Zones of Control
Future Wars Section

War, Mathematics and Simulation: Drones and (Losing) Control of Battlespace

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The organizing principle of the technical object is in this object *qua* tendency, aim and end.

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Introduction

This essay will reflect on aspects of the expansion of military drone usage by Western powers in the "war on terror" over the last decade or so. Theorists approaching drones from different fields such as Gregoire Chamayou and Derek Gregory have argued that the systematic and growing deployment of unmanned aerial vehicles puts into question established cultural, political, legal and ethical framings of war, peace, territory, civilian, and soldier in the societies on behalf of which these systems are deployed. Animating this profound undoing of cultural and geopolitical moorings is what Chamayou in *Théorie du drone* calls the "tendency inscribed in the material development of the [drone] weapon-system" (Chamayou 2013, 230).[1] I will explore the nature of this tendency inherent in drone materiality and technology, concentrating on the virtualizing, realtime digital developments in remotely controlled and increasingly automated robotic systems.

The projection over the inhabited world of a simulational model of the contested space is a constitutive part of this tendency. In the military logics and technologies powering this projection, the inhabitants of the spaces of concern in the global war on terror are better understood as environmental elements or threats in what Robert Sargent has called the "problem space." This is his term for the environment or situation the simulation designer seeks to model conceptually as a key prerequisite to programming the simulation so that it can provide an effective means to seek experimentally for a solution (Sargent 2005, 135). In a similar "experimental" manner, in Afghanistan and elsewhere a specifically designed spatio-temporality is enacting a performative reinvention of the lived experience of both inhabiting and contesting the control of space in time.

If, as the above writers have shown, this projection of and over "enemy territory" has clear precedents in European colonialist strategies and procedures, what is unprecedented today is the digitally-enabled expansion and intensification of this spatio-temporal reanimation of the world. This reanimation must be understood as key contributor to a transformative and troubling pathway toward the automation of military force projection across the globe. I will analyse the nature and implications of this reanimation of the world in digital modellings of the enemy in and as milieu, a milieu as tiny as the space around a single "target" and as large as the world, existing both in a brief "window of opportunity" and within a permanent realtime of preemptive, pan-spectrum surveillance.

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[1] Translations from Chamayou are my own.

In this essay I will first spend some time tracing the sources of this performative military-technological tendency back to the part mythical, part historical origins of Western civilization in ancient Greece. I will argue that the contemporary intensification of a technical and conceptual, military and digital projection of the battlefield "problem space" finds there its progenitors in the origins of geometry and mathematics, in strategic and tactical innovations and their philosophical, aesthetic and political accommodation in the classic foundations of Western society. Stretching back into pre-history, war games with pebbles were already playing a part in building these foundations. As John Onians has proposed, their proto-simulational techniques and artifacts for imagining territory and contesting control over it offered models and means for the conceptual developments in geometry and mathematics (Onians 1989). This dynamic between the material, technical and the conceptual in the production of a zone of control continues to animate traffic between war games, simulational forms and the implementation of robotic weapons systems in real geophysical conflict zones today.

In examining contemporary and envisaged drone deployments I am also concerned with what they can reveal about the technical tendency animating them. Tracing them back to the beginnings of Western culture shows that the material course of drone "advances" shares key features with wider trends in global digital technocultural becoming. "We"—"we" living in and enjoying the benefits (as well as suffering the toxifying effects) of today's realtime, online, ubiquitous media environment—perhaps too readily treat this environment as more or less distinct from and unrelated to the lived experiences of those in the contested spaces subject to military supervision and intervention. Documentaries such as *Unmanned: America's Drone War* (Robert Greenwald 2014) make it clear that many of those living under drones share much of "our" experience of the global media environment. This commonality of experience and aspirations—however unequally distributed—is also fundamental to the ethics of the humanitarian and social justice activism concerning drone use in targeting killings. This activism insists on the continuing legitimacy of human rights protections for non-combatants and agitates for adherence to the existing legal definitions of the spatial and temporal limitation of military conflict (Stanford International Human Rights & Conflict Clinic and the Global Justice Clinic of New York University 2012).

And there is a third, increasingly apparent, dimension of the commonality of technical tendency and material, lived experience that draws together drones and contemporary digital technoculture in the emerging global future. It is perhaps most apparent in developments toward commercial deployment of automated systems for security, surveillance and other uses (such as Amazon's delivery drone gimmick) as well as in their regular appearance in the latest releases of AAA shooters such as the *Battlefield* and *Call of Duty* franchises. But inasmuch as drones are also a leading edge innovation in the computerization and online networking of manufactured objects in general, they can be seen as overflying a generalized implementation of automated, permanent, realtime surveillance and regulation of lived experience that is unprecedented in human history.

The scale, historical scope and diverse overlappings of the technical tendency "inscribed in the material development of the [drone] weapon-system" represent a challenge to critical thought. In what follows I will set out an approach to thinking "tendentially" about military drones with an eye on the wider technocultural dynamics with which they are composed. In the course of this I will need to consider longer and shorter wave-lengths of this tendential development toward the reinvention of war—

which is also the reinvention of peace—and how these wave-lengths overlap and crystallize today in the post-strategic, post-political potential of drone deployment by the United States, Israel and other "advanced Western powers". The materialization of a tendency is never its complete realization, and also offers to thought other possibilities and other anticipations of the tendency. This gap of incompletion between the actualized devices, procedures and systems and the tendency is the space and the time for reflection, review, critique and renegotiation. If today it seems to be ever the shorter and smaller, it is nonetheless critical to inhabit it with a less operational mode than that described in Sargent's principles of simulation design. A properly critical engagement is less concerned with improving the validity of the conceptual modelling of the "problem space" of the real world, and more concerned with how the problem space has been defined, according to what logics, what questions, and supporting what inherent tendency. It is through posing and answering these questions that the possibility of altering its course arises.

Tendency, Composition and Ethnocultural Development

The expansion of drone operations is my principal concern and I will examine it in detail in subsequent sections. As their highest profile representatives (in the mainstream media as much as in wider academic and political debate) the unmanned aerial vehicles known commonly as drones can stand in for the wider gamut of robotic weapons developments across the armed forces and security agencies. These include the Samsung SGR1 armed machine gun system permanently monitoring the zone between the two Koreas, the bomb-disposal robots (such as the Cobham tEODor) used on the ground in Iraq and Afghanistan, and the various experiments in remotely operated naval surface and submarine devices. The SGR1 and similar automated targeting and firing systems like Raytheon's Phalanx CIWS (Close-in Weapon System) and its land-based variant the C-RAM (Counter Rocket, Artillery and Mortar), are sometimes excluded from categorization alongside the unmanned vehicles, understood to be part of the preceding "generations" of automatic weapons such as the "smart" missiles using infrared, radar or laser guidance. As M. Shane Riza argues in reflecting on an encounter with the C-RAM, however, the lines are blurred between automatic and autonomous weapons, and it is necessary to pay attention to the extent to which the automation of target acquisition and weapons fire has already become endemic in the warfighting conducted by the militaries of the advanced powers even before the recent phase of unmanned systems (Riza 2013, 2-4).[2]

As a further development of the doctrine and implementation of "air superiority," it is no surprise that drones are at the forefront of developments (and debates) concerning the expansion of automated and remotely operated weapons. As Philip Lawrence noted in *Modernity and War* control of the skies is a key principle of total war in the modern industrial age, an age in which "control of the future" has become the "watchword" (Lawrence 1997, 62). As Chamayou points out, the drone's eye in the sky sees all, adopting the prescient perspective of God, reaching out over

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[2] And this applies also to those able to access the advanced weapons systems of the advanced industrial economies, as was brought home (once more) by the downing in July 2014 of the Malaysian Airlines commercial flight MH17 over the contested territory of the Ukraine by what many believe (at the time of writing) was a SA-11 (Buk) surface to air missile developed by the former Soviet Union's military-industrial complex.

the territory of the enemy in a preemptive precondition for the desired total control of the enemy threat (Chamayou 2013, 57). To anticipate and interdict the enemy's capacity to act represents the key strategic functions of airpower: surveillance and strike. As I will examine below, the use of drones has expanded rapidly over the last decade and evolved in such a way as to put the coherence of this strategic goal in question through a rapid implementation in simulational, semi-automated systems that are largely (but not unanimously) supported by a rationalizing voluntarism in military and political circles.

It is important to understand this expanded implementation of remote and automated weapons systems, however, as continuing developments that were set in train in earlier trajectories of technical and cultural-political compositions of discourses, practices and inventions. For it is in the dynamics animating the composition of these that a material tendency finds its motive force. In *Technics and Time 1* Bernard Stiegler characterizes history as the product of a composition of human and technical forms. Stiegler's conception of the central role of technical development in human history draws on André Leroi-Gourhan's notion of the constitutive role played by the technical tendency of "exteriorization" in the evolutionary process of "hominization" through which human beings arrived at their most successful, globally extended form (Stiegler 1998, 62). The human evolves through a process of technical developments that export functions and capacities that were "interior" to the human as biological, genetic organism. At a certain (for Stiegler unlocateable but nonetheless attained) threshold, this process formed a new dynamic that takes human becoming beyond a strictly natural evolution to an ethno-cultural becoming that proceeds in tandem with this exteriorizing technical tendency.

