

Weapons for Strategic Effect

How Important is Technology?

Colin S. Gray

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Air University
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**Weapons for Strategic Effect:
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Disclaimer

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Preface

I am grateful to Grant T. Hammond, Director of CSAT, for the opportunity to serve as a Visiting Fellow in 2000-2001 and to contribute this Occasional Paper. Given the technical focus of most of the Papers, I thought it would be useful, by way of some contrast, to offer a wide ranging exploration of the relationship between technology and war. The paper draws upon several research efforts which have yet to see the light of day in published form. Most especially, the paper draws upon the theory and historical case studies developed in my forthcoming book, Strategy for Chaos: RMA Theory and the Evidence of History. Also, I have drawn upon my contribution (“Fuller’s Folly: Technology, Strategic Effectiveness, and the Quest for Dominant Weapons”) to an as yet unpublished collection of essays, A.J. Bacevich and B.R. Sullivan, eds., The Limits of Technology in Modern War.

The central organizing idea behind this paper is that technology and war (or, indeed, peace) are linked by the consequence that we understand as strategic effectiveness. Technology in weapon systems, and in other military machines as well as in relevant a civilian systems, delivers its payoff in the effectiveness secured by the threat or use of force for the purposes of high policy. The playing field is strategic behavior and technology is just one, albeit a necessary one, among the players that collectively deliver the result.

I. Introduction

There is no doubt that technology is important in war. While it is difficult to identify major security issues for which technology is not important, determining just how important is another matter. Despite a consensus on the salience of technology, there is little agreement on just what that means for strategic behavior. Following in the footsteps of Clausewitz, this monograph seeks to contribute to the general “theory [which] should cast a steady’ light on all phenomena so that we can more easily recognize and eliminate the weeds that always spring from ignorance; it should show how one thing is related to another, and keep the important and the unimportant separate.”¹ Just how is one thing—technology—related to another—strategy? As Clausewitz stated: “[i]t is the task of theory... to study the nature of ends and means.”² Just how is technology—the means—related to strategy—the ends?

The justification for this paper lies in the frequency with which the ends and means of strategy are either confused or reversed and in the need for some judicious removal of the weeds of ignorance. As with doctors, strategic theorists should be subject to the injunction that if they cannot help resolve a problem they should at least, “first, do no harm.” Alas, such is not always the case. Strategy is both art and science and essentially a creatively adaptive behavior that cannot really be taught. But careful study of “how one thing is related to another” should enhance the quality of strategic performance.³ Of course, being creatively adaptive may not suffice either, as both Ludendorff and Hitler demonstrated in the last century.⁴ In both instances, they committed fatal errors that flowed from the failure correctly to “study the nature of ends and means.”

The purpose here is to clarify what can be clarified. That is easier stated than accomplished. First, some truly key concepts are in dispute. These include the nature of man, the nature of war and the very concept of the popular notion of a revolution in military affairs (RMA). Second, because strategy is always “done” at a particular time and place, the strategy theorist may be ambushed by history in overextending an insight from one time and place to another. The analysis in this paper strives never to forget that the strategic theory that does not work in detail in the real world of strategic behavior cannot be sound theory. Bernard Brodie,

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the greatest American strategic thinker of the nuclear era, advised that strategy “is nothing if not pragmatic...above all, strategic theory is a theory for action.”⁵ Clausewitz, as usual, had proffered the same advice 140 years earlier. “Just as some plants bear fruit only if they don’t shoot up too high, so in the practical arts the leaves and flowers of theory must be pruned and the plant kept close to its proper soil—experience.”⁶

The principal title of this paper asserts both the logical dominance of strategic consequences over the tools of war, and refers to the ill-understood, but necessary, truth that all weapons have strategic effect. It is inherent in the nature of their function. The question in the subordinate title uses technology as a metonym for the weapons systems with which we fight. It subsumes those weapons, the machines of all kinds that support them, the relevant technological know-how and industrial skills that produced them and the science behind it all. “Technology” is thus a convenient shorthand for this hugely complex system.

The relationship between technological means and strategic effect is explored in two chapters that focus on topics of ascending specificity. Chapter II, “Technology and War”, probes the implications of technological innovations for the nature and conduct of war. It examines the synergism between Man and his tools (of war), and explores the idea that much of what Clausewitz understood by chance and by his compound mechanical concept of “friction” can be lifted by technological enlightenment. Chapter III, “The RMA and All That”, tackles the broad question of change in strategic history, and considers RMAs as strategic behavior. The concluding chapter answers the question, “how important is technology” in war and strategy? It may be useful to sound a warning note in order to help prepare readers for what follows: “if technology is the answer, what was the question?”

II. Technology and War

Change in military affairs is as unarguable as its meaning can be obscure. In only fifty years, from 1910 to 1960, the striking power of warships increased from c.10 to c.1,200 miles (i.e., from Dreadnought to Polaris).¹ But, did that mean that navies were much more powerful in 1960 than 1910? Courtesy of mutual deterrence and competition from land-based missiles and aircraft, such a claim would be hard to sustain. If fifty years is all but an eternity in modern times, so too is the period between the beginning and end of a single war. The contrast between the French regiments that marched behind hands and unfurled flags to open the attack in Lorraine in August 1914, and the warfare by combined-arms combat teams characteristic of combat in the fall of 1918 (by all the players on the Western Front, save only for the Doughboys of the American Expeditionary Force) was huge. Innovation, though varied in pace and effectiveness, is both usual and expected. Chapter III explores some contending theories about possible patterns of change in strategic history. Here in Chapter II, however, we examine some arguably constant (or, very slow to vary variables) elements which bear hugely upon the meaning of technological innovation in relation to war. These arguable constants are the institution war itself, human nature, and chance.

A Matter of Definition

Let us not mince words, war is organized violence for political ends. Those political ends can encompass a wide range of benefits among different eras and cultures, but they all can be corralled by Harold Lasswell's classic statement that politics is about "who gets what, when, and how."² Admittedly, there are discomfort zones where war appears to merge with crime and even sport and entertainment. As a spectator sport, war (even surrogate war, as with gladiatorial combat) has always been extremely popular. We humans find violence exciting, while war as spectator sport is agreeably safely exciting.³ Clausewitz tells us unequivocally that "all wars are things of the same nature."⁴ And what is that nature? It is, we are advised, "an act of force to compel our enemy to do our will."⁵ Also, according to Clausewitz' famous dictum, war has its only source in politics and "is simply a continuation of political intercourse, with the addition of other means."⁶

But what is war like? What distinguishes it more or less clearly from

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all other human activities? Again, our Prussian mentor said it best. “The decision by arms is for all major and minor operations in war what cash is in commerce.”⁷ Benjamin Lambeth reinforces Clausewitz when he writes: “Air power is a blunt instrument. It is designed, at bottom, to break things and kill people.”⁸ No less brutally, or accurately, Williamson Murray observes that “in the final result military organization are paid to kill the enemy in as effective a fashion as possible.”⁹ The threat and use of force, organized violence, for reasons of policy (be they dynastic, religious, spiritual - e.g., honor - or material), applied by contending political wills, is the very nature of war. It is the organization of violence that defines war, not the reasons of policy - provided the reasons are broadly political. After all, those reasons of policy prescribe peaceful intercourse most of the time.

War should be defined as a particular institution which is, at least logically, functionally instrumental. It is not the only functionally instrumental institution that secures policy ends. Diplomacy, economic statecraft, cultural subversion, and political warfare, are all, in theory, alternatives (or complements) to war. They are, however, different from war. The reason for risking belaboring the simple point that war is war, regardless of time, place, belligerents, or technology, is because many American commentators of recent years have asserted otherwise.¹⁰ The matter is not easily researchable, but there are many instances where theorists appear only to be guilty of the misdemeanor of conceptual carelessness, rather than the felony of conceptual error.

Why should it matter whether commentators confuse change in the character and conduct of war with change in war’s nature? The answer is that this confusion encourages belief in a myth of transformation. The myth at issue here is the conviction that the human conditions in world politics as we have known it is in the process of being transformed into a context beyond war (at least, war as we knew it).¹¹ This is somewhat reductionist, because the relevant myth comes in several well nuanced variations. Some People deem “major war” to be obsolete, or obsolescent, while others, uncomfortable with the “major” ascription, prefer to argue for the atavism only of inter-state war.¹² Less root-and-branch in their expectation or affirmation of change, though scarcely more plausible, are those who discuss a transformation in war rather than from war.¹³

It is tempting to dismiss claims that the nature of war is being changed by an information-led RMA as nothing more significant than loss

of semantic discipline. The misuse of “strategic” is disturbing, because such misuse suggests that the offender is confused about means-ends relations.¹⁴ Just as we are obliged to live with defense debate which routinely misuses “strategic” perhaps we should roll over without complaint when commentators claim that the contemporary RMA (whichever one or ones they happen to endorse) is changing the nature of war. However, and partly out of respect for the late Carl Builder, who wrote most tellingly about the need to keep “the strategic flame” burning bright,¹⁵ someone should blow the whistle on conceptual nonsense.

War does not and cannot have several natures. In the heated theological debates of the fifth century, in particular, the ever arguably dual nature (divine and/or human) of Christ was earnestly disputed.¹⁶ RMA theorists today tend to be less sophisticated and competent in logic than were fifth century theologians. Many of the more excited among the RMA literati assert—they can hardly argue—what would be a miracle were it true, or even merely plausible. Specifically, we are told that there is a change underway (or completed, or pending, or imminent, or probable, or possible—take your pick) in the nature of war.

The small problem with this claim is that it is literally impossible. Experts of equivalent competence can disagree about the pace or direction of change in the character and conduct of war. Furthermore, they can dispute whether or not war as we have known it is looking increasingly like yesterday’s poor solution to yesterday’s problems. But, they cannot logically disagree over the hypothesis that war is changing its nature. If war could change its nature, such a miracle would be akin to a dog becoming a cat, or - dare we venture the metaphoric analogy - a human being becoming a machine (or vice versa). If war changes its nature in response to challenges from technological and other conditions, then it becomes something else. Plainly, there are three classes of difficulty with an RMA debate that asserts change in war’s nature: empirical, logical, and semantic.

The damage to understanding wrought by this error can be insidiously pervasive, even when the mistake is casually inadvertent. Because we are prisoners to the words we use and the concepts we wield as tools, unchallenged and soon habitual reference to change in the nature of war cannot help but encourage exaggerated expectation of irreversible transformational change. If we strategic theorists are to mind the store of conceptual tools responsibly, we must try to insist that commentators say what they mean, and that they say it in ways that are literally meaningful.

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It is difficult to engage in debate over chance in strategic history, even more narrowly over the utility of rival RMA theses, when the conduct and character of war are hopelessly confused.

Lest the argument presented here be accused of a trivializing circularity, we must hasten to add that the empirical, logical, and semantic issues are clear and distinguishable. Far from being a necessary, and therefore trivial logical truth that war as defined here must always be with us, we can imagine an historical era wherein war—organized violence for political ends (power)—truly is *passé* in practice as well as in law and morality. However, we are unconvinced that such a happy time is at all likely to arrive in this Twenty-First Century. That is an empirically-based judgment. In summary, war can change its character cumulatively and radically. It could cease to function as an intended problem-solving institution (of last resort); but it cannot possibly change its nature, because in that event it would be transformed into something else.

If, as this author believes, the institution of war is, alas, likely to have as healthy a future as a past, what is the most important factor driving that pessimistic conclusion? To parrot the old adage, we have seen the enemy and he is us. The core subject for strategic study has to be mankind.

We are the Problem

From TNT, through machine guns, “strategic” airpower, nuclear weapons, to the internet, the latest marvels of technology have been hailed as the deus ex machina (and almost as machina rex et deus) which should banish the scourge of war. Unfortunately, thus far at least, technological innovation has proved effective only in solving or alleviating war’s contemporary technological problems. Man’s propensity to engage in organized violence for political purposes - which is to say, to wage war - has no more been suppressed by the latest machinery of death than it has by the burgeoning tools of communication. To be fair, the war-prone condition that appears broadly indifferent to technological change, also has proved substantially impervious to the ministrations of international law and organization. The record is by no means all black, of course. The nuclear revolution certainly caught the attention of potential belligerents and helped induce caution in military practices and conservatism in statecraft.¹⁷ Nonetheless, it is a continuing fact that the United States has nuclear war plans which, albeit highly contingent, include attack options designed to do more prompt and delayed damage to the foe than any polity

has inflicted in modern history. Even today, nearly a decade after the fall of the “evil empire” of the Soviet tsars, the United States is prepared, if necessary, to wreak such havoc upon Russia, or China, or both in concert, as to make the Third Reich of May 1945 look like a holiday camp by comparison.

