalisation of these various experiments in surfing at the edge of control within armed forces shaped in the hierarchical image of their state masters remains stubbornly elusive, however.

And yet, we plausibly stand at the cusp of a radical transformation in war. The former Deputy Secretary of Defense Robert Work even dares to imagine that it will change the "nature of war," a taboo thought among faithful devotees of Clausewitz (Freedberg 2017). Perhaps it won't even be apposite to speak any longer of what is to come as "war," insofar as our historical experience of it has always been one in which humans are the main protagonists. For in our pursuit of the scientific way of warfare we have arrived at a juncture at which our machines seem poised to take centre stage.

To be sure, today's military theorists (Scharre 2016, 151) place their hope in "human-machine teaming" and the figure of the "centaur," those "hybrid human-machine cognitive architectures [that] will be able to leverage the precision and reliability of automation without sacrificing the robustness and flexibility of human intelligence." Work (2015) thus expresses the belief that "artificial intelligence and autonomy will allow entirely new levels of what we refer to as man-machine symbiosis on the battlefield." Under this alluring vision, humans will set overarching strategic goals, determine relevant mission objectives with the assistance of machine learning algorithms modelling and simulating all the possible courses of action, and instruct autonomous platforms to complete the mission, maintaining oversight as they swarm the battlespace and devise contingent tactical responses at the speed of light. In the domain of cyberspace, a throng of bots, worms, and viruses will battle to protect and defend the flows of information necessary for situational awareness and the exertion of command and control while disrupting, corrupting, and misleading the adversary's own infostructure – all of which will again be

conducted at speeds and scale far exceeding human comprehension. As these new orders of battle encounter each other, setting in motion spiralling interactions whose non-linear effects are inherently unknowable, disquieting questions about the nature of control within human-machine symbiotes will inevitably arise. Indeed, those with a view from the edge already worry (Ilachinski 2017, 233) that "as autonomous systems increase in complexity, we can expect a commensurate decrease in our ability to both predict and control such systems."

Pointing on the horizon is a fully autonomous (s)war(m) machine whose control would be totally immanent to itself – in other words, for which there would be no outside from which to exert control over it. This would surely be the realm of "a purely tactical mode of operability" (Guha 2010, 173), unhampered by strategic or political considerations and constrained ethically only in so far as its emergent behaviour could be said to have its own ethos. Crucially, the emergence of such an unbounded martial condition is not premised on the speculative advent of a general artificial super-intelligence that would outstrip our own and develop its own deliberate anthropomorphic designs in opposition to our will. The stumbling, groping evolutionary intelligence of the animal swarm will suffice so long as its algorithmic decision loops become untethered from any rationale external to it, relentlessly pursuing their tactical becoming in a blind pursuit of survival. Nor is this potentiality even first and foremost the function of any specific technological development. For it ultimately rests upon the insistent impulse to surrender ourselves wholesale to chaoplexic warfare in the plenitude of its concept. And so the disquieting question must be asked: what if war at the edge of control served no other master than itself?

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