Human history subsequently develops and diversifies through a series of "adjustments" vis-à-vis the technical in the dynamics driving the various spheres or systems of human society such as the political, the religious and the economic. Their complex interplay unfolds on the basis of the technicity of human as technical, exteriorized becoming. Stiegler employs Bertrand Gilles' notion of adjustment (and maladjustment) between systems by way of formulating an account of the challenges posed by the sophistication and reach of industrial and increasingly complex and automated modern technology (Stiegler 1998, 41-43). In the industrial age of standardized production and the emergence of technology as the application of "scientific," rational principles to manufacturing processes, the technical system becomes increasingly dominant because of the speed of its innovation, the impact of its enhanced productive capacity and the ensuing global spread of its influence. As both concept and material form(s), technology is in this regard a specific historical (and Western European) development of technics. Technics refers in Stiegler's work to all those techniques and artifacts exterior to any individual consciousness and upon which its individual development as part of a collective, cultural identity is based. Culture is in this regard always a "technoculture" of sorts inasmuch as it is transmitted and evolves on the basis of this exterior archive and resource. The becoming technological of technics represents, however, a radical globalizing shift in the dynamics of this technocultural evolutionary process for the West and across its colonial extension.

Drawing on Gilbert Simondon's philosophy of technology, Stiegler qualifies this preeminence of the technological in modernity with a sense of the deeply compositional relations through which each sphere of existence develops in relation to the others (Stiegler 1998, 65). As the being (or becoming) who anticipates, the human plays a crucial role in the ongoing advance of the technical tendency as technological

innovation and this means the human (via its other spheres of existence and concerns) retains a key potential to inflect its course. Stiegler's analysis of the contemporary moment, however, is that we are witnessing a troubling destabilization of the balance of the composition of human and technical becoming. The complex, technologically framed scenarios in which the human anticipates the future of technology tends today to limit the extent to which the non-technical spheres of experience can inform or qualify that anticipation. Stiegler asks in what metastable, "organological" arrangement of human biological and techno-cultural "organs" and instrumentalities is this anticipation of things to come properly fostered? And what happens when its stability unravels? (Stiegler 1998, 78-81)?[3]

Stiegler's approach to this questioning deserves a more careful unpacking than I can provide here, but what is key to grasp is that it treats the technical as both a sphere of existence with its own dynamic and as inherently composed through and with the other spheres of human existence. The classic either/or of the technological determinism debate—technology as determining or as culturally and historically produced and rationalized—appears in this light as a misreading of the complex co-constitutivity of the technical and the cultural. The "what invents the who just as it is invented by it," argues Stiegler in summarizing his position on the origin (and future) of the human and the part played by technics (Stiegler 1998, 177). This reposes the dilemma of technological determinism as one concerning the nature, politics and ethics of the adjustments made by the cultural, political and other systems to their composition with technological developments. The key question becomes how to adopt and modify the course of the tendential unfolding of new configurations of ethno-cultural becoming.

I will argue that the radical overturning of political and cultural notions and practices of "territory" already recognizable in the trajectory of drone deployments indicates that a reconfiguration of the very conditions of human-technical evolution is on the horizon of their "material tendency." In Stiegler's view the "human" in this composite term does not refer to a stable or transcendental entity, but to a contingent and at best metastable organization and promise of a particular kind or kinds of social and individual existence. It has to be argued over and argued for today. For instance, the legal activism against remote-controlled killings makes it readily already apparent that the program of drone use is heading in a radically different direction to the project announced in declarations and conventions on "human rights". As the human rights-focussed *Living Under Drones* report demonstrates, the life of those who have to live under the everpresent surveillance and immanent threat of Hellfire missile strike posed by drones is reduced to one of survival. The social and cultural activities and practices which make life worth living as a *human* being are suppressed by a permanent threat from the air (Stanford International Human Rights & Conflict Clinic and the Global Justice Clinic of New York University 2012).

Tracings: Mathematics, War and Technics in the Seat of Western Civilization

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[3] The tool is the *organon* in ancient Greek and Stiegler plays on this to argue for an approach to technology and culture that acknowledges their intrinsic interconnection. Organology is also in part Stiegler's response to Simondon's call for a "mechanology" to understand technological becoming; Stiegler insists on thinking the technological in composition with human becoming to develop an appropriately historical and political account of technology.

The contemporary Western involvement in Afghanistan and Pakistan incorporates two contrasting projects that share a common heritage as Western European in character. One the one hand there is the ongoing legal and human rights agencies' efforts alluded to above agitating for a truly global realization of the human rights of a humanity whose universality was first proposed as a key theme of Enlightenment philosophical humanism. On the other hand there is the experimental techno-militarist expansion of a (no less universalizable) operational battlefield in which human rights are increasingly irrelevant and provide no practical orientation for those acting on and within its limits. Each of these projects has key philosophical, political, scientific and technical roots in Ancient Greece. The legacies of ancient Greece represent for us today a wellspring of scientific, philosophical and cultural-political advances of abiding significance for the West. These advances also had a history—strictly speaking a pre-history—of technical, ethnocultural and political developments in Egypt, Assyria and the Mesopotamian region more generally. These included the invention of geometry in Egypt and the invention of writing and the gradual emergence of phonetic alphabetic scripts in Assyria.[4] Nonetheless ancient Greece names a singular period of transformations that crystallized in a philosophical and technocultural program—carried forward and modified by the Romans—whose significance for the subsequent histories of Western European ethnocultures is indisputable. Since the Sixteenth century CE this history is also a global history of European colonization of the "new world" and its aftermath, right up to today's post-colonial, global world order.[5] If, as I am proposing, the drone program is at the avant-garde of the West's passage toward another technocultural (and technopolitical) shift in the wake of the long and catastrophic twentieth century of global war and social and economic reinvention, it does so in part as an inheritor of certain key compositions of technical, scientific and cultural-political development that characterized the "miracle" of ancient Greece.

John Onians makes this abundantly clear in "War, Mathematics and Art in Ancient Greece." He shows how the constant conflict between the Greek city-states was a significant driver of those developments in mathematics, art and architecture, philosophy and politics so central to the legacy of ancient Greece. Indeed, he argues, war must be understood as the dominant motive force of their achievement (Onians 1989, 40). In contrast to the relatively more stable (internally at least) Egyptian or Persian civilizations, the status and significance of the advances in Greek philosophy, politics, mathematics, architecture and sculpture must be thought in relation to the importance of military considerations in securing or expanding the territory of the

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[4] See Stiegler's analysis in *Technics and Time 2: Disorientation* of these progenitors or what he characterizes (in response to Assyriologist Franz Bottero's account) as moments of "conception" prior to the "birth" of Greek civilization, (Stiegler 2009, 47-53).

[5] Chamayou (2013) and Gregory (2011a, 2011b) spend considerable time analyzing the continuities of contemporary military operations with the history of European colonial involvements in the region. Also in this regard see the experimental video project, *Airminded* (2014) produced by the Ontofabulatory Research group in a collaboration led by Rob Coley, available at http://antipodefoundation.org/2014/01/28/intervention-airminded/. This project traces historial and geo-spatial continuities connecting distant cultures and communities through the Lincolnshire-based Royal Air Force operations in Afghanistan and Pakistan in the Twentieth century and today.

competing Greek city states. Onians provides a variety of examples of linkages between advances in military techniques and technics and the conceptual and theoretical developments of Greek mathematics, art and philosophical and political thought.

I am most interested here in tracing two of these linkages between military technics and conceptual "discoveries": that which goes from the development of the phalanx battle formation to the formulation of abstract, mathematical laws of order and proportion; and the related dynamic connecting a proto-simulational modelling of the politico-strategic real with mathematical formalization and philosophical speculation. Between them, they mark a decisive turn towards the conceptual and technical complexes of automation and simulation I wish to examine in the deployment of drones.