The point to emphasize is not that the United States (et al!) is wrong, morally or practicably, to maintain a fearsome nuclear capability. Indeed, it is not wrong. Rather the point is that even today’s casualty-averse and ever more politically correct American society is comfortable enough living with a nuclear basis to its national security. Social learning—or culture, if you prefer—and technological conditions may appear to effect great changes in Man, but a closer look at the historical record tells a different tale. Sensitive people in the West today are apt to be appalled by the gruesome detail of slaughter lovingly provided in the most violent work of popular literature ever composed, Homer’s *Iliad*. The almost mechanistically brutal hoplite combat of Greece’s “golden age” is more appalling still.¹⁸ However, although the abattoir-like features of ancient Greek battle suitably shock our civilization, it can seek solace in the comfort of historical distance. More puzzling than the willingness of Greek heroes, and ordinary citizens tactically obliged to behave in the phalanx as if they were heroes, to engage in brutality for a couple of hours at a time, was the endurance of modern citizen armies through more than four years of war from 1914 to 1918.¹⁹ As if 1914-18 were not had enough, the War to End All Wars transpired to be but round one of a new Thirty-Years’ War. We completed the Twentieth Century with a third great global conflict. Readers can choose whether they are more impressed by the Cold War’s virtuality, or by its potential for limitless catastrophe. For the best and worst of reasons modern, indeed contemporary, Man has been able and willing to kill his own kind on an industrial scale.

At no little risk of incurring hostility from readers encultured to be generally optimistic about the course of history, this theorist must affirm the conviction that in human affairs little changes. Those who would study the past in order better to understand the present, could just as well study the present in order better to understand the past. *Plus ça change, plus c’est la même chose*. Although the forms of war alter with political and social organization, and certainly with technology, inter alia, the driving motives do not. If we see ourselves, as we should, in “the Western way of war” as invented in Ancient Greece, we should see ourselves also in the

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causes of war identified by Thucydides. “Fear, honor, and interest” comprises as satisfactory a general explanation of modern war and defense preparation, as it does for like activities in earlier times)²⁰

Although war is fraught with problems with a technological dimension, the institution of war is not itself a technological problem. That fact happens to be deadly for the utility of negotiated arms control regimes.²¹ To control arms we need to control the demand for arms, and that demand flows from some mix in Thucydides’ formula of “fear, honor, and interest.” Four generations of scholars, over eighty-plus years, have assaulted the world’s forests in covering paper with well-intentioned speculation on the causes of war(s) and the conditions for peace. No advance worthy of theoretical or practical note has been secured over Thucydides.²² If good intentions, sophisticated methodology, and bold speculation could crack the conundrum, truly war would be yesterday’s nightmare.

A part of the problem is that war is not all nightmare. Usually, it is undertaken for at least some sensible, even noble reasons, while the worst of circumstances does bring out the best of behavior in some people some of the time. Naturally, all too naturally, war also provides license and opportunity for the worst of behavior. Whatever one makes of his raft of strong opinions on a wide range of security topics, Ralph Peters, more than others of recent years, comes close to targeting the proper enemy. He writes:

Our enemies of the future will be enemies out of the past. As the United States armed forces put their faith and funding behind ever more sophisticated combat systems designed to remove human contact from warfare, mankind circles back to the misbehaviors of yesteryear. Technologies conic and go, but the primitive endures. The last decade of this millennium has seen genocide, ethnic cleansing, the bloody rending of states, growing religious persecution, the ascendancy of international crime, an unprecedented distribution of weaponry, and the persistence of the warrior—man of raw and selfish violence—as a human archetype. ...We must study the minds and souls of violent men, seeking to understand them on a level our civilization has avoided for 2,000 years. We can no longer blame atrocities and the will to violence on the devil, or on mistaken ideologies, or even a childhood

deprivation. None of the cherished explanations suffice. In this age of technological miracles, our military needs to study mankind... The heart of the problem is not the weapon, but the man who builds and wields it.²³

With those words Peters sinks much of the desperately irrelevant arms control experience of the past century. Efforts to legislate peace by control of the weapons which express human antagonism proved as misguided in great power relations in the 1920's and '30's,²⁴ as they are failing again today in Northern Ireland. The problem, or condition, of the ever-changing institution of war is worse even than Peters allows, War is possible not so much because there are socially misfitting "rogue warriors," though such certainly exist (if not abound), -but rather because a very large fraction of Mankind - or, ironically, humanity - contingently is willing to take up arms and to kill. Modern technology, with its expanding horizon of the feasibility of reaching out to damage someone - albeit often precisely - does nothing to help banish war.

When technology poses all but intolerable risks and costs, even to the (Pyrrhic) victor, it is in the nature of strategic affairs for people to seek competitive solutions to the actual or impending stalemate.²⁵ "Modern warfare" was invented in 1916-18 in an only partially successful effort to resolve the paralysis consequential upon the fruits of pre-war civil and military developments.²⁶ The solution was found in a combined-arms style of combat keyed principally to technological improvement in artillery, and to new, or revived, tactical skills on the part of assaulting infantry.²⁷ The tanks and aircraft of 1918 were useful, but no more than that. For a more recent case, when the technology of the nuclear age denied the Cold War superpowers the practical option of grande guerre, they—the United States in particular—sought to escape paralysis by the invention of "limited war in the nuclear age."²⁸

In common with global weather, the dynamics of war are so complex and chaotic that they resist comprehensive understanding. It should be needless to add that human dimension of war imposes extraordinary complications for research and policy which the natural realm cannot begin to match. Many scholars, commentators, and policymaker either ignore or neglect the point, but the social sciences are systematically more difficult than the physical sciences. For example, on the one hand, buildings and hillsides may be unstable, but tint instability should be approximately calculable, even if non-linearity is possible. On the other

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hand, the political relations which determine decisions for war and peace, as well as price movements in financial markets, float along axes according to beliefs and sentiments which defy predictable calculation. Two generations of American defense analysts (this author included) were raised on the RAND Creed of rationally calculable Strategic Stability: I believe in invulnerable strategic forces, in the strategic forces triad, in quantifiable cost-effectiveness..., and so on. What the intellectually dominant RAND school of national defense analysis attempted was the reduction of the all too humanly political possibility of war to an economically rational engineering challenge.²⁹ Apply the principles of strategic stability to the Soviet-American strategic relations and, *ceteris paribus*, peace with security should be assured. This, as Ken Booth noted insightfully in 1974, was a vision of a “technological peace.”³⁰ Get the force structure right (enough), comport ourselves prudently and responsibly in rational strategic behavior, and all should be well.

It is entirely possible that the American theory of strategic stability for stable deterrence, though well intentioned and notably rational, may have been thoroughly misconceived. The theory, and the policies it inspired and explained, was painfully bereft of human and political content. Even if policy is largely explicable with reference to *raison d'état*, that *raison* should include the Thucydidean factor of honor/reputation, and ought to recognize that the political velocity of policy is very much a matter of human volition. People who do not understand this point are vulnerable to the dangerous fallacy that deterrence is, or can be made, reliable.³¹ It is the same mentality which is willing to believe in unsinkable ships, thoroughly safe sex, and which finds no discomfort in the ridiculous concept of the foreseeable future.

Much of the literature on the causes of war is as misconceived as consequentially it is unhelpful. Kenneth Waltz's classic study of *Man, the State, and War*, is a superior holistically inclusive enquiry. It recognizes the traffic among three levels of analysis—Man, the internal political arrangements of states, and the system or (anarchic) society of states which we would call world politics. Waltz concludes persuasively as follows:

The third image [the system of states] describes the framework of world politics, but without the first and second images [respectively the behavior of Man and the

domestic character of states and societies] there can be no knowledge of the forces that determine policy; the first and second images describe the forces in world politics, but without the third images it is impossible to assess their importance or predict their truth.³²

The problem, or condition, of war-proneness is structurally too complex for developments in a single relatively simple dimension, the technological, to have profound implications. Man is a social being and as such cannot sensibly be considered as having a nature other than a social one. The Greeks took this point to the extreme with their belief that civilized life, indeed meaningful existence, was possible only through membership of a *polis*, with its balance of rights and duties. The arguable assertion that is the title of this section - “we are the problem’s - might be improved if amended to read, “Man in Society is the Problem”. But Man is always, and inalienably, in society.

Recent scholarship on “killing” is interesting and more than a little contradictory. Joanna Bourk’s selectively anecdotal study of face-to-face killing yields the unsurprising conclusion that many psychologically apparently unremarkable people can come to enjoy, certainly to tolerate, killing.³³ By way of some contrast, Dave Grossman’s rather more rigorous review of the same terrain emphasizes the challenge posed by, and the costs of, the need so to brutalize ordinary soldiers that they will kill when it is militarily necessary for them to do so.³⁴ This exploration of the relations among Man, technology, and war, points to three broad conclusions relevant to the on-going debate about the implications of technological innovation for the future of the institution, and character, of war.

- New technologies, even when packaged for effectiveness with appropriate changes in military organization, ideas for operations, and forces, must encourage strategically’ competitive responses from abroad.
- The forms that war can assume are all too richly various. As Clausewitz stressed, “[w]ar is more than a true chameleon that slightly adapts its characteristics to the given case.”³⁵ In other words, as one style of war becomes obsolete, so another will replace it. Moreover, many different styles of war will remain effective, only in

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different geographical and geopolitical contexts. The U.S. military that may need to help protect Taiwan from an armed missile attack, *inter alia*, also may have to be prepared to wage classic air-land combat to seize ground. Or, it may have to fight its way, block-by-block, through some African, Asian, or Latin American city and to police a patched-up quasi-peace in some multi-ethnic disaster zone.

- Whatever we may think (If some of the fine print of Daniel Goldhagen's analysis (If German anti-semitism, the title of his book about *Hitler's Willing Executioners* does point to a troubling, unarguable truth.³⁶ It is incontestable that the German Army and, ergo, much of German society, was massively implicated in the conduct of the Holocaust, as well as the murder by neglect of millions of Soviet POW's.³⁷ For reasons that seem good enough at the time, most of us condone killing on our behalf, and similarly most are prepared to participate in acts of violence for reasons of state (and even to enjoy it). Make of this what you will, but it is a fact.

A Chaotic World of Chance?

If the nature of war and the human factor effectively are constants, what is the historical domain of Clausewitz's argument that "[w]ar is the realm of chance?"³⁸ Was he correct in his claim that "[n]ot only it's objective but also its subjective nature makes war a gamble"?"³⁹ Contra Clausewitz, is it possible to believe that uncertainty in war is a highly variable characteristic governed in good part by the technical competence of belligerents? 'The latter postulate is advanced today by Admiral William Owens as a consequence of his claim that the computer revolution enables us to lift the fog of war. Is it possible that Clausewitz mistook a passing condition of technically imposed ignorance for a systemic truth about war? Notwithstanding some minor genuflection in recognition of the complexity of the subject, Admiral Owens' advocacy of a computer-assisted RMA points "to the profound transformation of warfare itself that is taking place before our eyes."⁴⁰ While not strictly challenging the nature of war as we have defined it here, nonetheless Owens is portraying a vision of (hopefully) U.S. military effectiveness resting upon near-perfect real-time information in a theater of operations (at least, in a battlespace 200x200 miles in area). Owens' RMA looks to U.S. ability to turn any extensive battlespace into a shooting gallery wherein all but invulnerable American military personnel would teach

malefactors the evil of their ways by long-range precision bombardment.