The phalanx was a key tactical discovery of Greek military commanders for organizing the armed foot soldiery, the *hoplitai* (hoplites), into an effective rectangular formation maximizing the defensive capacity of the form as it maneuvered and engaged enemy units. It predates the celebrated philosophical and mathematical advances that were to follow in the classical period from the Fifth to the Fourth century BCE. By exactly how long is the subject of debate among scholars of ancient Greece, a debate that may be interminable given the developments in question span the threshold of the pre- or proto-historical periods and the beginnings of recorded history. Researchers rely on different source materials to develop competing hypotheses concerning the nature, significance and historical trajectory of the phalanx and its relation to the development of the Greek *poleis* (city-states) in the classical period. These sources include archaeological evidence, geographical survey data, artistic and mythopoetic and dramatic texts (subject to philological and literary analysis), and the non-contemporary accounts of later historians and philosophers of Greek and Roman antiquity. The scholarly orthodoxy—subject to revision and challenge in recent decades—has it that the phalanx developed quite rapidly in the Seventh century BCE as a revolutionary transformation of Eighth century mass battle tactics, associated with a new double-handled, heavier shield design (*hoplon*), and that this new approach to fighting land battles based on tight formations of armed infantry was adopted by most or all of the major Greek city-states in their frequent battles over territory and conflicting colonial aspirations (Hanson 2013).[6]

Training and discipline were required to maintain the phalanx's effectiveness in battle as the shield's substantial weight and method of holding it—by inserting the left forearm through a strap to grip a handle on the right side—indicate that the individual *hoplite* depended on the shield held by the warrior to his right for protection on his spear-carrying right side. The discipline was celebrated in Homer's *Iliad* with metaphorical allusions to the fence and tower-like qualities of the battle formation in which the soldiers had become perfect compositional elements of a

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[6] The controversies over the "Grand Hoplite Narrative" include "gradualist" revisions of the "revolutionary" character of the arrival and spread of the phalanx formation, as well as more profound challenges to the orthodox account of the significance of the phalanx for an understanding of the social and political transformations in classical Greece *poleis* away from dynastic monarchies and towards more democratic political arrangements of various kinds (Viggiano, 2013). I will return to this briefly in what follows, inasmuch as the debates touch on my observations here concerning the relationship between war and technical and conceptual tendencies still animating Western technoculture today.

unified architectural entity (Onians 1989, 43). The earliest extant records of Homeric poetry are from the Eighth century BCE but the canonic texts may have crystallized in their enduring forms over the subsequent centuries (Snodgrass 2013, 89-90). While Homer's mythic poetry relates accounts of battles from a legendary, heroic Bronze Age past, it has been interpreted by some classicists as reflecting the already mass character of Iron Age warfare of the archaic period preceding the classical period. Anthony Snodgrass discusses this recent movement to read the Homeric texts in terms of the context of their production. While sceptical of reading the *Iliad* and the *Odyssey* as fully coherent and consistent fictional portrayals of the historical state of warfare at the time of the writing down of the oral narrative tradition, Snodgrass states that at the least they provide a clear indication that mass war and formation fighting were significant features of conflict in the time the *Iliad* crystallized prior to the historical accounts of phalanx warfare in the Fifth century and later (Snodgrass 2013, 86).

For Onians, the Homeric allusions to the disciplined, architectonic character of the phalanx of tightly formed soldiers in the *Iliad* illustrates key combat-forged virtues for the subsequent development of Greek civilization and culture. In a similar vein, he proposes the "Geometric" style of Eighth Century BCE funerary pottery be renamed "Military" style since "the qualities they reveal"—armed men reduced to a repetitive patterns of shields and spears—"are precisely those valued in a war situation" (Onians 1989, 40).

In the Fifth Century Pythagoras and his followers inherited this appreciation of the value of "geometricality" passed down in the cultural tradition from a number of sources, including the pre-Socratic, cosmological writings concerning the foundational role *eris* (strife, conflict) plays in the universe and in human affairs. Pythagorean mathematics developed a metaphysics of polarized forces locked in *eris* the secret ordering of which could be formulated and utilized.[7] The primacy of number as a material cause of entities in the world, and the importance of mathematical patterns and order in the *kosmos* were central to Pythagorean doctrine and its philosophico-political practice. Onians tells us that *kosmos* (order) is a cognate term with *kosmeo*, "I arrange" or "I marshall," and *kosmetor*, "supreme commander" (Onians 1989, 45). The configurations of important Pythagorean number patterns— mystical entity-principles derived in the uncovering of the cosmic order—resemble the phalanx and other "foundational" military groupings: the rectangle principle develops into a phalanx-like structure of rows of dots, while the *Tetragonos* corresponds to an alternative square tactical formation from around the same period (the Fifth century). The most revered pattern, the *Dekas* takes its name from that for a basic company of ten soldiers first mentioned in the *Iliad* (Onians 1989, 45).

The "harmonious" order of the Pythagorean cosmos conceptualized in the musical movements of the planetary spheres is a further confirmation of the military inspiration for this mathematical conception of reality: *Harmonia*, daughter of the God of war, *Ares*, was a term associated in Homer and Hesiod with the use of music in war and military training, and as a figure for the close linkages required in the phalanx and other battle formations (Onians 1989, 46). Onians asserts that "*Kosmos* and *harmonia* are two of the key terms in the Pythagorean program of reducing the universe to numbers primarily because they had long been associated with numerical

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[7] Onians lists some of these Pythagorean polarities: "Limited and Unlimited, Odd and Even, One and Many, Right and Left, Male and Female, Square and Rectangular, Light and Dark, Straight and Curved etc" (Onians 1989, 45).

order on the battlefield" (Onians 1989, 48). He goes on to discuss Pythagoras' ill-fated venture in Croton—the city he chose as a base for his community—to train three or six hundred (both numbers having associations with the phalanx formation) male youths through an instructional regime incorporating military, political and mathematical training aimed at improving the lot of the city following a recent military defeat (Onians 1989, 49).

Similar ventures will be undertaken or at least proposed by subsequent philosophers. Plato's utopian *Republic* sets out the program of training for an ideal philosopher-warrior "best at philosophy and best equipped from birth for war" (Plato *Republic* 543A). A metaphor or rather, a Pythagorean translation of the aim of such training from Simonides, a contemporary of Pythagorus, is cited by Plato in *Protagoras*: "It is difficult for a good man to come into being, square [*tetragonos*] in hands and feet and mind, wrought without blame" (Onians 1989, 53). Training is the craft of shaping what is "wrought"—and here I would gloss Onians' comment by noting that training is a kind of *tekhne*, that is craft, technique and skill in the fashioning of technical artifacts. Crafting the "good man" aims at an outcome corresponding as close to the ideal mathematical entity of the square as possible.

Tekhne is dedicated here to the ideality of the shape it struggles to bring into being imperfectly. Simonides' comment typifies what Stiegler characterizes as the metaphysical development of the ancient Greek thought of technics in this period inasmuch as it removes from view the dynamics of technical development and the part they play in the very conceptualization of experience. *Tekhne* is not central to the key questions about the true nature of experience or being inasmuch as it concerns "means and ends" in the transitory, imperfect realm of material existence. What counts is the animating principle of the ideal form (Stiegler, *Technics and Time 1*, 1).[8]

The tendential analysis I am proposing here on the basis of Stiegler's approach to technics sees the animating force as a compositional dynamic involving an interplay between material, technical developments and the "discovery" of abstract and generalizable concepts. Onians describes the way this movement toward the ideal realm of mathematical order, regularity and abstract perfection in Pythagorean and later philosophical work on the application of metaphysical principles was accompanied by a conceptual movement that envisaged the human element as a building block in larger structures reflecting the ideal order. Onians' evidence for this is aesthetic as much as it is textual, and he claims this is a major current of classic proportionality in Greek art and architecture (such as the Parthenon) that also resonates in literary and philosophical works. This relation of material forms and Greek thought can be explained readily in the terms of the Western philosophical tradition whose origins and influences are in question here as the necessarily imperfect, material exemplification of the transcendental ideal forms sought after by the fathers of Western Philosophy. Beyond Onians' acute demonstration of an influence that is soon glossed over or "repressed" in the course of Western history and culture, I find here a key instance of a tendential composition of material and conceptual development, a decisive mutual evolution of a technical tendency developing across tactical, strategic, architectural and aesthetic domains and a conceptualization of war, the warrior and their relation to the *polis* as community and state.

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[8] *Tekhne* has no "self-causality" for Aristotle and hence has no dynamic of its own (Stiegler 1998, 1).