Although discussion of the RMA hypothesis per se is deferred to Chapter III, here it is necessary to flag our conviction that no measure of practicable technological change is likely to transform the effectiveness of military power. The reason why Owens' vision of close to immaculate performance by an RMA-led U.S. military has to be vainglorious nonsense can be summarized generically as all those systemic factors in the nature of war as explained by Clausewitz, but which the Admiral ignores. One could critique the Owens story technical item by technical item, as Michael O'Hanlon attempts in a recent study,⁴¹ or - as here - one can identify the deeper reasons for skepticism. Those reasons, generally well treated by Clausewitz, may be reduced to recognition of the influence of Man and his emotions, of war as a struggle between two competing wills, of non-linearity in strategic affairs and of friction.⁴²

War is by no means a comprehensively nonlinear event. Criticism even of Admiral Owens for linearity of vision can be overdone. The chaotic possibilities in war are so ripe, the triggering events and players so unpredictable, that it is illusory to think the fog of war can be banished. New technologies, even when intelligently absorbed into a plausible RMA, are not likely to lessen the gamble inherent in war.

Even if we grant the fairly heroic assumption that 40,000 square miles of battlespace truly is transparent to us alone,⁴³ commanders and politicians still could find many creative ways to snatch strategic defeat from the jaws of what is predicted to be certain military victory. Information usually is useful, but it is not synonymous with power-meaning strategic success properly understood.

For example, in order to stand a chance of winning in Vietnam, USMACV had to be permitted to attempt to effect isolation of the relevant battlespace. This meant that General Westmoreland had to be licensed and armed to fight in the Laotian panhandle so as to close off North Vietnamese access to the South.⁴⁴ It is not obvious that Admiral Owens' RMA could have affected the appallingly incompetent decisions on high policy and strategy made by the Kennedy and Johnson Administrations.⁴⁵ Or, consider the case of the escape of the British Expeditionary Force (BEF) from France and Belgium in May-June 1940. 2000's-style dominant battlespace knowledge (DBK) would have eased some German anxieties in the last week of May, but would not have precluded fatal operational error. The Fuhrer "halt order" of 24-26 of May froze the

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panzer divisions in place just as they were about to pre-empt the BEF's creation of a defensible perimeter around Dunkirk, the last remaining port of evacuation. That order did not stem principally from misinformation. The politically and strategically fatal halt order flowed rather from a combination of Hitler's willingness to entrust the final destruction of the BEF to Goering's Luftwaffe, and his, and much of the military high command's, strong desire to preserve the scarce panzer assets for the impending battle for France.⁴⁶

Although Hitler's decision to halt his panzers from 24 to 26 May 1940 was no less erroneous than was the U.S. decision not to defend South Vietnam in Laos, it was a far more excusable mistake. No-one, the British included, expected virtually the whole of the BEF to escape from Dunkirk, Fuhrer Halte Befehl or not. How the United States could allow itself to fight a war wherein the principal enemy effectively was granted sanctuary beyond a long and rugged land frontier, is a mystery to this author. The point in deploying these two illustrations of error is simply to register the claim that the more modern belligerent (in these cases, Germany and the United States), enjoying many strategic advantages in military effectiveness, is capable of snatching defeat from a reasonable prospect for victory.⁴⁷ That granted, the argument must not be taken too far. Yes, war is a gamble; it is the realm of chance that Clausewitz claimed. Similarly, he was powerfully persuasive when he expounded his theory of friction; the exploration of what it is that distinguishes "real war from war on paper."⁴⁸ Lost orders, heavy rains and mud, sick generals (and troops), solar disturbances - the list is endless of the reasons why "[a]ction in war is like movement in a resistant element."⁴⁹ However, friction impedes all belligerents and war is not only the realm of chance.

For a host of reasons, an army, air force, or navy, may have a bad day, but the "better" army, air force, and navy is going to succeed most of the time. Analogy with the NFL is compelling. "On any given Sunday" any team can beat any other team, but the objectively better teams still win most of their games and make the playoffs.⁵⁰ War is a gamble because there is a legion of interacting possibilities of disaster, great and small. It would be absurd, though, to argue that war is only a gamble: it is not. Armies that are well led, well trained, well equipped, and - no less important - well guided by policy, will be far more effective strategic instruments. Those deficient in some or all of these respects will not. Better technology should aid military effectiveness, which, in its turn,

should improve strategic effectiveness. But even if we ignore the facts that new technology will bring new vulnerabilities as well as advantages, the killer claim against the aspiration for technology to lift the fog of war lies in the scope of the problem. Even though this may be purchased at the near-term cost of less reliability and lower numbers, the strategic problem of effectiveness in war (and in deterrence also) is at least as much a matter of poor political and operational judgment, in the context of a unique enemy with an independent will, as it is of immature technology. Moreover, even when technological innovation is suitably integrated by an RMA, war remains an activity that does not get easier as history moves on.

The focus in this chapter has been on the context for the enduring structure of strategic problems. We have argued: that war does not, indeed cannot, change its nature; that Man is a wholly social species, always liable to fight for reasons of “fear, honor, and interest”; and that the element of chance can never be removed from war, no matter how advanced the technology acquired. The story of technology and war for strategic effectiveness is not, however, strictly a tale of constant factors: far from it. Strategic history offers a kaleidoscope of dynamic technologies, innovative tactical and operational ideas, and changing political and social contexts. More to the point, perhaps, a small catalogue of competing theories is on offer for the interpretation of historical change, past, present, and future. It is to this debate that we now turn.

III. The RMA and All That

The nature of war is eternal, but its character is in perpetual motion at varying speeds. What sense can we make of the occurrence, frequency, and consequences of strategic change? Is there a theory that captures and explains the process of change? The leading answer of recent years is, of course, the idea and theor(ies) of RMA.⁵¹ For the particular purposes of this study, we are most interested in what the RMA hypothesis might tell us about the role of technology in war (and strategy). In order to pursue this matter, Chapter II proceeds by ascending specificity: to examine the origins of the phenomenon of RMA debate; to explore the apparent fit of RMA theory with the course of strategic history; and to consider how RMAs, including their technological elements, function as strategic behavior. The last among those topics is concerned especially to discuss how relative technological advantage and disadvantage can affect performance.

RMA: The Birth of a Notion

Much as discussion of spacepower has been captured since 1983 by the imperial grasp of debate over the SDI and its pale BMD successors, so it has been difficult since 1991 to speculate about the relationship between technology and strategy outside the toils of the RMA hypothesis. It is necessary to protest against the conceptual sway of RMA and its associated ideas, all the while surrendering gracefully to it and making of it what we can.

The history of the RMA concept illustrates the significance of the dialogue between theory and practice for the essentially practical subject of strategy. The intellectual history of RMA has been very much a Soviet story. During the inter-war years V.K. Triandafillov and Mikhail N. Tukhachevskiy pioneered the theory and would-be practice of “deep operations” by fast moving mechanized forces;⁵² in the 1950’s, and early 1960’s, following Stalin’s death in March 1953, previously mandatory faith in the strategic authority of “permanently operating factors” in war was overtaken by a fairly enthusiastic endorsement of a nuclear (and missile-led) revolution in military affairs;⁵³ while the 1970’s and early 1980’s witnessed Soviet speculation about a new RMA keyed to the exploitation of frontier technologies, especially the computer.⁵⁴ There was

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a double historical irony in that, first, the revolutionary Soviet notion of mechanized deep battle was aborted by Stalin's purge of the Red Army in the mid-1930's; the notion had to be survived when applied by the German foe; and was rediscovered and adapted in real time in the later course of the Great Patriotic War.⁵⁵ The second irony was that the third surge in Soviet military enthusiasm for deep-thrusting mechanized campaigning in the late 1970's and early 1980's, following two-plus decades of nuclear-missile enthusiasm, was thwarted by the acceleration of the computer-led RMA. The Soviet concept of deep mechanized operations thus was negated by politics in the 1930's, when it was probably militarily sound. It re-emerged briefly in the 1970's as an arguably effective answer to NATO's nuclear firepower and doctrine of flexible response, only to become instantly obsolescent in the face of Western emerging technologies (ET).⁵⁶

Eliot Cohen, Director of the USAF's highly influential Gulf War Air Power Survey (1993), makes plain the relative tardiness of American adoption of RMA concepts.

Awareness of the Soviet notion of a "military-technical revolution" did not immediately translate into an acceptance of it. Rather, the subject remained confined to a few defense specialists until the Persian Gulf War of 1991 which seemed to some Americans to validate the notion of an RMA.⁵⁷

As the saying goes, the rest is history. What remains, today, is to make some sense of the great RMA debate of the past decade. Whether or not RMA truly is a superior idea, its U.S. popularity in the 1990's probably bore only tangential relation to its inherent merit. To put the matter in comparative context for maximum clarification, Americans in the 1990's found RMA theory as irresistible as did Russians the theory of geopolitics, and for approximately the same set of reasons.

Russian strategic thinkers newly adrift from the erstwhile comforting certainties of a military science guided and legitimized by the organizing tool of Marxism-Leninism, have shifted credo to a new faith in geopolitics.⁵⁸ The American thinkers whose strategic compass no longer had a magnetic north of "dominant threat" (in the USSR), could reorient their attention to the usefully master idea of RMA. This is not to suggest

that geopolitics and RMA are without value as large organizing ideas. Far from it. It is to suggest, though, that each of the two new credos was chosen because it promised to fill a strategic void in ways characteristically attractive to Russians and Americans, respectively.

Geopolitics quintessentially is holistic and even global. It asserts the interconnectedness of many threads and seeks to explain those connections in political terms. Anthropologists tell us that Russia's is a polychronic culture, deeply attached to the idea that in order to explain anything you have to be able to explain everything.⁵⁹ From time to time, understandably suspicious U.S. negotiators have found this Soviet-Russian liking for complexity enormously frustrating. Not infrequently, what we suspected as devious negotiating tactics probably was only the manifestation of Soviet-Russian cultural style. Where Russians tend to be polychronic and attracted to political driving forces, so Americans are wont to be monochronic and to seek out technical motors of change. RMA, though a highly complex notion when viewed properly as strategic behavior, does lend itself to simple monochronic explanation. What could be more American than to believe that "technology rules!" The conceptually imperial notion of strategic change propelled by the engine of technology driven RMAs was just the idea needed to fill the vacuum created by the self-retirement of the Soviet threat. In its Soviet phase, the RMA concept, though keyed to technology, was cocooned in the embrace of the all-encompassing explanatory power of Marxism-Leninism. In its subsequent American phase, RMA is free-floating, bereft of the political or strategic context which yields a pressing purpose.

RMA and the Course of History

Nearly ten years into RMA debate, this may seem a foolishly belated juncture at which to question the fundamental integrity of the concept. By integrity we refer neither to explanatory power, nor to elegant parsimony, but rather to pragmatic fit with the record of the course of strategic history. Is that history plausibly explicable with dominant reference to a series of great discontinuities?