The ability of the citizens both to equip themselves with the "hoplite panoply" of armour and weapons and to make themselves available to participate in the training for and conduct of mass formation warfare was central to their increased participation in the political assemblies and juridicial institutions that replaced the dynastic monarchies of the major Greek city-states of preceding eras. In Victor Davis Hanson's defense of the longstanding orthodox interpretation of the significance of the *hoplitoi* in the emergence of democratic forms of government in ancient Greece, the "revolution in military affairs" that led quite rapidly to the spread of phalanx warfare in the Seventh century was a key causative force in the overturning of aristocratic monarchic rule across the Greek world (Hanson 2013). Dependence on larger numbers of soldiers drawn from the non-aristrocratic and largely agrarian, "middling class" of the *poleis* (who could afford the money and time to fight in the growing ranks of the phalanxes) translated into political challenges to aristocratic rule and in time to various kinds of timocratic or more inclusive democratic political structures, in all of which the right and obligation to fight was instrumental (Hanson 2013, 259). The weight given to the hoplite revolution in Greek political transformation, the demographic constitution of the Greek communities and of their armies, the historical timing of the emergence of phalanx-based combat, and even the nature of phalanx tactics are some of the subjects debated in recent challenges to this orthodoxy (Krentz, Foxhall, van Wees, 2013).[9] Evaluating these respective positions is beyond the scope of this paper (and the expertise of this author). That political constitutions across Greece incorporated greater numbers of non-aristocratic members of the community, and that these members became increasingly central components of the frequent and long-lasting conflicts between the *poleis* in the late archaic and classical periods is not in dispute. Following Onians' lead, it is enough for my purposes to cite one of the major sources of the orthodox position, Aristotle who in his *Politics* asserts that "once the *poleis* grew and those with hoplite armor became strong, more people shared in government" (Aristotle 4.1297b20-24, cited in Hanson 2013, 259). While arguments continue as to precisely how to interpret Aristotle's sociology of Greek political history, this is further evidence of the perceived significance of military developments for Greek civilization in the classical period.[10]

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[9] For his part Stiegler (engaging with other philological and philosophical scholarship) attributes the Greek innovations in democratic political forms in large part to the invention of a non-military technology, linear orthographic writing, inasmuch as it enabled the kind of analysis, critique and reform of legal constitutions and judgments that writing affords, and that this was now accessible to all those able to read and write (Stiegler 2009, 39-41).

[10] In his afterword to his and Gilles Deleuze's *Anti-Oedipus: Capitalism and Schizophrenia* Felix Guattari cites the phalanx as a privileged example of the concept of the "machine" mobilized in their reinterpretation of culture and history in this and subsequent works (Guattari 2013). The phalanx is a combination of elements (the hoplite warriors), each a machine comprised of soldier and arms (the hoplite panoply) and the phalanx is itself a machine element in larger machines, right up to the Greek city-state machine. A fundamental point of this characterization is to circumvent a conventional historical analysis of the political and cultural causes and influences leading to and from the phalanx and to instead posit the significance of the combination of human and non-human, material, technical and strategic and conceptual elements as an ensemble that drives history and events. As an arrangement of equal elements (in machinic "phyla"), the machine's dynamic is not reducible to a

In the classical sources Onians mobilizes, the soldier is prepared by *tekhne* for conversion into an artifactual state. Through rigorous physical training and behavioural and intellectual habituation he learns to adopt an instrumental role as an element in larger structural formations that (ideally) will realize a harmonious architectonic materiality. Submission to this process entailed a willingness to submit to the potential sacrifice of life in return for a political citizenship that took various forms at different times in the course of the major Greek *poleis* in the first millennium BCE. From this perspective the celebrated Greek origins of Western democracy—reference point for the subsequent emancipatory, democratic movements of European modernity seeking to universalize political citizenship—can be thought of here as the negotiation of a right to rise above the condition of artifactual component of the state when not required for its military operations to expand or preserve itself. With the development of automated robotic weapons systems the promise of a perfected artifactuality of the soldier implies the redundancy of this foundational negotiation between the modern democratic state and its citizens. I will return to this implication of a movement beyond this legacy of a political negotiation of the state's power to wage war below.

Alongside this mathematically conceived artifactual conversion of the citizen-soldier into architectonic element of state power is an imaginative technical practice of conversion that begins before Greek mathematics but contributes to the mathematical transformations of war (and the ancient Greek *polis*) noted above. Today it is readable as a proto-simulational conceptualization of the technical and strategic implementation of war as governed by mathematical abstraction. Onians observes that it "is also surely likely that pebbles were used to show young men the different formations of the battlefield long before they were used to illustrate points of mathematics, as is suggested by their established use in board-games which simulated battles" (Onians 1989, 45). The rendering geometric, compositional element of the warrior in Pythagoras and Plato passes from pebbles to dots to the conceptual space of the mystical number patterns. In Onians's conjectural reconstruction, the pebbles find their way, via a graphical translation into dots, from material forms for war gaming and training to symbols in a transcendental plane of number and shape.

These pebbles and board-games evidence a simulational—as distinct from a more symbolic—representational technics as seen in other games and ludic artifacts from other civilizations with histories stretching back into pre-history. According to archeological evidence Mancala ("pit and pebble") games appear early in ancient Egypt before spreading southwards to West Africa and westwards to Asia (Parlett 1999, 217) and the Chinese beginnings of *Weiqi* (*Go* in Japan) recede into legend but are generally situated around the second millennium BCE (Parlett 1999).[11] Each of

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human-centred narrative of ideas and their projected materialization, nor to an account of tools as means to human-authored ends. In this Deleuze and Guattari's "machine" corresponds to Stiegler's efforts to think the constitutive role of technical developments in human becoming (further evidence of the debt they each owe to Simondon's philosophy). Stiegler's more "anthropocentric" (to be understood here minus the assumption concerning the essential stability or inevitability of the *anthropos*) concerns with the possible ethico-political dimensions of the future of the technical tendency offers me a better basis on which to approach critically the developments in automated and unmanned systems I am concerned with in this essay.

[11] The most well known and studied war board-game in a European context, *Chess*, traces its predecessors to Persian sources in the Sixth century CE which in turn look

these traditions of games bear witness in different ways to the playful modelling of the labour of living and surviving through a process combining material and conceptual work. This modelling work involves a miniaturization and a selective representation of more complex spatio-temporal phenomena such as the seasons and seasonal variation, the nature and intentions of the enemy, movement in space and the unpredictable concatenation of natural and human-authored events.

The abstract realm—of the imagined battle against the enemy conducted through the calculation of choices between possible moves—is conjured through and hence co-dependent upon the material realm in these ethnoculturally diverse compositions of experience and technical forms. The production of and play with the "pebble-representatives" in the prehistorical Greek war games Onians mentions is such an exteriorization of experience through technical form and gesture. As Stiegler explains in a commentary on the development of number as a transcendental concept, no concept emerges in the absence of such an exteriorization (Stiegler 2011, 48-51). Immanual Kant forgets this when discussing the transcendental realm of number (and by extension of mathematics), even as he himself writes the material marks that represent the transcendental concept.[12] These marks, Stiegler reminds us, have a material history of emergence, from objects to single marks to symbols representing larger numbers and the relations between different values. Onians proposes just such a history leading from game "counters" (as they are known today in their generic, arithmetical guise) to dots with a mystical numerical significance in the Pythagorean cosmology. Philip Sabin notes that "one can find instances as far back as Thucydides and Polybius using mathematical calculations to explore the relationship between the numbers, depth, spacing and frontage of troops within a battle line" (Sabin 2014, 5). Writing about the history of war games in Germany from the medieval to the modern period of computer simulation, Philipp von Hilgers acknowledges that it was an ancient Greek achievement "to think strategies and numerical figurations together" (Hilgers 2012, 8).[13]

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further back to the Indian game *Chaturanga* (Parlett 1999, 278). As with the "hoplite controversy," identifying the origins of this and the older games is provisional and subject to different interpretations of archeological finds and later literary allusions. For instance, there is archeological evidence suggesting an even earlier appearance of a mancala game in Sri Lanka as far back as the fourth century BCE, but Parlett follows Murray's earlier *History of Board-Games Other Than Chess* in preferring to start the story in the Egyptian "Empire Age" of 1580-1150 BCE (Murray 1952, 159).

[12] Stiegler deconstructs the Kantian "schematism" whereby certain concepts (such as number) mediate between the empirical contents of and the transcendental structures of consciousness, asking "in what sense is a number like one thousand *possible*, as a method conforming to a 'a certain concept' for the consciousness of which it is the object, *without an image*? The answer is clear: in *no* sense" (Stiegler 2011, 51, Stiegler's emphasis).

[13] Hilger's approach, influenced by Friedrich Kittler's materialist media and cultural theory, is not unlike Stiegler's thought of the composition of cultural political and technical tendencies. He analyses the role played by the material and technical practices of war games in the transforming cultural political context of an emerging German nation state in the centre (geopolitically and in terms of cultural, philosophical and scientific developments) of Europe. Hilgers' insightful account places war games not only as signficiant contributors to the European history of conflict and cultural transformation, but as major conduits for the advances in

The inside and the outside—thought and technics—are born and develop together. Making things is dedicated to a future outside the maker where it will have significance, worth and thus be worthy of being remembered, reflected upon and reproduced. With the pebble game this means being worthy of replaying for fun and/or for the lessons learnt. This game for soldier-boys is already a future-directed, proto-simulational modelling of a "problem space" but is not yet subject to formalizing procedures based on mathematical regularities and algorithms making it repeatable across domains of practice and experience. Today's board-game and computer simulations of battle continue to develop iterations of their ancient pebble ancestor for fun and/or for the lessons learnt—from amateur board-gaming practices to serious military simulation and gaming to the more commercial video games such as the *Total War* series (Creative Assembly, from 2000). These war games, with a "mathematical modelling of reality" as a fundamental component, have revisited the ancient battlegrounds of Greek and Roman antiquity to replay historical conflicts, tested the hypotheses of the hoplite orthodoxy concerning phalanx tactics, and have utilized the inferential power of computer simulation to stage hypothetical conflicts between anachronistic military forces and orders of battle (Sabin 2014, 4).[14] Simulation-based research on (and play with) historical, contemporary and future conflict continues today and continues to play a significant role in military and strategic-political spheres as well as in commercial and popular entertainment.

These board-games and computer simulations are, however, only the nearest descendents of the ancient practices and artifacts of simulating war in a contemporary technoculture that is at the other end of the tendential trajectory of the mathematical translation of specific material practices to more widely applicable conceptual formulations (and materializations). As Onians so compellingly demonstrates, these formulations were discovered and developed substantially for their potential to order and regulate the course of war as a (or possibly *the*) fundamental contingency of existence for the ancient Greeks. This tendency of Greek thought is readable in the passage from the game space and its playing pebbles via the Pythagorean (and subsequent Greek) mathematical transformation of geometry into an abstract, conceptual space of numbers and their formulaic relations to each other. Geometry, the measuring of the earth developed by the ancient Egyptians, became the proto-science launching Western science. Archimedes, whose inventions served the defense of his native Syracuse from the invading Romans in the Third century BCE, symbolizes this dynamic between military technical development and conceptual elaboration as much as he does the advance of mathematics as foundational technique and analytic method informing geometry, astronomy, architecture and the other knowledges of the world. And, as Hilgers has shown, in the early Nineteenth century mathematically innovative war gaming practices in Germany dovetail with (among

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mathematics in the West that lead on to its preeminent role in the modern military-technological complex driving key innovations of the Second World War, a state of affairs that will extend into the post-war technoscientific transformation of culture into global technoculture.

[14] The *Total War* game engine has been used in television series to animate historical reconstructions of famous battles (as in the History Channel's *Decisive Battles* in 2004) and to stage replays of historical engagements as a competition between contestants (*Time Commanders*, Lion TV/PlayGen, 2003-2005, see for example the "Battle of Leuctra" episode at https://www.youtube.com/watch?v=Id9GRHA2bzE).

other things) the major cartographical enterprise that will eventuate in the systematic, mathematically accurate surveying and mapping of the territory of the prospective German nation first surveyed and rendered as a battle space (Hilgers 2012, 55). The dynamic between abstract concept and practical application continues and intensifies in the heart of European modernization. "Mathematics," argues von Hilgers, may be distinguished by its abstractness, but it nonetheless requires forms of evidence and visibility" (Hilgers 2012, 91).

 The West.

Postwar Technoscience: Computerized Battlespace

This tendency toward the demonstration in practice of an expanding activity of conceptualization reaches a new level and is realized on an unprecedented scale in the Twentieth century with the rise of scientific and increasingly mathematical innovations in military technologies and techniques. Tracing this tendency through the intervening eras is a task beyond the scope of this essay, but its modern techno-scientific course received key bearings both from the emergence in Eighteenth entury Europe of the modern sciences (from out of the domains of philosophy and theology) and their mobilization to accelerate and multiply the ramifications of the technical discoveries that led to the industrialization of production towards the end of that century. Hilgers' account (cited above) of the role of war games in aspects of these developments is no small contribution to an analysis of the course of this material-conceptual dynamic.

The industrialization of production has also entailed the industrialization of destruction and this been central to the course of Western modernity's global expansion in the Twentieth century.[15] The century of industrial modernization was also that of the two global conflicts, of the emergence of "total war" as industrial project requiring "total mobilization," of the rise of the global superpowers, and of the prospect of global thermonuclear war. In the post-Cold War period global geopolitical conflict has been characterized by what James Der Derian calls the "postwar warring" of the industrial powers—a blurring of military and security operations with actions supporting other agendas and agencies in a context where "war" as state versus state and armed forces versus armed forces no longer occurs (Der Derian 2001, 59). The "asymmetrical" conflicts that have ensued in Iraq, Afghanistan, the Palestinian occupied territories, Somalia and elsewhere continue the legacy of this century of globalizing modernization.

Onians is right when he says that "mathematics was not exclusively military in character" and that it soon "acquired a life of its own" in later cultural contexts (Onians 1989, 62). This is still true, but if it is a mistake to forget or repress its connections to military practices and motivations in imagining a more pacific and idealist (and idealized) history of the Ancient Greek "miracle," Onians concludes with

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[15] As Manuel De Landa demonstrated, the standardization of mass-produced items gained its "impetus" from advances in French and American weapons manufacture. The standardization of rifle production during the U.S. Civil War was influential in the development of the assembly line system of production and its generalization via Taylorist "scientific" principles (De Landa 1991, 31).

the speculation that it is perhaps "an unconscious recognition of the military relevance, not just of Greek mathematics, but of Greek art too, which has guaranteed them their continued authority" (Onians 1989, 62). Indeed, but in the light of my concern with the composition of conscious (and unconscious) interiority with exterior technical material dynamics, the relevance of military concerns to mathematics (and art and architectural works), however sublimated in histories of science and civilization, remains decisive in their mutual becoming in the ongoing history of the Greek legacy.

Moreover, this relevance is heightened in the explicitly strategic-political postwar reorganization of the relations between science and technological innovation that Andy Pickering has characterized as the emergence of a military-led technoscience (Pickering 1995). This reorganization has produced material and conceptual "inventions" that lead directly onto the developments in the contemporary technical tendency that drones instantiate and intensify. Above all these are the simulation of the conflict and the virtualization of its conduct, along with the possibility of automating the latter.

In his work Derek Gregory has traced developments in aerial bombing and surveillance that lead from World War Two to the counter-insurgency and antiterrorist operations in which drones play a significant part today in the air over what he calls the "global borderlands" (Gregory 2011a and 2011b). Drones act either in support of other attacking units through their ability to provide the persistent monitoring of targets or as a "hunter-killer" platform combining reconnaissance and strike capabilities. Vietnam was crucial to these developments for the emergence of three constitutive elements of contemporary "armed overwatch": the systematic deployment of "remotely piloted aircraft, real-time visual surveillance and a networked sensor-shooter system"—as yet not integrated in a larger operational complex (Gregory 2011a, 2). In this regard the principal achievement of the post-September 11 military actions of the U.S. and its allies is to have attained such an integration, one which is conceived and implemented as a unified sphere of spatio-temporal coordination achieved by realtime networked digital communications.

The unified sphere of war operations was envisaged in post-Vietnam military doctrine. It emerged tendentially as a conceptual consolidation of the most technologically sophisticated, computerized military "advances" of the U.S.-led campaign. The spectacularly unsuccessful prosecution of the geopolitical strategy of the containment of communist expansion in Vietnam spawned the so-called "Revolution in Military Affairs" that sought to re-think military operations in an explicitly systemic and informational manner. Military commander in Vietnam (1964-68), General William Westmoreland's vision of war in the age of computers, articulated in a report to the American Congress in 1970 is often cited as the catalyst for this revolutionary movement toward an era of "smart weapons" and realtime command and control networks. Westmoreland predicted that "enemy forces will be located, tracked and targeted almost instantaneously through the use of data links, computer assisted intelligence evaluation and automated fire control" (Chapman 2003, 2). The paradigm-shift is exemplified in the subsequent redefinition of the theatre of war as a "battlespace." Tim Blackmore states that this three-dimensional, volumetric space incorporates land and sea (on the surface and below), the air above and the space above that, and the spheres of signals and communications, information and mediation (Blackmore 2005, 3). Achieving victory in operations in battlespace becomes a question of attaining "full-spectrum superiority" across all of the spatio-

temporal dimensions of "air, land, maritime and space domains" and the "information environment (which includes cyberspace)" (Department of Defense 2014, 113).

Battlespace is a conceptual elaboration of the "abstract and technical" distancing of the enemy other and the enemy territory Gregory identifies in his analysis of the electronic surveillance technologies and sighting techniques that emerged in the conduct of the airwar over Vietnam (Gregory 2011a, 2). In this regard he discusses the "pattern bombing" of Vietcong-dominated regions of South Vietnam, the area bombing of forests (with defoliants) by B-52s and the subsequent damage assessment analysis. At 25-30,000 feet in the air, the bomber crews executed a highly impersonal, familiar technical exercise, as instruments of the command and policy decisions of others (Gregory 2011a, 5). Photo-interpreters read images of the results in terms of holes in the ground and target boxes: "Throughout the targeting process the language of patterns, areas, circles, holes and boxes erased people from the field of view; bombing became a deadly form of applied geometry" (Gregory 2011a, 4).