The proposition that from time to time there are radical changes in the character or conduct of war, the RMA hypothesis, is entirely reasonable. The plausibility of such minimalist statement of the RMA hypothesis is, however, easily shaken by more ambitious efforts at definition. The heartland of American RMA theory offers this characterization:

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For the Office of Net Assessment [ONA], a revolution in military affairs occurs when technological change makes possible material, which when combined with organizational and operational change, results in a transformation in the conduct of warfare. Further, what is important is not the speed with which a revolution takes place, but rather the magnitude of the change itself.⁶⁰

The same conceptual school, in and about ONA, has yielded what may be called the founding definition for the American RMA debate. In 1994, Andrew F. Krepinevich wrote:

What is a military revolution? It is what occurs when the application of new technologies into a significant number of military systems combines with innovative operational concepts and organizational adaptations in a way that fundamentally alters the character and conduct of conflict.⁶¹

These are well crafted definitions which carefully eschew technological determinism. That granted, both are egregiously specific. By offending against the principle of parsimony required by William of Occam, they assert as true that which remains to be discovered. Can there be radical, even transformational, change in the conduct of war without the application of new technologies? Moreover, even when new technologies are present, as usually will be the case, how important are they relative to other factors, both those cited and others? It is hard to locate new technology in the Napoleonic RMA.⁶² Moreover, both the new machines in the mechanized RMA(s) of the 1930's,⁶³ and the IT behind the supposedly information-led RMA which arguably laid down a historical marker in 1991, were both dwarfed in relative operational significance by training and tactical combat skills.⁶⁴ This is not to claim that the technology of Blitzkrieg in 1939-41 or of "parallel operations" in 1991,⁶⁵ did not matter. That would be an abstract position. Nonetheless, the defeat of France (and the BEF) in 1940 was enabled by the modern machines which granted the possibility of an operational mobility wholly impracticable for the soldiers of 1918. But it was secured because the Germans were better trained, had the sounder tactical and operational

doctrine, and were extremely lucky.⁶⁶

Some of the dazzle of RMA dissipates when the concept is removed from theoretical discourse and from advocacy-analysis on current defense issues, and instead is introduced to the full complexity of historical narrative, wherein “nothing comes from nothing, nothing ever could”, as the once popular song affirms persuasively. Obviously, there is radical change in the character and conduct of war. But, is it defensible to argue that there has been a series of succeeding, sometimes overlaying additional, historical RMA’s? Furthermore, even if there have been such historically demonstrable “events”, have they been very important - given the multi-dimensional complexity of strategic history? In other words, have well attestable RMA’s, if there be such, shaped the course of (strategic) history? We may choose to be careful in our answers when we consider Charles Tilly’s clever judgment that “war made the state and the state made war” (or was it vice versa?).⁶⁷

A trouble with RMA theory is that, in English parlance, it “over-eggs the pudding”, and it does so at the expense of more mundane ingredients than obviously different technologies. No one should dispute the facts of chance in the character and conduct of war, even of radical change, and occasionally perhaps radical change effected swiftly. However, do those non-controversial facts, which we may choose to equate with historical RMA’s, really help explain very much? On close examination, it transpires that although the RMA ascription can be applied quite plausibly to particular changes in warfare, those changes are far from functioning as independent variables in their influence on the course of events. While it is true that a lead in military prowess should have strategic consequences with practical benefits, no prizes are awarded for the less than brilliant insight that better armies tend to beat worse armies. But this is only if *ceteris* is tolerably *paribus* (e.g., not if there is a huge mismatch in quality of interest, and therefore political will, between belligerents, to the disadvantage of the nominally superior party). Unfortunately for neatness of analysis, only rarely is modern war usefully reducible to an austere contest between armed forces. States, coalition of states, and-above all else - societies, make war. The better army, the German, lost both World Wars, while the nuclear revolution has only modest explanatory power to help reveal the mystery of why the USSR lost the plot in the 1980’s and crumbled precipitately and ignominiously. It may well be true, as Norman Friedman argues, that it was the emerging and anticipated IT revolution

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that proved fatal to the Soviet system.⁶⁸ The reason why he is plausible, though, has politics and society at its core and technology, and technology oriented RMA theory, only as a dependent factor.

A difficulty with RMA theory is that it is so easy to criticize that the determined skeptic is tempted to rack up points on the critical scoreboard, even at the expense of the merit in the hypothesis. Just because a lot of RMA theory is naively reductionist, showing little understanding of strategic history and less grasp of how-strategic behavior works, it does not follow that radical changes in the character or conduct of war do not occur or are not important. For example, the nuclear revolution was truly such.⁶⁹ For another class of argument, although relative deficiency in mobilizable assets is critical to explanation of why Napoleonic France, and Germany (twice) lost their bids for hegemony, inadequate mass, alone, was not the reason. In all three cases, final defeat was suffered because enemies sufficiently endowed with mass had learned the trade of modern war well enough.⁷⁰ The historical significance of an RMA inexorably is diminished by the implications of strategic competition among states.

The truth of the matter is that RMA theory is a glass half-full, or half-empty, as the commentator prefers. However, the more useful we find the RMA concept, the more aware we need to be of its systemic bias in favor of discontinuity. By any definition, RMA theory had to assert a break with the past. In Carl Builder's words, "[revolutions] overturn the order we have known."⁷¹ Even if a candidate RMA poses novel looking challenges, many of the ingredients that produce military effectiveness either do not change at all, or change only slowly. Earl H. Tilford reminds us that "[i]n the final analysis, war is about people, not systems. Armies, air forces, and navies function with people who use and employ machines and weapons."⁷² "The soul of an army", is fighting spirit, or morale, not its most favored items of weaponry.⁷³ The need for the sound military organization, discipline, and realistic training that fosters fighting spirit and channels it for maximum effect, has been a constant from Greek hoplite warfare to the NTC and Top Gun. There is a danger that enthusiastic endorsement of the RMA postulate may dull recognition both of the "permanently operating factors" which are prominent among the eternal basics making for military effectiveness (morale, leadership, discipline), and of the importance of much of yesterday's wisdom about military science.

To illustrate the last point, in part *faute de mieux* the skillful use of artillery in combined arms warfare was perfected in 1918: technologies have improved since then, but not comprehension or methods. The mechanized warfare and aviation RMA's (if such they were) of the inter-war decades persuaded all major powers, save only for the USSR (and to a lesser degree the United States), to abandon the exceedingly bloodily learnt lessons of 1914-18 concerning good artillery practices. Only by 1944 did the British Army, and arguably the American, recover the lost art of the proper centralized management of artillery. The German Army in World War II, overimpressed with the potential of mechanized firepower on the ground and especially from the air, never came close to recovering its lost artillery skills and combat power of early 1918.⁷⁴ As Zahecki notes tellingly, the Israel Defence Forces of 1973 similarly were over persuaded that tanks and airpower had largely overtaken apparently old-fashioned artillery.⁷⁵ When they ceased to rule the skies, Germans and Israelis rediscovered the necessity for a powerful artillery arm, albeit too late in the German case.

Critics of Admiral Owens' variant of RMA theory have not been slow to note that he and his close followers have developed a technocentric story about future war that is almost wholly lacking in a human dimension. After all, Man, as combatant, victim, influential bystander, taxpayer, parent, and so forth, is the most constant of constants both across the entire spectrum of possible forms of war and throughout all of strategic history. For a vital example, the human dimension of war and strategy always "plays," in that a self-willed enemy must be motivated, and may be able, to craft terms and conditions of conflict that pose an awkward challenge to our preferred style of fighting. The current fascination with "asymmetric threats" has all the weaknesses of intellectual fashion, as did its once similarly fashionable and intellectually close antecedent, "competitive strategies" (as if strategy, or strategies, could be described as anything other than competitive!).⁷⁶ However, these rather obvious ideas are no less important just because they are not exactly startling discoveries deriving from outstandingly penetrating strategic thought. They do help keep alive understanding of the permanently competitive nature of war and strategy. No RMA, of any character, can overturn the "order" of the nature of war which is the struggle for advantage between the independent, and interdependent, wills and mobilizable capabilities of rival security communities.

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Social scientists look to historians to produce good history that they can use. A difficulty in the RMA literature is that because its extensive subject matter requires both historical and social scientific scholarship, what might be called crossover error has been legion. To clarify, historians way out of their depth in theory-building have drafted poor RMA theory. Meanwhile social scientists to whom anything prior, say, to the Korean War is *terra incognita*, have ranged incompetently over the centuries in quest of apparently telling illustration (one can hardly say proof) of bold RMA theory. At the peril of sounding post-modern, we have to appreciate that RMA theory can be neither true nor false, and that ever more detailed and careful historical research, though valuable for the better education of theory-builders, cannot resolve the broad questions that are most interesting about RMA's in strategic history.⁷⁷ The reason is because RMA is an intellectual construction invented and developed by commentators, defense analysts, and strategic theorists. The concept of RMA, though referring to real things and particular behaviors, ultimately is unverifiable. A nuclear weapon has a physical actuality, and its presence (though probably not its yield) or absence can be registered for certain. Claims for "the nuclear era", or "the nuclear age", lend themselves to empirical enquiry which should produce a conclusive answer. By way of contrast, "the nuclear revolution" is inherently an irreducibly contestable idea. The adjective points to material referents that can be photographed, measured, and counted; the noun does not. It follows that no amount of careful historical research can possibly reveal definitively whether or not a favored brand of RMA theory really is more valid than other brands. Further scholarship by historians would be welcome, but it carries no promise of settling the more important questions that RMA theory has raised.

Intrepid readers of RMA literature may be puzzled, possibly repelled, by the acronymic swamp that theorists have created over the past ten years. This paper ruthlessly collectivizes the contending acronyms under the simple, if admittedly reductionist, rubric of RMA. Because of its importance for our theme of technology and war, as well as because of the confusing diversity of usage, let us pause briefly to itemize an intellectual survival guide to the key acronyms (of which there are four, one of which has two meanings!).

1. MR (Military Revolution): These are very rare events, effectively beyond prediction or guidance.⁷⁸ They are tied to deep, sweeping,

unavoidable, and irreversible political, social, and technological trends. The emergence of the modern state in the Sixteenth and Seventeenth Centuries, the French and Industrial Revolutions, and the upheaval of World War I - all are associated with MR's. Scholars do not agree on whether or not the nuclear, and now the information (computer based) revolutions, merit classification as history-shaping MR's.

2. RMA (Revolution in Military Affairs): MR's are preceded, implemented, and succeeded by RMAs. As stated above, RMA refers to a radical change in the character of war. The engines of such change include, but are by no means limited to, technological innovation. Scholars note, in fact, that most historically plausible RMA's have not obviously been led by new technologies.⁷⁹
3. MTR (Military-Technical Revolution): Those RMA's wherein the spur to, and agent for, radical change is overwhelmingly technological, are called MTR's. Some theorists allege for example, that today's "information revolution" for warfare (and state and society) is merely yet another MTR.⁸⁰
4. A. RSA I (Revolution in Strategic Affairs)⁸¹: This option directs attention to allegedly broad and profound changes in the utility of force of different kinds as a servant of policy.
5. B. RSA II (Revolution in Security Affairs): Whereas RSA I looks primarily to sharp shifts in the relative effectiveness of military power in its various forms, RSA II points up notable discontinuities in the relevance of military power altogether. The premise underlying RSA II theory is to the effect that defense and security are not synonyms.⁸²

It is sensible to eschew choice among the five options just listed. Each in its way helps understanding and none, please note again, can be true or false. MR's and RMA's (and MTR's), at the very least, can be treated as partial guides to help interpret the course of strategic history. As global weather has cycles within cycles within cycles, and is substantially non-linear, so, with caveats, strategic history lends itself to explanation in

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terms of the greater cycles of MR's and their preceding and succeeding lesser cycles of RMA's and MTR's. It is necessary to retain an open mind on the question of MR and RMA/MTR succession. Military revolutions great and small tend to overlay, rather than literally succeed, each other. For example, the aviation revolution - probably best viewed as an MTR (perhaps several MTR's) - is still with us, notwithstanding the historically succeeding processes of nuclear and information-led revolutions. Indeed, there is a school of thought that holds that the full maturing of airpower in the 1980's and 1990's is the real RMA/MTR of today.⁸³

Theory in the social sciences is not like theory in the physical sciences. We social scientists can test our preferred theory of RMA strictly in the crucible of plausibility, and our highest aspiration is only that our theory should prove useful as an aid to explanation. The next section argues that, for all its fragilities, RMA theory is particularly rewarding when it is addressed by the theory of strategy.

RMA as Strategic Behavior

Poor understanding of the relative importance of technology for the practice of RMA has been inevitable, gives the no less poor understanding of how strategy "works". By analogy, people ignorant about automotive engineering for performance have difficulty grasping the pluses and minuses of front-wheel drive and of turbo-charging. When divorced from a holistic, historically grounded theory of strategy, RMA debate is quite worthless. The practice of RMA, or, strictly, of what we choose to identify as RMA, necessarily is strategic behavior. Understand strategy and we can understand RMA.

Strategic behavior is the product of the dynamic complex relations among many contributing factors. It does not much matter how many factors, elements, or dimensions we choose to identify as distinctive "players" in strategy. What is important is to encompass all that needs encompassing. Clausewitz noted five "elements" in strategy (moral, physical, mathematical, geographical, and statistical); Michael Howard found four (social, logistical, operational, and technological); while I prefer a finer cut.⁸⁴ There is no right number of strategy's dimensions, just as there is no correct way to label them. I have found it convenient to identify no fewer than seventeen dimensions of strategy.