This applied geometry became increasingly "virtual" with the "electronic battlefield" established in 1967 to interdict the supply of Vietcong forces along trails running from North Vietnam to the south along the border with Laos. Operation "Igloo White" established a large sensor field over the "Ho Chi Minh trail". The seismic and acoustic sensors dropped by parachute listened and felt for the movement of vehicles and people along the trail and their signals were monitored in an electronic map-screen at a command centre in Thailand from where air strikes were ordered in and then monitored live. The Assessment Officers at the Infiltration Surveillance Center in Thailand looked for trails of lights from the sensors indicating the passage of a potential target along the trail. These "target signatures"—"abstract geometries" of "lines on screens" and "boxes on maps"—traced the movements of people via these ephemeral electronic signals until they disappeared. Their last moments were played over the P.A. in Thailand and later for the "Electronic Battlefield Subcommittee" of the Senate's Armed Services Committee (Gregory 2011a, 8).

Gregory points out that today's "drone wars" evidence the unification of Vietnam war era developments (in realtime surveillance, networked sensor fields and remote piloting of aircraft) in a single operational system. The key difference is that "the 'viewing screen' now occupies a central place and has become indispensable for those who wage remote war" (Gregory 2011a, 9). As an instance, or acceleration of the Revolution in Military Affairs, however, it is equally fundamental to the nature and implications of its implementation that this systemic integration is "powered" by the computer microprocessor revolution (Chapman 2003, 3). The digitization of what were analog electronic networks of reconnaissance, surveillance and the coordination of strike aircraft represents a profoundly significant alteration in the mathematical-technical abstraction of war in this realtime, global assemblage of elements. The integration of diverse elements is facilitated by the translation of phenomena and procedures for analysing and acting on them into databases and algorithms inscribed in binary code. As Paul Edwards has argued, in the Cold War technoscientific matrix out of which computer hardware and software emerged, the promise of digital computerization was to contain the world of dangerous contingency within the parameters of programmable routines (Edwards 1996). If analog networks of reconnaissance, analysis and communications made realtime "dynamic targeting" possible in Vietnam, the expansion of global digital networks led toward a computational pursuit of this promised incorporation of what is external and contingent in an integrative digital spatio-temporality. It is in this light that Edwards discusses Operation Igloo White as model for the computerized enclosure of the

world desired by military strategy and Cold War political doctrine (Edwards 1996, 15-20).

I have elsewhere analysed the development of flight simulation (and virtual reality) technologies in this period as a launchpad for the materialization of this ambition by emphasizing how the modelling of the battlespace served an anticipatory logics of developing a pre-emptive mastery of the territory and its potential threats (Crogan 2010). Today's "drone wars" represent the contemporary stage of the materialization of this tendency in a process which radicalizes this simulational modelling of the enemy's potentiality. It alters the nature of war and peace in the manner I identified at the outset of this essay as a symptomatic but highly problematic trajectory of the West's global technocultural expansion.

Drones and Mathematical Materializations: Simulation, Virtualization and Automation.

It is important to emphasize—as Gregory does in his analysis of the lines of descent leading to the contemporary remote controlled military operations in Afghanistan and elsewhere—that tracing the lines of these tendential developments is neither to affirm faith in the promise of total incorporation and control of the enemy, nor of the earlier rhetoric of "progressive" or "beneficial bombing" realizing an increasingly rational and efficient conduct of war (Gregory 2011a, 1). On the contrary; I will suggest at the conclusion of this piece that a better candidate for a "futurology" of global military-led security operations is Paul Virilio's speculations, dating from the 1970s, concerning the "territorial insecurity" which develops as the "reality projected by the system" dedicated to attaining this total control (Virilio 1976, 37). For his part, Gregory's detailed analysis of a botched joint U.S.A.F and Special Forces operation in Uruzgan province in 2010 which led to the deaths of many Afghani civilians (and to the prosecution of members of the team remotely operating the drone involved in the attack) forcefully demonstrates the large distance between the promise and the reality of a fully integrated and systematically coordinated militarized modelling of battlespace (Gregory 2011a and 2011b).

The efforts to realize this incorporation of contested territory in a "system of systems" capable of full-spectrum superiority nonetheless transforms the conduct and conceptualization of war (Chapman 2003, 3). I am emphasizing the simulational character of this by which I mean it evidences the application and extension of a process that corresponds to Sargent's influential account of the simulation design cycle I cited at the outset of this essay. I argue that essential features of the simplification and abstraction of phenomenal complexity that characterize the simulational modelling of a "problem space" able to be defined and resolved—or rather whose problems can be anticipated and controlled—through software-based "solutions" are manifest in many aspects of drone deployments.

The use of drones such as the MQ-1 Predator (first deployed with Hellfire missiles in 2001) and MQ-9 Reaper (since 2007) as hunter-killer systems combining surveillance and strike depends on such a process of abstraction and simplification to execute strikes on designated targets (Gregory 2011b, 207). Drone operations proceed on the basis of the systemic coordination of numerous computer-based systems, including those for the coordination of remote vehicle piloting between the Nevada-based pilot and sensor operators and the "Launch and Recovery" crews (responsible for take-off and landing) at bases in the contested geographical territory where the drones are stationed, for the pilot's interface setup (screens and sensor outputs,

joystick, throttle and other input devices) in the ground control station and the drone's translation of this remote user input into aerial manuevers, for the communications linkages and video/sensor feeds between ground control with other elements engaged in joint operations, tactical command positions in the battlespace and strategic command centres situated in the U.S. and elsewhere, the smart weapons systems and their communications with these other networks of command and tactical elements, and so on.

The computerization of systems supporting targeting is a key feature of the above complex system of systems for conducting remote war, and one which displays most vividly the simulational logics emerging in these operations. Gregory is right in identifying the centrality of the visual video feed from the remotely operated vehicle for targeting and execution as a key transformation from the Vietnam era developments in remote control warfare. The "immersive" involvement of the ground crews in the digitally-enabled battlespace occurs as a juxtaposition of intimate proximity and extreme distance. As Gregory states, the remote "pilot and payload" team are located both 18 inches from the video monitor and at around six to seven thousand miles from the contested territory (Gregory 2011b, 207). Many of the crucial ethical, political and psychological themes explored in response to the expansion of the UAV program turn on the issues and implications of this paradoxical combination of proximity and distance. Gregory characterizes this combination as an uneasy ensemble of "near-sighted" and "far-sighted" vision that creates as many uncertainties as it resolves concerning the accuracy of its tactical implementation and the effectiveness of its strategic and political goals. The video game-like "immersive capacity" of the remote drone operator interface places them virtually in the battlespace occupied by allied soldiers and pilots. It connects them in a community mediated by realtime audiovisual monitoring of the enemy. This network of screens amounts to a "political technology of vision," one that "renders our space familiar even in 'their' space—which remains obdurately other" (Gregory 2011a, 12).

This confusion of near and far perspectives is repeated in the U.S. domestic sphere (and its global diffusion) in the proliferation since the first Gulf War in 1991 of what Roger Stahl has analysed as "militainment" (Stahl 2010). Stahl examines the trend towards a more intensive and "interactive" experience of combat in video games, embedded reporting and reality tv, and more recently via online video sharing of footage of firefights captured by helmet-cams, of drone strikes, and so on. This experience of war as increasingly immersive entertainment corresponds with and indeed occasions a movement away from a deliberative social or political engagement in the far-flung operations against terrorism and the enemies of U.S. interests. For Stahl, the miltainment's contradictory movements ever closer to the action but away from a political means for collectively negotiating its significance generate cultural political tensions. I would characterize these disturbances of the body politic (and its collective visual imaginary of the "virtual citizen-soldier") emanating from the commercial media sphere as symptomatic of the destabilizing impetus of the technical tendency at whose leading edge drone operations develop today (Stahl 2010, 110).

If "eyes on" the target via high resolution video imaging is crucial both for the surveillance capabilities of drone vehicles and to the positive identification required for authorization of a strike, it is important to recognize that the video image is part of a larger flow of sensory data feeding the reconnaissance and targeting operation. The drones themselves supply multi-spectral image data—infrared, daylight and image-intensified video. Developments are well underway in the operational implementation of wide-area composites of multiple high resolution surveillance scans to form a kind

of tiled mosaic of detailed video scanning of the contested territory—"Gorgon Stare" and ARGUS-IS are two such projects (Gregory 2011b, 193). The persistent flow of data-feeds from these various sensors are treated by video analysis software designed to selectively identify key information required for intelligence analysis and targeting processes. These "highly formalized" procedures—that is statistical, algorithmic programs for making usable an overwhelmingly enormous database of pixels—set out to "distinguish 'normal' from 'abnormal' activity in a sort of militarized rhythmanalysis that is increasingly automated" (Gregory 2011a, 10).