1. People
2. Society
3. Culture
4. Politics
5. Ethics
6. Economics and logistics
7. Organization (defense planning)
8. Military administration
9. Information and intelligence
10. Theory and doctrine
11. Technology
12. Military operations (fighting performance)
13. Command (political and military)
14. Geography
15. Friction and chance
16. Adversary
17. Time

Each dimension is always in play and influences other dimensions as a contributor to strategic behavior. The structure and working of strategy are truly timeless. Whether it is the performance of Carthage and Rome in the Punic Wars, the Great Powers in the World War of 1914-18, or the several state, sub-state and multi-state coalition belligerents in the Wars of Yugoslavian Succession in the 1990's, strategy and its many dimensions endures immortal. The details of weaponry, mores, social support for combat, generalship, and so forth, must vary from historical case to case. But strategic behavior does not alter its nature from period to period, or from war to war. Furthermore, as claimed already, strategy "works" in the same dynamically complex, possibly chaotic, way in all instances. On non-linearity in strategy, Williamson Murray has this to say:

The relations among technological innovations, the fundamentals of effective military operations, and innovations in concepts, doctrine, and organizations that govern those operations are fundamentally nonlinear: changes in inputs like weapons systems, whether large or small, do not necessarily yield changes of proportionate magnitude in outputs or combat dynamics.⁸⁵

Murray's message, if true, plainly is bad news for those RMA theorists who believe that new technologies, particularly when married to suitable changes in organization and for concepts of operation and doctrine, will transform military performance for the better. If Murray's assertion of non-linearity provides unwelcome tidings, then my argument

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that strategic behavior has many dynamically interpenetrating dimensions really rains on the RMA parade. The reason, of course, is that the now all too classic elements of RMA first popularized by Andrew Krepinevich—new technologies, numbers of new weapons, organizational adaptation, and innovative operational concepts—are not synonymous with strategy and strategic behavior. The neat notion of RMA purveyed by theorists insensitive to strategy is vulnerable to ambush on any of the seventeen dimensions cited above. A radical change (presumably for the better?) in the character and conduct of war by us, even if achievable in principle, may founder in practice in non-permissive geography (the Blitzkrieg in Russia). Or, it may not deliver victory fast enough (meaning that enemies have time to be militarily reeducated, and to gather allies). It may fail operationally because of social and cultural considerations (Bosnia, Somalia, Kosovo, and more). And—perhaps above all else—it may fail to work well in achieving strategic effect for a lasting national security, because of folly in high command (the Napoleonic adventure). Examples abound, actual and potential.

Strategic performance always has to be the product of a struggle to exploit elements of relative advantage to compensate for areas of relative weakness. RMA's, including MTR's, have to perform historically in the full multi-dimensional context of strategy. For example, whatever the merits in the U.S. Army's new concept of air mobile operations in the mid 1960's, the strategic potential of that hold innovation was utterly negated by the appalling incompetence of a deeply flawed U.S. strategy for the conduct of the war in South-East Asia.⁸⁶ For a much grander case, the Napoleonic RMA, though capable prior to 1809 of delivering army-smashing victories, could not compensate in its operational merit for the "strategic lunacy" of its eponymous commander.⁸⁷ For another fairly grand scale of example, Murray observes that in World War II the undoubtedly superior operational dexterity of the Wehrmacht could not compensate for systemic German military incompetence in logistics and intelligence.⁸⁸ Indeed, for that German case one is able easily to overexplain the defeat of 1945. Poor choices in policy and strategy (the human, organizational, and command dimensions), or logistical and intelligence insouciance - either would suffice to offset glittering operational accomplishments.

Like movie stars blinded by the brilliance of their own stardom, or politicians to whom "spin" and reality are fused seamlessly, so strategic theorists can be captured by the cleverness of their own conceptual

inventions. Both the high concept of RMA and the notion that the complex world of strategy and war is non-linear (and indeed “chaotic”),⁸⁹ have considerable value as aids to help understand strategic history and also how strategy and war “work”. Each idea, though, lends itself to a quite exaggerated respect. Social scientists, and especially professional historians dabbling in social science with speculation embracing such powerful theory as RMA, need to learn not to take their grand theory and elegant concepts too seriously.

Following the excellent example set by Thucydides, Clausewitz does indeed emphasize the role of chance in war.⁹⁰ However, if we warm over-enthusiastically to that theme, and begin to argue that Clausewitz was a chaos theorist, we are as likely to be misled as to be enlightened. While assuredly war is “the realm of chance”, accident, and all that creates friction, recognition of such is but a fairly mundane statement of an obvious condition. Strategy frequently is undone by chance and by friction in its many manifestations, but is it true, can it be true, to argue that strategy (and war) fundamentally is non-linear and even chaotic? Without denying complexity, some disproportionality between inputs and consequences, the salience of initial military conditions, let alone the frailty of prediction in war is behavior in the strategic world akin to rolling dice?

This is a case of over-explanation. Clausewitz appreciated wonderfully that war is chaotic: he is not, however, a chaos theorist. He warns of the uncertainty of war and insists persuasively that “friction... is a force that theory can never quite define.”⁹¹ But he does not abandon hope for strategy.

The good general must know friction in order to overcome it wherever possible, and in order not to expect a standard of achievement which this very friction makes impossible.⁹²

Strategy is purposeful behavior that should apply suitable means to secure chosen ends. If the realm of military force truly were dominantly non-linear, let alone technically speaking “chaotic”,⁹³ then strategy would be impossible. While recognizing the Truth that non-linearity and even chaos obtain in strategic affairs, we need to guard against losing sight of the yet Bigger Truth that strategy works. Moreover, sometimes strategy

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works in the ways, as well or better than, intended. It is appropriate to criticize unduly technophilic RMA theory on the grounds that strategic behavior in war is too complex in its multi-dimensionality to have its course reduced to determination by the application of machine power alone. We can argue persuasively that our strategic universe is not a clockwork one; predictably improved performance in precise bombardment will not yield a like predictability in strategic and political effect. Nonetheless, broad non-linearities in strategic performance have a way of flowing along unsurprising paths. Those who mock “the principles of war”, especially those who disregard the dependencies connecting means and ends, tend to find that complexity - non-linearity - chaos theory does not serve them. Poor teams generally lose.

IV. Conclusions

Because technology characteristically is photogenic, and machines in motion play well on the silver screen, specialist television channels endlessly rerun series that confuse “the weapons with which war was decided”, with “the weapons which decided the war”. It is as easy to show exciting film footage of T34 tanks and P-51 Mustangs, as it is difficult to explain the conditions which allowed these particular weapon systems to be extraordinarily effective. This paper deliberately’ has sought to discuss technology, weapons, and support systems inclusively. At times it may even have seemed to some readers that my theme of technology and war, or weapons for strategic effect, all but disappeared in an exceedingly crowded strategic landscape. In fact, the whole wide-ranging discussion above was designed to identify and explore the context within which technology/weapons must function. Here in this concluding chapter we restore a focus on technology explicitly to center stage for analysis. What follows are six “working conclusions” which from complementary angles address the question, “how important is technology”, in strategy and war.

1. Relations of technological advantage and disadvantage and disadvantage are dominated by the political, strategic, and operational contexts within which they play.⁹⁴

For example, RAF Fighter Command won the Battle of Britain in August-September 1940 even though it had marginally inferior equipment to the Luftwaffe and, particularly at the outset, notably less skillful pilots and inferior tactics. But the Battle was waged by a British air defense system (the world’s first such), following sound operational concepts, in support of intelligent strategy, with good enough equipment and combat skills at the sharp end, over friendly geography. In combat, the Luftwaffe, though arguably superior unit-by-unit, lacked consistently sound operational direction, supported an ambiguous strategy, was logistically overextended, and was obliged to fight over unfriendly geography.⁹⁵ The RAF needed neither clearly superior technology, nor the bloody rout of the foe. What it needed was equipment that was good enough (i.e., combat competitive), while “victory” could be achieved simply by not losing. The Germans had to achieve air superiority over the Channel and most of Kent and Surrey;

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the RAF did not. So as long as RAF Fighter Command could continue the fight over the prospective invasion beaches and beachhead areas, the Germans could not invade.⁹⁶ American readers may recall that in Vietnam the NVA did not have to defeat USMACV in battle. Instead it only had to stay in the fight, using equipment good enough to sustain itself and to enable it to outlast U.S. political determination at home, so that eventually it would have an unblocked run at the ARVN.

In short, the demands made upon technology, and the benefits and disadvantages of technical superiority or inferiority, depend very much upon the contexts within which military competition and war is conducted.

2. The use made of technology typically is more important than is the technology itself.

Early in the Pacific War, in 1942, Japanese military aviation enjoyed a distinct lead over American. But this temporary advantage in equipment was more than offset by an American response keyed to training in new aerial dog fighting tactics derived from painful combat experience.⁹⁷ In France and Belgium in 1940, French and British land and air forces on balance were marginally superior to German both in quantity and quality of equipment (and numbers of men). The Germans, however, characteristically handled their armed forces with a tactical and operational skill of which their enemies could only dream. By 1918, the World War I RMA, “the modern style of warfare”,⁹⁸ had matured on both sides of the Western Front. The evolution of that “modern style” had required some new technologies (e.g., tanks, light machine guns, asphyxiating and poison gas, more robust aircraft, better communications, and so on). But the distinguishing feature of warfare in 1918, as contrasted with 1914-16, was the skill with which the Germans, British, and French (and their associated air forces and corps) could wage genuinely combined-arms combat.

3. The person behind the gun matters more than the gun itself.

Cliché or not, it is true that people, not weapons, kill and wage war (and deter and keep the peace). Of course, people perform those functions with weapons. However, if a military unit, even an army, does not fight well, it will not much matter whether it does not fight well with equipment

superior, or inferior, to that of the enemy. There are many reasons why the fighting power and military effectiveness of a force can be unimpressive and uncompetitive with the like outputs of the foe. Provided that kit is good enough, which is to say is within “the compensatable range” (by training, discipline, morale, leadership, numbers, intelligence, logistics, use of terrain, and more), war can be won. History does reveal, though, that technological inferiority in weapons and other equipment is rarely the dominant plausible cause of poor military performance. By analogy, the technically (marginally) superior Formula One racing car does not necessarily win all its races. The racing cars driver is vitally important, albeit not all important (which is to say, he will not win regardless of technical disadvantage).

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4. In principle, though not always in practice, it is relatively easy to compensate for technological disadvantage.

When we consider the contribution of technology among the seventeen (!) dimensions of war and strategy I have identified above, it is all but self evident that this realm of relative advantage/disadvantage should be among the easiest to manage. After all, the technologies behind military and useful civilian systems are the artefacts of social, political, industrial, and military procurement processes and decisions, are influenced by strategic and military cultures,⁹⁹ and they express some particular geographical orientation... and so forth. In other words, the technology in weapons and support systems is highly derivative. It should be much more difficult to correct the contexts from which weapons-grade technology emerges, than to improve the machines themselves. Moreover, even if the pertinent social, political, industrial, and military organizational contexts place a belligerent at a comparative technical disadvantage, in principle it is possible for choices to be made in policy, strategy, operations, and tactics, which should offset technological deficiency. If Allied tanks are sufficiently technically inferior, as was the case in 1944-45, then wage a style of combined-arms warfare which has our tanks amply supported by close-support aircraft (weather permitting), towed and SP artillery, and-of course - infantry. In the last resort, find compensation both in numbers and in tank fighting tactics which prescribe maneuver to secure advantageous firing positions on the flank and to the rear of enemy armor. But, available compensation for technological disadvantage is never guaranteed. Had the Luftwaffe not been defeated in the air Battle of Germany in the late winter and early spring of 1944, but instead been available to contest the skies over northern France, the Allied armies would have paid a possibly fatal price for their errors in tank design.

5. True technological shortfalls happen.

Although ways usually can be identified to work around serious technological deficiencies, the impression should not be given that such “work arounds” are always practicable. Some forms of non-technical compensation can be prohibitively expensive. For an extreme example, an enemy with superior firepower (e.g., the United States in Vietnam) might be overwhelmed by (at least, locally) a vastly superior number of bodies.