This cutting edge "big data" software development includes the NVS system (National System for Geo-Intelligence Video Services) being produced under the direction of arms manufacturer giant, Lockheed-Martin. According to Paul Richfield, NVS will filter, sort and produce video-on-demand reports through software agent functions comparable to Netflix's user profiling of preferences and related searches (Richfield 2011). Reports combine various statistics concerning the full motion video playback and resemble financial reporting on MSNBC or watching a football game on ESPN (Richfield 2011). Like all database processing software, the generation of useful reports depends on the quality of the metadata produced through the indexing of video data according to relevant categories. The allusion to ESPN is more than illustrative: Chamayou notes that the U.S. Army had licensed a version of the video analysis software ESPN uses in its football coverage to aid research and development of its drone-supported counter-insurgent targeting (Chamayou 2013, 61). The software is especially good for collecting and cataloguing videos associated with a particular player from a massive archive of game coverage, and this dovetails with the desire to map and characterize the past actions of individuals identified as insurgent or terrorist.

Chamayou comments that this turn to professional sports coverage seems to fulfil Walter Benjamin's prediction that future war (in a dystopian, fascist future) will replace categories of warrior and war in favour of sporting terminology (Chamayou 2013, 62). From our perspective on these developments as a continuation and exacerbation of the military-mathematical tendency of Western technoculture, this adoption is one of many indications of the digital extension of the game space of pebble counters on a little field of circumscribed action to a more generalized simulational space.[16] The analysis of enemy "play-moves" is now subject to a formalized procedurality that seeks to render less incalculable the complexity of events in real geophysical space on the basis of a ludic, abstracted, simplified and delimited game space. Moreover, this software processing of the pattern of the enemy-as-player is becoming increasingly automated. Projects such as the Defense Advanced Research Projects Agency's (DARPA) "Mind's Eye" are working on Artificial Intelligence to analyse and annotate video automatically. The envisaged

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[16] Key moments in the history of this extension of wargaming, from Chess to Kriegsspiel to computer simulated gaming and simulation practices are covered in considerable detail in Hilgers (2012) and in other essays in this volume. In "Wargaming and Computer Games: Fun with the Future" I argued that Kriegsspiel crystallized a simulational practice that advanced the notion of the applicability of a rationalizing logic and mathematical procedure to the conduct of that most unpredictable affair of warfare (Crogan 2008). The formalization of principles for the abstraction and miniaturization of terrain, and the algorithms for calculating movement, unit damage and so on are progenitors of the battle simulation software pervasive today across the military-entertainment complex.

"visual intelligence" would be able to "learn generally applicable and generative representations of action between objects in a scene directly from visual inputs, and then reason over those learned inputs" (DARPA Information Innovation Office, 2011). Beyond machine vision developments in pattern recognition and object identification, the ambition of this project is to automate a cataloguing of actions and relations between objects. The ever-growing flows of multi-spectrum video scans from battlespace will necessitate the implementation of such programs able to "automatically translate the aggregations of pixels into nouns, verbs and propositions" (Chamayou 2013, 62).

Systems and software such as NVS and Mind's Eye will be added into the suite of statistical and analytical software delivering the "militarized rhythmanalysis" Gregory describes. These include Geotime which gathers together and visualizes various forms of surveillance data such as satellite monitoring and mobile phone signal tracking. Mobile phone tracking, made possible by the "spectrum dominance" over the communications sphere of battlespace, has become a significant contributor in the intelligence analysis supporting the targeting of individual "insurgents" in the deployment of drones to support or execute targeted assassinations. It has also been at the centre of some of the more infamous mistaken strikes such as the alleged killing of an election campaign team in northern Afghanistan by a joint operation relying on cell phone tracking to identify the target (Gregory 2011a, 13). According to Kate Clark, the special forces team came to believe the Taliban deputy leader of Takhar had switched phones and adopted an alias when in fact the phone they tracked in order to locate the target and execute the strike was still in the hands of its original user, a former Taliban figure well known in democratic Afghani politics (Clark 2011, 2).

The U.S. military have rejected the claims that this strike was a catastrophic case of mistaken identity. Wherever the truth resides, Clark's detailed investigation shows both that it is widely held to be so in Takhar province and in Afghanistan more generally, and that "technical intelligence" from phone tracking was central to the special forces operation. The phone tracks are an important part of what is known as "pattern of life" analysis used across the drone operations of both the U.S Air Force and the Joint Special Force operations they are involved in and by the C.I.A's targeted assassinations in northern Pakistan and elsewhere. A person's activities, associations and electronic communications with others can be compared against a "normal" civilian set of routines and social exchanges for people in the surveilled territory in order to identify unusual "patterns" or associations. Such abnormal patterns indicate potential targets for further monitoring or possible assassination. The individual identified with such a pattern may find themselves graduating from the database of potential targets—the "Disposition Matrix"—to becoming a "nomination" on the "kill-list" under consideration in the Pentagon and ultimately by the U.S. President (Becker and Shane 2012).

It has been claimed that strikes based on pattern of life analysis represent a significant component of drone-based hunter-killer attacks on individuals who are only known as potential threats through a process reliant on software-based analysis (Becker and Shane 2012, 16). These targeted individuals no longer need to be identified except as a certain kind of deviation from a norm established through the statistical modelling of sets of data drawn from full-spectrum monitoring of the battlespace. Their names and lived reality are less relevant than this conceptualization of them as potential threat known as a "signature target" as opposed to a "personality"—the signature refers to the particularity of their abnormal data pattern

of movements, habits and web of associations that marks them as threat (Becker and Shane 2012, 18).

In their "anonymity" and "abstraction" the signature targets "are ghostly traces of the target signatures that animated the electronic battlefield" of the Ho Chi Minh trail (Gregory 2011a, 13). Moreover, they register the systemic transformation of this Vietnam era experiment in remote warfare: from a dynamic targeting procedure responding to "signature" analog traces of the movement of (presumed) enemies, to the programmatic generation of a pattern from data processing that is used to produce the targets *in advance of their threatening movement or action*. As Chamayou notes this technical procedure instantiates a promise to "predict the future and be able to modify its course through preemptive action" (Chamayou 2013, 66).

The simulational character of this procedure is striking. It repeats the rationale offered for SIMNET's development in the 1980s as a comprehensive, computer simulation-based training system enabling a precocious mastery of the contingent complexity of future conflict: to use history to anticipate and prepare for the future. As Lenoir and Lowood demonstrate, the networking of military simulation enabled the collective training of joint force elements in a distributed but unified battlespace based on detailed archives of terrain, military units and prior operations. SIMNET developer Jack Thorpe expressed the desire to make an interactive training vehicle that would use history to prepare for the future (Lenoir and Lowood 2005, 19). In analysing these SIMNET developments in *Gameplay Mode* I posed a question about the effect of this modelling of the terrain and the enemy and its future impacts on battlespace. Lenoir and Lowood had already indicated that simulational systems were finding their way closer—in both spatial and temporal terms—to ongoing operations through battlefield-deployment of systems aiding tactical planning (Lenoir and Lowood 2005, 20). In this regard I would say that the emerging practices of increasingly automated and schematic generation of targets represents a radicalization of this preparatory logic that drove simulation ever closer to the conduct of war. The modelling of the enemy as a set of behaviours is no longer limited to the realms of a hypothetical operational scenario—however close its correspondence to envisaged operations. This modelling of enemy-as-pattern is now performatively rather than hypothetically enacted in targeting decisions. The anticipatory impetus of simulational technologies have overtaken the very processes spawning military actions in a creeping barrage of increasingly automated data-scraping and scenario modelling.

In a similar manner the digital simulation of space supporting the planning of attacks has found its way out of the hypothetical mode of simulation with the digital implementation of "joint fire areas" or what were known as "kill-boxes." These are names for a procedural designation of physical space enabling the coordination of elements engaging targets within a specified area that is both temporary and scalable according to the nature of the target and the conditions and constraints of the operation. As Chamayou explains, the killbox describes a process as much as a space: "one opens, activates, freezes and then closes a killbox" (Chamayou 2013, 83). The killbox is a zone of temporarily and flexibly realized virtual space: virtual inasmuch as it comes into existence digitally thanks to the realtime technologies of modelling, monitoring, measurement and transmission. It puts into practice the redefinition of traditional geographical and strategic-political territory projected in the theory of battlespace. Killboxes can in principle (and in their virtuality as digital diagrams) be opened anywhere in the world, and be as small or as large as required, rendering irrelevant traditional geopolitical limitations such as national borders, city walls, and

geophysical boundaries such as mountain ranges, rivers and so forth. Chamayou speaks about the killbox's combination of precision measurement and flexible delineation enacting a dual principle of the "globalization and homogenization" of space (Chamayou 2013, 86).