Similarly, if we lack artillery and specialized vehicles to clear minefields, and time is of the essence, we can send bodies to find the mines. A generic problem with the principle of compensation for technical deficiency, is that heroic and desperately personal achievement is likely to be required of the chosen agents of compensation. If BMD and air defense simply does not work very well to produce substantial defensive counterforce effect, then the offensive forces need to be quite extraordinarily competent or lucky, since they alone have to do the whole counterforce job. If the enemy's tank armor is all but impenetrable to our anti-tank guns, and if poor weather deprives us of close air support, then we may look to the individual infantryman to earn the tank destroyer medal by highly personal endeavor. It can be done, but not reliably and not for long.

Systemic technological limitations can have profound operational, strategic, and hence political consequences. For example, Napoleon's Grande Armée was always likely to fail in Russia in 1812 because its animal-powered logistical train simply could not support the pace of advance required to support the Emperor's operational ambitions.¹⁰⁰ For another case, the most modern and militarily potent armies in 1918 - the British and German - lacked the technical means of transportation to transform a break-in and then a breakthrough into an operational level breakout. This was strictly a technological-industrial problem. For technical reasons the generals of 1918 could not exploit battlefield success. The German problem was worse than the British, because they had failed to develop the tank. This meant that they had to waste men's lives, artillery ammunition, and precious time, overcoming the tactical challenge of barbed wire harrier zones - the one challenge that the primitive tracked fighting vehicles of 1918 could meet successfully.¹⁰¹

There is no shortage of cases of the "true technological shortfall", the vital machine that either is absent or, worse, is present and does not work reliably. An especially painful historical example is provided by the bug-ridden history of the torpedo. Both Germany and the United States began operations in World War II with a submarine force whose principal weapon was, at best, highly unreliable. It is extraordinarily difficult to find a tactical, or other, "workaround" for a submarine fleet whose torpedoes do not explode when they should.¹⁰² For another case, scarcely less perilous to unfortunates, British soldiers facing the Zulu Army in the late 1870's discovered that the metal cartridges for use in their newly issued Martini-Henry breechloading rifles were apt to expand as the weapon

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grew hotter in action. The result was a case which could not be ejected, therefore a jammed rifle, and a consequent need to demonstrate prowess with the bayonet.

6. Technological advantage tends to be fleeting.

If a technological lead is rarely decisive, also it is apt to be temporary. So varied are the machines of war and relevant to war, yet so globally common in modern times is science and technological and even industrial expertise, that any expectation of enduring technological advantage were best retired. These observations need to be read in the context of my earlier explanation of the extensive multi-dimensionality of war and strategy. It would seem to be the case that technological advantage is doubly restrained from exercising militarily decisive effect. First, it comprises but one element in the brew which produces military and strategic effectiveness. Second, it cannot be sustained in the context of a globally technological “civilization”. Although the latter point self-evidently is correct for today, it happens also to be true for the entire strategic history of competition among peer polities. The great struggles in history, from Ancient Greece to, and including, those of the Twentieth Century, were not decided by technological advantage. Perhaps we should “never say never”. Nonetheless, the historical record of technological advantage proving partial, fleeting, and strictly contributory to strategic success, is impressive indeed.

The strategic culture of a defense community can be revealed in the style of its strategic behavior.¹⁰³ As a machine-minded culture on the cutting edge of what some now regard as an information-led RMA, the American is inclined to seek advantage through the exploitation of technology. In and of itself, a quest for technical improvement is strategically innocent. However, if appreciation of the benefit of better military tools becomes an article of faith in the power of machines, great harm can be done. Better golf clubs help the game only of good golfers. In this paper I have sought to emphasize the importance of people rather than technology, or, if you prefer, of the human dimension integral to the weapon system. However, to contextualize technology is certainly not to dismiss it. Although “[h]istorically, good men with poor ships are better than poor men with good ships”,¹⁰⁴ the quality and quantity of weapons matters. Technology is only one of strategy’s dimensions, but it always plays.

Notes

1. Immediately prior to World War I, 10 miles was judged by the Royal Navy to be extreme range; effective battle range was expected to be little more half, that distance. “The prewar development of gunnery materiel and technique had been based upon the assumption that the ma in fighting would take place at much less than 10,000 yards”. Jon Sumida. “Harder Than It Looked: British Preparations for Battle Fleet Action, 1912-1916”, draft unpub. paper, 9 June 1999. On Polaris A-1, see Graham Spinardi, From Polaris to Trident: The Development of US Fleet Ballistic Missile Technology (Cambridge: Cambridge University Press, 1994), Ch.4. The range of 1,200 miles was as nominal as the W47 nuclear warhead was unreliable.

2. Harold D. Lasswell, Politics: Who Gets What, When How (New York: Peter Smith, 1950).

3. See Cohn McInnes, “Spectator Spurt Warfare”, Contemporary Security Policy, Vol.20, No.3 (December 1999), pp.142-65.

4. Clausewitz, On War, p.606 (emphasis in original).

5. Ibid., p.75

6. Ibid., p.605.

7. Ibid., p.97.

8. Benjamin S. Lambeth, “The Uses and Abuses of Air Power”, The Wall Street Journal, 27 July 1995.

9. Williamson Murray, “Armored Warfare: The British, French, and German Experiences”, in Murray and Allan R. Millett, eds., Military Innovation in the Interwar Period (Cambridge: Cambridge University Press, 1996), p 30 n.90.

10. For a rare example of an RMA theorist recognizing the distinction between the nature and the conduct of war, see Jeffrey R. Cooper, Another View of the Revolution in Military Affairs (Carlisle Barracks, PA: Strategic Studies institute, U.S. Army War College, 15 July 1994), p.42 n.16. Cooper allows the “nature of war” to be “defined by the entities that engage in the conflict and the objectives over which they fight while conduct of war will refer to the modalities of the conflict, that is, how the war is fought” (emphasis original). By way of contrast, Michael J. Mazarr breezily allies the two claims. The transformation we face in the

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nature and conduct of warfare is no less fundamental than that of Napoleon's time'. The Revolution in Military Affairs: A Framework for Defense Planning (Carlisle Barracks, PA: Strategic Studies Institute, U.S. Army War College, 10 June 1994), p.2. While Andrew W. Marshall and his associates in the Office of Net Assessment (ONA) usually are careful to claim only that RMAs can "transform the way wars are fought" (Marshall testimony before the Senate Armed Services Committee, Subcommittee on Acquisition and Technology, 5 May 1995), occasionally they venture into much deeper water. For example: "Information advances will affect more than just how we fight wars. The nature and purpose of war itself may change". Andrew W. Marshall, "Foreword" to Zalmay M. Khalilzad and John P. White, eds., Strategic Appraisal: The Changing Role of Information in Warfare, MR-1016-AF (Santa Monica, CA: RAND, 1999), p.1.

11. I develop this argument in detail in 'Clausewitz Rules, OK? The Future is the Past - with GPS', in Michael Cox, Ken Booth, and Tim Dunne, eds., The Interregnum: Controversies in World Politics, 1989-1999 (Cambridge: Cambridge University Press, 1999), pp. 161-82.

12. See "Is Major War Obsolete? An Exchange", Survival, Vol.41, No.2 (Summer 1999), pp. 139-52.

13. For the leading example, Martin van Creveld, The Transformation of War (New York: Free Press, 1991). Mary Kaldor, New and Old Wars: Organized Violence in a Global Era (Cambridge: Polity Press, 1999), is not without merit.

14. Judy M. Graftis, "Strategic Use with Care", Airpower Journal, Vol.8. special edn. (1994), pp. 4-10, gets it right.

15. Carl H. Builder. "Keeping the Strategic Flame", JFQ. No.14 Winter 1996-97), pp 76-84

16. George Ostrogorsky, History of the Byzantine State (New Brunswick, NJ: Rutgers University Press, 1969), pp. 50-68.

17. Useful, historically book-end commentaries on the meaning of the atomic/nuclear era to date, are Bernard Brodie, ed., The Absolute Weapon: Atomic Power and World Order (New York: Harcourt, Brace. 1946), and T.V. Paul, Richard Harknett, and James J. Wirtz, eds., The Absolute Weapon Revisited: Nuclear Arms and the Emerging International Order (Ann Arbor, MI: University of Michigan Press, 1998). For recent scholarship on the impact of nuclear weapons on statecraft from

the mid-1940's to the early 1960's, see John Lewis Gadd et al., Cold War Statesmen Confront the Bomb: Nuclear Diplomacy since 1945 (Oxford: Oxford University Press, 1999).

18. The grim story is revealed in Victor David Hanson, The Western Way of War: Infantry Battle in Classical Greece (London: Hodder and Stoughton, 1989), and Alan B. Lloyd, ed., Battle in Antiquity (London: Gerald Duckworth, 1996),

19. Hugh Cecil and Peter Liddle, eds., Facing Armageddon: The First World War Experienced (London: Leo Cooper, 1996), is helpfully multinational in scope. As one would expect, John Keegan, The First World War (London: Hutchinson, 1998), is exceptionally strong on the human dimension of the struggle.

20. Robert B. Strassler, ed., The Landmark Thucydides: A Comprehensive Guide to The Peloponnesian War, trans. Richard Crawley, rev. edn. (New York: Free Press, 1996), p.43.

21. As I have explained, at least to my own satisfaction in House of Cards: Why Arms Control Must Fail, (Ithaca, NY: Cornell University Press, 1992).

22. Geoffrey Blainey, The Causes of War (London: Macmillan, 1973), is a superior analysis. By far the most information and amusing brief review of this sad literature is T.C.W. Blanning, The Origins of the French Revolutionary Wars (London: Longman, 1986), Ch. 1.

23. Ralph Peters, Fighting for the Future: Will America Triumph (Mechanicsburg, PA: Stackpole Books, 1999), pp.171, 172.

24. A leading British historian recently has written "Efforts to limit war in the inter-war period duly concentrated on the means of fighting, not on the reasons for resorting to war in the first place. The Kellogg-Briand Pact [1928] failed because, although it outlawed war, it did not address the causes and in Geneva, the League of Nations debated the abolition of conscription, limited on submarines, and control of bombers. What preoccupied the powers, then, was the machinery of modern war, not the causes of its use". Hew Strachan, "On Total War and Modern War", The International History Review, Vol 22, No.2 (June 2000), p.359. For the same story, see Merze Tate, The United States and Armaments (Cambridge, MA: Harvard University Press, 1948), esp. p.264. It would seem that every generation of scholars has to discover anew the irrelevance of arms control.

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25. Because war is a duel entailing “reciprocal action”. Clausewitz, On War, pp. 75, 77.

26. See the outstanding analysis in Jonathan Bailey, The First World War and the Birth of the Modern Style of Warfare, Occasional Paper 22 (Camberley, UK: Strategic and Combat Studies Institute, Joint Services Command and Staff College, 1996).

27. Bruce I. Gudmundsson, Stormtroop Tactics: Innovation in the German Army, 1914-1918 (New York: Praeger Publishers 1989; and David T. Zahecki, Steel Wind: Colonel Georg Bruchmuller and the Birth of Modern Artillery (Westport, CT: Praeger Publishers, 1994, somewhat overpraise German innovation; while Paddy Griffith, ed., British Fighting Methods in the Great War (London: Frank Cass, 1996), and J. P. Harris, Amiens to the Armistice: The BEF in the Hundred Days’ Campaign 8 August – 11 November 1918 (London, Brassey’s, 1998), balance the ticket.

28. Morton Halperin, Limited War in the Nuclear Age (New York: Wiley, 1963), probably said more than there was to say on the subject.

29. Prominent texts in the RAND canon are: A.J. Wohlstetter et al., Selection and Use of Strategic Air Bases, R-266 (Santa Monica, CA: RAND. April 1954): idem, Protecting U.S. Power to Strike Back in the 1950’s and 1960’s, R-290 (Santa Monica, CA: RAND, April 1956): Wohlstetter, “The Delicate Balance of Terror”, Foreign Affairs, Vol.46, No.2 (January 1968), pp.242-55: Charles J. Hitch and Roland N. McKean, The Economics of Defense in the Nuclear Age (New York: Atheneum, 1966); and E.S. Quade, ed., Analysis for Military Decisions: The RAND Lectures on Systems Analysis (Chicago: Rand McNally, 1964). While I am highly critical of the RAND vulnerability studies and of the school of (nuclear) strategic analysis associated with it, I am far from unsympathetic to the rigorous efforts made by strategic thinkers in the 1950’s and 1960’s to tame the nuclear revolution. In that connection, see Gray, Modern Strategy (Oxford: Oxford University Press, 1999), Chs. 11-12.