It is in the technological implementation of procedures such as the killbox (and its more recent iteration as the "joint fire area") that the redefinition of the theater of war as "battlespace" is concretized in the manner of the technical object: that is, as the ongoing materialization of a tendency that demands critical-theoretical as well as legal-humanitarian attention.[17] This is made clear in the history of the "killbox" concept that Chamayou dates to a 1996 U.S.A.F report scoping the future use of unmanned aerial vehicles in zones of "autonomous operation" (Chamayou 2013, 326). Today's remote operations involving UAVs are semi-autonomous, requiring the coordination of teams across the globe. They employ a virtualizing principle and procedure, by which I mean a mediation of space and time via an interface that translates and transacts actions back and forth between actual and virtual, physical and digital. "Classic" questions of digital technoculture concerning the impact of realtime communications and telepresence on subjective experience, cultural identity and social-political structures are posed by the virtualization of missile strikes in a way that brings into focus the long history of the military motivations of technological and techno-scientific advances.

The drone is, in this regard, a materialization of the tendency to fashion an artifactual warrior identified by Onians in ancient Greek philosophy, literature and material culture. As weapons system it repeats the contradictory, dualistic treatment of the citizen-soldier in the origins of Western democracy—the composition of political subject and pure object of the State's strategic-political will is mirrored in the virtual, globally distributed composition of the military personnel with the drone weapon platform. If the seeds of democracy are to be found in the warrior's negotiation of the rights and responsibilities that are entailed in a conditional, intermittent acquiescence to a state of artifactual instrumentality of state violence, however, this was on the basis of his commitment to the life or death stakes of the collective struggle. In drone operations this composition is undergoing a disorienting dis-integration. The tendency is most apparent in the use of drones as both targeting support and target elimination.

The military personnel—at least those "at home" in the U.S. Air Force base in Nevada, or in the strategic command centers far from the drone in flight over its target—are still part of the military machinery but less as warriors than operators of a technological system for the preemptive resolution of environmental problems that threaten to impede its effective functioning in coordinating its many elements in the global battlespace. Tensions within the U.S. military evidence this ambiguous status

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[17] The human rights and legal challenges to the expansion of targeted assasinations by drones and U.S. special forces has focussed on the way they abandon the legal and conventional delimitation of the theatre of war as they identify and pursue targets in the "global battlefield". See for example, Human Rights Watch (2010) and Stanford International Human Rights & Conflict Clinic and the Global Justice Clinic of New York University (2012). War becomes a "manhunt" in Chamayou's thesis, conducted by the hunter on the basis of a unilateral claim to the right to pursue a suspected threat to the homeland or its citizens anywhere it can be found (Chamayou 2013, 107-108).

of the drone operators in Nevada.[18] At the same time, as Gregory has shown, their virtualized spatiotemporal involvement in joint operations via video feed with forces on the ground, voice communications and chat windows can involve them intensely and intimately in a vicarious experience of the warrior's exposure to risk (Gregory 2011b, 198ff). Those who suffer psychologically from this unprecedented involvement and experience of the carnage of industrial, hi-tech killing have stretched the boundaries of the definition of post-traumatic stress disorder in that exposure via proximity to the risk of death is a central diagnostic criterion (Chamayou 2013, 155). The contradictions multiply.

Conclusion

The tendency of this materialization of a digitized, preemptive modelling of global "problem space" is toward an automation of lethal robotic systems. Its proponents, such as the controversial AI scientist Ron Arkin, suggest that this would resolve the various legal and practical contradictions of virtualized war through automation of both the deliberation and execution of the preemptive processing of the enemy. Advances in AI would deliver a superior application of rational decision-making better equipped to function in the extreme circumstances of life-or-death conflict than human consciousness with its emotional and instinctual baggage (Arkin 2010). Arkin's claims for AI capable of making correct and ethical combat decisions is echoed in scoping documents such as the U.S. *Air Force's Unmanned Aircraft Systems Flight Plan 2009-2047*. The vision of a "path to autonomy" is clearly mapped out, where robots will conduct operations supervized by personnel "on the loop" rather than in the loop, once "legal and ethical questions" have been resolved by "political and military leaders" (United States Air Force 2009, 41).

This promise of the future of automated global warfare bears something of the transcendent, universalizing ambition of the Pythagorean incorporation of military procedures and principles in the pursuit of a *kosmic* harmony of close-fitting and well-ordered elements. A confidence in the future technological realization of the mathematical incorporation of the world in a system of global monitoring and preemption of rationally identified and precisely actioned anomalies is to be expected in the rhetoric of its proponents and those hoping to advance the fields of AI and robotics to support its implementation. The technical realization is, however, never only an instrumental process of approximating some transcendent, mathematical ideality. The "legal and ethical questions," and with them techno-cultural and political implications of the pursuit of such a trajectory from remote to automated war will inflect and detour the flightpath to autonomy. It is already doing so. The technical and conceptual composition of the West's globalizing future course is already materializing what Virilio thematized as a paradoxically essential accident of the Cold War effort to impose a global system of military oversight ensuring the anticipation of security threats (Virilio and Lotringer, *Pure War*). This accident is the emergence of a generalized counter-tendency toward an insecuring of territory, both in the homeland and in the distant border zone of what was the global chess-game of the nuclear superpowers. This insecuring undermines the ostensible Western geopolitical program of the spread of stable, democratic government, material security and economic development, individual liberty and rights.

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[18] Chamayou discusses the controversy over a proposition to award service medals for "bravery" to drone operators (Chamayou 2013, 145).

Today these "global borderlands" undergo a post-Cold War continuation of these efforts to secure the territory. The accident continues to unfold beyond the end of the nuclear standoff through the technoscientific tendency to pursue what Virilio characterizes as an ever more extreme and nihilist projection of a computerized, ubiquitous, realtime, automated integration of the social and political realms within a closed, militarized world order (Virilio 1997, 167-172). In a similar vein Gregory proposes that the military adventures in remote counter-insurgency at the borders of the West's zones of control in Afghanistan and Pakistan will produce a "vortex": "If the battle space is now global, and if the United States claims the right to use lethal force against its enemies wherever it finds them, then what happens when other states claim the same right? And when non-state actors possess their own remotely piloted aircraft?" (Gregory 2011a, 15).

Chamayou captures best, perhaps, the systemic dimension of this contradictory production of the very opposite of the secured geo-political world future projected with and through the current deployments of drones. He criticizes the remote conduct of counterinsurgent operations, citing military strategist David Kilcullen's condemnation of these as the misuse of an effective tactic that threatens the very strategy of counterinsurgency inasmuch as this depends on the building up of relationships and sympathies between armed forces and local inhabitants on the ground (Chamayou 2013, 100-103). Chamayou sees here the victory of an anti-terror doctrine over a counterinsurgent one. Moreover "dronified anti-terror" can be understood as employing a perversely strategic logic whose pursuit implies its own failure as strategy. The fact that drone operations tend to produce the conditions for the recruitment of more radicalized extremists—the core of the counterinsurgent strategists' critique of their use—becomes the rationale for their expansion and technological "improvement." The system incorporates its inherent contradiction in what Chamayou characterizes as an "endless spiral" that is unable to "decapitate the Hydra that it itself permanently regenerates by the productive effects of its own negativity" (Chamayou 2013, 108).[19]

As in Newsgaming's elegant and prophetic critical game, *September 12th: A Toy World* (Newsgaming 2002), the remote eradication of targeted terrorist threats is also the guarantee that the threat in general is never eradicated—in fact it is central to the systemic perpetuation and exacerbation of threat. In this critical simulational intervention in the post 9-11 context of renewed military mobilization in the U.S., the player's only move in response to the appearance of terrorist icons moving amongst the general population of a generic Middle Eastern town is to launch a missile from her aerial (drone-like) perspective. The missile destroys terrorist and civilians indiscriminately, however, and the more strikes the player orders the more terrorist icons are generated.[20]

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[19] Chamayou cites another commentator on military strategy, Joshua Jones in this regard. Jones likens the drone operations aimed at tallying up lists of eliminated terrorist threats to the failed "body count" strategy in Vietnam, saying that "the kill list never gets shorter, the names and faces are simply replaced" (Jones 2012).

[20] *September 12th* can be played on Newsgaming's website at http://www.newsgaming.com/games/index12.htm. Among others, I have written about the eloquence of its "procedural rhetoric"—to cite a term from one of Newsgaming's founders, Ian Bogost's analysis of the critical potential of ludic and simulational forms (Bogost 2007). See Crogan (2010), 146-148.

Playing *September 12th* quickly evokes the sense of the paradoxical counter-productivity of pursuing such a military-technological approach to global terrorism that one gains from reading the more substantially elaborated figurations of Chamayou's spiral and Gregory's vortex. These geometrical figures trace the uncertain future of a Western technocultural tendency whose envisaged automation of security within a digitally integrated, virtualized spatiotemporality is anything but assured. Instead of securing the global borderlands the projected implementation of a mathematically conceived and regulated *kosmos* will make everywhere a borderland of uneasy transactions between the virtual and the physical, the simulated and the actual, the state of war and the state of peace, the "life worth living" and the anomalous pattern of life.

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