30. Kenneth Booth, “Teaching Strategy: An Introductory Questionnaire”, Survival, Vol.16. No.2 (Match/April 1974), p.82.

31. Anyone who has bought the idea of reliable deterrence has to be in urgent need of exposure to Keith B. Payne, Deterrence in the Second Nuclear Age (Lexington, KY: University Press of Kentucky, 1996).

32. Kenneth N. Waltz, Man, the State and War (New York: Columbia University Press, 1965).

33. Joanna Bourke, An Intimate History of Killing: Face-to-Face Killing in Twentieth-Century Warfare (London: Granta Books, 1999).

34. Dave Grossman, On Killing: The Psychological Costs of Learning to Kill in War and Society (Boston: Little Brown, 1995), Hugh McManners, The Scars of War (London: Harper Collins, 1993), is a work in similar vein.

35. Clausewitz, On War, p.89.

36. Daniel Jonah Goldhagen, Hitler's Willing Executioners: Ordinary Germans and the Holocaust (London: Abacus, 1996).

37. The Nazi Party and its SS arm can be blamed for the Holocaust, even though the German Army was hugely cooperative in its execution, but as Murray and Millett record, “[i]t was the army that held responsibility for the care of Soviet POW’s”. A War To Be Won, p. 140.

38 Clausewitz, On War, p.101.

39. Ibid., p.85.

40. Admiral Bill Owens, Lifting the War (New York: Farrar, Straus, and Giroux, 2000), p.24.

41. Michael O’Hanlon, Technological Change and the Future of Warfare (Washington, DC: Brookings Institution Press, 2000).

42. For a powerful critique of the Owens vision of RMA, see Paul K. Van Riper and F.G. Hoffman, “Pursuing the Real RMA: Exploiting Knowledge-Based Warfare”, National Security Studies Quarterly, Vol.4, No.3 (Summer 1998), pp.1-19, and the subsequent “Response and Rebuttal”, by James R. Blaker and F.G. Hoffman in National Security Studies Quarterly, Vol.5, No.1 (Winter 1999), pp.83-91. Barry D. Watts, Clausewitzian Friction and War, McNair Paper 52 (Washington DC Institute for National Strategic Studies, National Defense University, October 1996), also is notably damning the Owens-eye strategic worldwide (see esp. pp. 122-23).

43. Owens, Lifting the Fog of War, p.14.

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44. Such, at least, is the deeply expert opinion of Colonel Bui Tin of the NVA. Virtual history is not history, but still the Colonel's speculative judgment merits unusual respect. In his opinion, "[i]f Johnson had granted General Westmoreland's request to enter Laos and block the Ho Chi Minh Trail, Hanoi could not have won the war" Quoted in Richard H. Shultz, Jr., The Secret War Against Hanoi: Kennedy and Johnson's Use of Spies, Saboteurs, and Covert Warriors in North Vietnam (New York: Harper Collins, 1999) pp.205-6.

45. See H.R. McMaster, Dereliction of Duty: Lyndon Johnson, Robert McNamara, The Joint Chiefs of Staff, and the Lies that Led to Vietnam (New York: HarperCollins, 1997), pp.205-6

46. Telford Taylor, of the March of Conquest: The German Victories in Western Europe, 1940 (Baltimore: Nautical and Aviation Publishing Company of America, (1991), pp. 252-65; Klaus A. Maier et al., Germany and the Second World War: Vol. II. Germany's Initial Conquests (Oxford: Clarendon Press. 1991), pp 289-95.

47. This means what it says. I am claiming both that Nazi Germany could have won its war(s) in the 1940's, though not the World War II as actually structured, and that the United States could (and should) have won in Vietnam (and Laos and Cambodia) in the 1960's.

48. Clausewitz, On War, p. 119.

49. Ibid., p. 120.

50. This is not to deny the role of luck in the health of players in the skill positions. Nonetheless, prudent NFL franchises invest in it depth for those positions, and hence reduce their exposure to ill fortune.

51. The Air University Library maintains an excellent RMA bibliography (contact Steve Chun, AWC bibliographer). In addition to the works already cited, readers should find the following helpful: Michael J. Mazarr et al., The Military Technical Revolution: A Structural Framework, Final Report of the CSIS Study Group on the MTR (Washington, DC Center for Strategic and International Studies, March 1993); Andrew F. Krepinevich, "Cavalry to Computer: The Pattern of Military Revolutions", The National Interest, No.37 (Fall 1994), pp.30-42; Colin S. Gray, The American Revolution in Military Affairs: An Interim Assessment, Occasional Paper 28 (Camberley, UK: Strategic and Combat Studies Institute. Joint Services Command and Staff College, I 997); Williamson Murray "Thinking About Revolutions in Military

Affairs”, *JFQ*, No.16 (Summer 1997), pp.69-76; Lawrence Freedman, The Revolution in Strategic Affairs, Adelphi Paper 318 (London: International Institute for Strategic Studies, April 1998). I have developed a critical overview of the RMA debate, of RMA theory, and of some candidate historical RMA’s, in my book Strategy for Chaos: RMA Theory and the Evidence of History (London: Frank Cass, forthcoming 2001). Also forthcoming in 2001 is MacGregor Knox and Williamson Murray, eds., The Dynamics of Military Revolution, 1300-2050.

52. V.K. Triandafilov, The Nature of the operation of Modern Armies, ed., Jacob W. Kipp (1932; London: Frank Cass, 1994); Shimon Naveh, In Pursuit of Military Excellence: The Evolution of Operational Theory (London: Frank Cass, 1997), Ch.5.

53. See Nikolai Galay, “The Soviet Approach to the Modern Military Revolution”, in John Erickson, ed., The Military-Technical Revolution: Its Impact on Strategy and Foreign Policy (London: Pall Mall Press, 1966). pp. 20-34, and Jacob Kipp, “The Other Side of the Hill: Soviet Military Foresight and Forecasting”, in Derek Leebaert and Timothy Dickinson, eds., Soviet Strategy and New Military Thinking (Cambridge: Cambridge University Press, 1992), pp.248-75. The nuclear-missile revolution dominates the first edition (of three) landmark contemporary text, V.D. Sokolovskii, ed., Soviet Military Strategy (Englewood Cliffs, NJ: Prentice-Hall, 1963). Note the comment on this book in Andrei A. Kokoshin, Soviet Strategic Thought 1917-91 (Cambridge, MA: MIT Press, 1998), pp. 49-55.

54. See N.V. Ogarkov, Always in Readiness to Defend the Homeland, trans. FBIS, JPRS/10412, 25 March 1982, and idem, History Teaches Vigilance (Moscow: Voenizdat, 1985). The whole story of Soviet military strategy is well told in David M. Glantz, The Military Strategy of the Soviet Union, (London: Frank Cass, 1992).

55. David M. Glantz and Jonathan House, When Titans Clashed: How the Red Army Stopped Hitler (Lawrence, KS: University Press of Kansas, 1995); Murray and Millett, A War To Be Won, pp. 386-404, 445-55, 471-76, 481-82. The latter authors believe that “the Soviets displayed the greatest abilities at the operational level of war ... Their victories were far superior to anything the Germans had achieved early in the war”. P.482.

56. Norman Friedman is very much on the money when he writes: “While the Soviets wrestled with political problems in Poland [in 1980-81], they also faced a reversal of their military position, due to a new military revolution, computer proliferation”. The Fifty-Year War: Conflict and Strategy in the Cold War (Annapolis, MD: Naval Institute Press, 2000), p. 446. Later in his excellent book, Friedman argues convincingly that Gorbachev “failed not because Reagan outspent the

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Soviets, but because what he [Reagan] was buying involved a [computer-led] revolution in military technology. P.468.

57. Eliot A. Cohen, Michael J. Eisenstadt, and Andrew J. Bacevich, "Knives, Tanks, and Missiles: Israel's Security Revolution (Washington, DC: Washington Institute for Near East Policy, 1998), p. 3.

58. John Erickson, "Russia Will Not Be Trifled With: Geopolitical Facts and Fantasies", in Cohn S. Gray and Geoffrey Sloan, eds., Geopolitics. Geography and Strategy (London: Frank Cass, 1999), pp. 242-68.

59. Edward Hall, Beyond Culture (Garden City, NJ: Anchor Books, 1977), Chs. 6-8; Robert B. Bathurst, Intelligence and the Mirror: On Creating an Enemy (London: SAGE Publications, 1993), Ch.3.

60. Thomas J. Welch, "Technology and Warfare", in Keith Thomas, ed., The Revolution in Military Affairs: Warfare in the Information Age (Canberra: Australian Defence Studies Center, Australian Defence Force Academy, 1997), p.28 (emphasis original).

61. Krepinevich, "Cavalry to Computer", p.30.

62. Peter Paret, "Napoleon and the Revolution in War", in Paret, ed., Makers of Modern Strategy: From Machiavelli to the Nuclear Age (Princeton, NJ: Princeton University Press, 1986), pp.123-42.

63. See Murray and Millett, eds., Military Innovation in the Interwar Period. Also see these authors' chapter (2) on "The Revolution in Military Operations, 1919-1939", in their book, A War To Be Won.

64. For the case of the Gulf War, see Stephen Biddle, "Victory Misunderstood: What the Gulf War Tells Us about the Future of Conflict", International Security. Vol.21, No.2 (Fall 1996), pp.139-79, and the essays in the "Symposium on the Gulf War and the Revolution in Military Affairs", International Security, Vol.22, No.2 (Fall 1997), pp.137-74.

65. "Parallel war brings so many parts of the enemy system under near-simultaneous attack that the system simply cannot react to defend or to repair itself ... Our best example of parallel war to date is the strategic attack on Iraq in the Gulf War". John A. Warden III, "Air Theory for the Twenty-first Century", in Barry R. Schneider and Lawrence E. Grinter, eds., Battlefield of the Future: 21st Century Warfare Issues, Air War College Studies in National Security No.3, rev. edn. (Maxwell AFB, AL: Air University Press, September 1998), p.116. In the same collection, see also Richard Szafranski, "Parallel War and Hyperwar: Is Every War a Weakness?" Pp.125-48. On the reasons for the German victories of 1939-41, see James S. Corum, The Roots of Blitzkrieg: Hans von Seeckt and German Military Reform (Lawrence, KS: University Press of Kansas, 1992), and Eugenia C. Kiesling, Arming Against Hitler: France and the Limits of Military Planning (Lawrence, KS: University Press of Kansas, 1996). Robert A. Doughty has explained how "the Germans themselves fell victim to the myths surrounding the campaign [in France and Belgium, 1940] and to their own propaganda about the effectiveness of the

Blitzkrieg”. “Myth of the Blitzkrieg”, in Lloyd J. Matthews, ed., Challenging the United States Symmetrically and Asymmetrically: Can America be Defeated? (Carlisle Barracks, PA: Strategic Studies Institute, U.S. Army War College, July 1998), p.65.

66. The Germans were persuaded by their own newsreels that they had discovered in Blitzkrieg the formula for certain victory. This hubristic, and naive, reductionist conviction had dire consequences for the planning of the invasion of the USSR.

67. Quoted in Brent Stuart Goodwin, “Don’t Techno for an Answer: The False Promise of Information Warfare”, Naval War College Review, Vol.53, No.2 (Spring 2000), p.2 19. I am grateful to Mr. Goodwin for the reference.

68. Friedman, Fifty-Year War, Ch.36, “The Computer Bomb”.

69. For -reasons surely definitely provided in Robert Jervis, The Meaning of the Nuclear Revolution: Statecraft and the Prospect of Armageddon (Ithaca, NY: Cornell University Press, 1989), Ch.1.

70. There is a Law of Superior Numbers in strategy which holds that when other factors are tolerably equal, the bigger battalions eventually will win. Size alone will not deliver victory reliably, but size plus competence is very likely to do so. Napoleon and his Grande Armee at their peak in 1805-6 were close to invincible. But France’s most persistent foes, Austria and Britain, were not easy marks for the Napoleonic RMA. The Austrian Army was rarely, if ever, entirely outclassed by the French, while the Napoleonic style in decisive warfare was unavailing against an insular power with a superior navy. See Peter Paret, Yorck and the Era of Prussian Reform. 1807-1815 (Princeton, NJ: Princeton University Press, 1966); Robert M. Epstein, Napoleon’s Last Victory and the Emergence of Modern War (Lawrence, KS: University Press of Kansas, 1994); and Gunther F. Rothenberg, Napoleon’s Great Adversary: Archduke Charles and the Austrian Army, 1792-1814, (New York: Sarpedon Publishers, 1995), on military improvement by three of France’s continental enemies. On the British foe, see Cohn S. Gray, The Leverage of Sea Power: The Strategic Advantage of Navies in War (New York: Free Press, 1992), Ch.5, and Rory Muir, Britain and the Defeat of Napoleon, 1807-1815 (New Haven, CT: Yale University Press, 1996). Inadequate mass for Nazi Germany is emphasized in John Ellis, Brute Force: Allied Strategy and Tactics in the Second World War (New York: Viking Penguin, 1990); while Richard Overy, Why the Allies Won (London: Jonathan Cape, 1995), Glantz and House, When Titans Clashed, and Murray and Millett, A War To Be Won, all point to an upward learning curve of military skill by the Allies, without denying the significance of numbers. A generation earlier, the Allies did not defeat the Central Powers in 1914-18 because of superior military skill, but because their hard-learned skill eventually was good enough to allow their growing material and human superiority of numbers (thanks to U.S. co-belligerency) to wear the Germans out. It was neither pretty nor elegant, but it worked. Strategy is like that.

71. Carl H. Builder, “Are We Looking in All the Wrong Places”, in Thomas, ed., Revolution in Military Affairs, p.26.

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72. Earl H. Tilford, Jr., "Reviewing the Future", Parameters, Vol.30, No.3 (Autumn 2000), p.151.

73. Ian Hamilton, The Soul and Body of an Army (London: Edward Arnold, 1921), speaks for the ages.

74. Zabecki, Steel Wind, Ch.7.

75. *Ibid.*, pp.141-42.

76. The annual report from the Secretary of Defense routinely blesses the latest strategic buzzword - good, bad, and ugly. "Asymmetric threats" duly appears in William S. Cohen, Secretary of Defense, Annual Report to the President and the Congress (Washington, DC: U.S. Government Printing Office, 2000), pp.19-21, as did "competitive strategies", in Frank C. Carlucci, Secretary of Defense, Annual Report to the Congress (Washington, DC: U.S. Government Printing Office, 17 January 1989), pp.46-8. Asymmetry in strategy is handled well in Freedman, Revolution in Strategic Affairs, Ch.3, "Asymmetric Wars".

77. Murray could mislead when he offers the caveat that "the historical record is not yet in; and until there is detailed research on the subject [of RMA's] most commentaries may be distortive". "Thinking About Revolutions in Military Affairs", p.70.

78. On the possible distinctions among MR's, RMA's, and MTR's (i.e., 1-3 in my text), see Steven Metz and James Kievit, Strategy and the Revolution in Military Affairs: From Theory to Policy (Carlisle Barracks, PA: Strategic Studies Institute, U.S. Army War College, 27 June 1995), pp.9-10; Murray, "Thinking About Revolution in Military Affairs"; Brian R. Sullivan. "The Future Nature of Conflict: A Critique of 'The American Revolution in Military Affairs' in the Era of Jointery", Defense Analysis, Vol.14, No.2 (August 1998), pp.91-100; and Gray, Strategy for Chaos, Ch.3.

79. Murray, "Thinking About Revolutions in Military Affairs", p.70.

80. Sullivan, "Future Nature of Conflict".

81. Freedman, Revolution in Strategic Affairs, emphasizes the changing political and social contexts of war which shape the utility of military forces. For example, even the most modern of RMA-led armed forces must have their strategic value reduced if their political owners dare not employ them if there appears to be some risks either of them suffering, or inflicting, casualties. If bloodless war is mandated by policy, very little war will be waged. Edward N. Luttwak has nominated himself as Principal Prophet for the changing social context of strategy. See his articles: "Toward Post Heroic Warfare", Foreign Affairs, Vol.74, No.3 (May/June 1995), pp.109-21; "A Post-Heroic Military Policy", Foreign Affairs, Vol.75, No.4 (July/August 1996), pp.33-44; and "From Vietnam To Desert Fox: Civil-Military Relations in Modern Democracies", Survival, Vol.41, No.1 (Spring 1999), pp.99-112.

82. Cohen, Eisenstadt, and Bacevich, Knives, Tanks, and Missiles, Ch.4, “The Israeli Revolution in Security Affairs”, offers a mix of what I mean by RSA I and RSA II. Academics in strategic studies have been under pressure for some years from colleagues who argue that the military dimension to security is being overtaken in relative importance by such other dimensions as the political, economic, societal, and environmental. Barry Buzan, People, States and Fear: An Agenda for International Security Studies in the Post-Cold War Era, 2nd edn. (Boulder, CO: Lynne Rienner Publishers, 1991), is the landmark text. Also see Ronnie D. Lipshutz, ed., On Security (New York: Columbia University Press, 1995), and Terry Terriff et al., Security Studies Today (Cambridge: Polity Press, 1999). Richard K. Betts, “Should Strategic Studies Survive?” World Politics, Vol.50, No.1 (October 1997), pp.7-33, is an articulate defense.

83. Benjamin S. Lambeth, “The Technology Revolution in Air Warfare”, Survival, Vol.39, No.1 (Spring 1997), pp.65-83. See Gray, Modern Strategy, pp.250-51.

84. Clausewitz, On War, p.183; Michael Howard, “The Forgotten Dimensions of Strategy”, Foreign Affairs, Vol.57, No.5 (Summer 1979), pp.975-86; Gray, Modern Strategy, Ch. 1.

85. Williamson Murray, “Innovation: Past and Future”, in Murray and Millett, eds., Military Innovation in the Interwar Period, p.302.

86. Andrew F. Krepinevich, Jr., The Army and Vietnam (Baltimore: Johns Hopkins University Press, 1986), pp.112-27, 168-72, is strategically damning. Shelby Stanton, The First Cay in Vietnam: Anatomy of a Division (Novato, CA: Presidio Press, 1999), tells the story.

87. MacGregor Knox, “Conclusion: Continuity and Revolution in the Making of Strategy”, in Williamson Murray, Knox, and Alvin Bernstein, eds., The Makers of Strategy: Rulers, States, and War (Cambridge: Cambridge University Press, 1994), p.616.

88. Murray, “Innovation”, p.316. The argument finds full support in Murray and Millett, A War To Be Won.

89. See Alan Beyerchen, “Clausewitz, Nonlinearity, and the Unpredictability of War”, International Security, Vol.17, No.3 (Winter 1992/93), pp.59-90, and Roger Beaumont, War, Chaos, and History (Westport, CT: Praeger Publishers, 1994).

90. See Strassler, ed., Landmark Thucydides, pp.44, 66, for powerful examples.

91. Clausewitz, On War, p.120.

92. *Ibid.*, emphasis added.

93. See Stephen R. Mann, “Chaos Theory and Strategic Thought”, Parameters, Vol.22, No.3 (Autumn 1992), pp.54-68. David S. Alberts and Thomas J. Czerwinski, eds., Complexity, Global Politics, and National Security (Washington, DC: Institute for National Strategic Studies,

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National Defense University Press, June 1997), and Tom Czerwinski, Coping with the Bounds: Speculation on Nonlinearity in Military Affairs (Washington, DC: Institute for National Strategic Studies, National Defense University Press, 1998), are both useful.

94. I am grateful to Williamson Murray for strengthening my conviction that this is so. Murray, "Innovation", esp. pp.305-8.

95. Overy, Battle, is the outstanding brief analysis, while Stephen Bungay, The Most Dangerous Enemy: A History of the Battle of Britain (London: Aurum Press, 2000), also warrants respect.

96. Scholars continue to differ over whether or not Hitler was bluffing in 1940 with his invasion preparations. Murray and Millett are not persuasive when they claim that "[a]n amphibious landing on the British Isles was never a serious option". A War To Be Won, p.84. Overy is more plausible, with the view that "[t]here need be no doubt that under the right circumstances Hitler was serious about invading Britain in 1940". But, "[h]e wanted invasion to be foolproof, 'absolutely assured'." For that reason, "[i]t is evident that not a lot was needed to deter Hitler from the idea of invading Britain. Fighter Command tipped the scales". Battle, pp.120. 121. It seems to me that Overy's careful wording is as close to the truth as we can reach.

97. The Zero fighter which entered service in 1940 achieved its superiority in performance over all contemporary American designs at the cost of protection. The Zero lacked armor and self-sealing fuel tanks. Until the U.S. sea services could fly the new F4U Corsair (initially land-based for the USMC as of February 1943) and F6F Hellcat (first production model, November 1942), tactics, training and experience would have to compensate for technical disadvantage. See Clark G. Reynolds, The Fast Carriers: The Forging of an Air Navy (Huntington, NY: Robert F. Krieger Publishing, 1978), pp.16-17; Ronald H. Spector, Eagle Against the Sun: The American War with Japan (New York: Free Press, 1985), pp.46-7.

98. Bailey, First World War and the Birth of the Modern Style of Warfare.

99. Allan R. Millett is both plausible and amusing when he argues that "[s]ome weapons [designed in the 1930's] even showed national characteristics". He observes that "American armored vehicles did not match the same superb performance of army jeeps and trucks; the Americans seemed predisposed to carry, not fight". "Patterns of Military Innovation in the Interwar Period", in Murray and Millett, eds., Military Innovation in the Interwar Period, p.345.

100. "[F]rom the very outset of the campaign [Russia. 1812], lack of mobility and associated problems were threatening to ruin Napoleon's brilliant strategic plan. Neither the Emperor nor his subordinates had any real previous experience of the detrimental effect that long, bulky convoys could exert on their rate of advance; they were, in fact, like frustrated sprinters with balls and chains fixed around their ankles". David Chandler, The Campaigns of Napoleon (London: Weidenfeld and Nicolson, 1967),

p.771.

101. The story is complex and interpretation controversial. See Gudmundsson, Stormtroop Tactics; Tim Travers, How the War Was Won: Command and Technology in the British Army on the Western Front, 1917-1918 (London: Routledge, 1992); and Harris, Amiens to the Armistice.

102. On the German problem, see John Terraine, Business in Great Waters: The U-Boat Wars, 1916-1945 (London: Leo Cooper, 1989), pp.231-41. With commendable understatement, Terraine observes that “[s]ailors — but submariners in particular — like airmen are peculiarly at the mercy of their technical apparatus”. P.233. On the American problem, it is quite startling to learn that “[n]ot until summer 1943 would the U.S. submarines have torpedoes that worked”. Holger H. Herwig, “Innovation Ignored: The Submarine Problem — Germany, Britain, and the United States, 1919-1939”, in Murray and Millett, eds., Military Innovation in the Interwar Period, p.260. Reasoning operationally and strategically, these authors argue that German U-boat successes both in 1940 against Britain, and then in Spring 1942 against the United States, proved counterproductive because they provided painful, but survivable, wake-up calls. In contrast, the inability of U.S. submarines to effect much damage prior to mid-1943 denied Imperial Japan such a wake-up call. See Murray and Millett, A War To Be Won, pp.239-40. In 1940 and even 1942, Germany lacked the U-boat numbers to conduct a decisive campaign. Until late 1943. the same limitation applied to the U.S. Navy.

103. For detailed argument, see Gray, Modern Strategy, Ch.5. To extend the point in the text, the military culture(s) of a defense community are revealed in the style of its military behavior. As so often in these notes, see Williamson Murray: “Does Military Culture Matter?” Qrbis, Vol.43, No.1 (Winter 1999), pp.27-42, a question plainly intended to be rhetorical; as made abundantly clear in “Military Culture Does Matter”, Strategic Review, Vol.27, No.2 (Spring 1999), pp.32-40.

104. A.T. Mahan, The Influence of Sea Power upon the French Revolution and Empire, 1793-1812, Vol.1 (1892; Boston: Little, Brown, 1898), p.102. I am grateful to Jon Sumida for pointing me towards Mahan’s statement of this sound maxim.

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