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Case Study II: The RMA of the First World War

The First World War has no close rivals as a theatre of controversy for combative historians. Despite the passage of more than eighty years since the guns fell silent at 1100 hours on 11 November 1918, intellectual firepower ranging over many aspects of the war is livelier that ever. To the longstanding debates on the war's origins and precipitating causes,[1] and the merits or otherwise in its characteristic higher generalship,[2] have been added disagreements about the skill with which the war was conducted tactically and operationally. To a social scientist whose professional focus typically is on the near future (e.g. the contemporary RMA debate), it can be quite startling to realise that virtually every major question one can ask about the First World War is as yet not settled beyond reasonable doubt by scholarship. Citing a stream of innovative studies which began to appear in the 1980s, Williamson Murray claims persuasively that it was only with the appearance of those recent works

that we have finally began to understand the World War I battlefield. We still do not have an equivalent work [to those by Lupfer and Travers] for the French, Italian or Russian armies. If historians who possess the documents and unlimited time have taken seventy years to unravel the changing face of the battlefield, one should not be surprised that the generals had some difficulty during the war.[3]

Fortunately for our study, much of the historians' combat about the First World War, though fascinating, falls short of posing a potential threat to the integrity of these proceedings. Indeed, some of the more traditionally active zones of historians' contentions seem notably unlikely to shed much useful light on strategic history. For example, it is not obvious that further argument about Sir Douglas Haig's style of command, and performance in generalship, can yield more nuggets of clarification—unless such argument is tied closely to study of the effectiveness of his army.[4] Similarly, finely grained comparison of German and Allied (especially British) military-technical competencies as contributions to combat proficiency also stand in dire peril of missing the all-important strategic point. Specifically, the armed forces of the Allies did their strategic job well enough, while those of the Central Powers did not. It is all too easy for careful historians of the tactical and the operational conduct of the First World War so to lose the plot of a necessary strategic perspective that ironically they mirror in their errors those of their German subjects. Some of the new scholarship on the First World War, heralded by the appearance in 1981 of Timothy Lupfer's paean of praise for the changes in German tactical doctrine, has been vastly impressed by German military excellence. In defence and on offence, we are told, the German Army had the combat edge. The literary

arguments are powerful, while the unilateral detail of German achievement is telling indeed. There is, however, a need somehow to account for the embarrassingly inconvenient fact of German defeat. To staple together in an analytically convincing way the odd couple of alleged tactical excellence and strategic incompetence is a task beyond most historians. For example, there is something deeply unsatisfactory about these summative thoughts by Bruce Gudmundsson:

That the excellence that was achieved in the realm of tactics did not win the war for Germany does not make the revolution that occurred between 1914 and 1918 any less significant.[5]

Gudmundsson sacrifices a major strategic truth—that German arms did not fight well enough to win—in order to record a minor one—that a revolution in tactics was effected. Semi-plausibly he proceeds to argue that

The failure of the German Army in 1918 was not a failure then of German tactics at the squad, platoon, company, battalion, regimental, division, or even army level, but a failure of German operational art, German strategy, and German national policy.[6]

By analogy, a sports journalist might extol at great length the multidimensional skills of a football team in all aspects of the playing of the game, while blaming the strange fact of persistent defeat on the coach, team management, and the schedule. If tactical superiority should have led the way to operational and then strategic, for ultimate political, success in any great conflict, it was in the First World War.[7] Armies that reliably win tactically, which is to say fight more effectively than do their enemies, win wars. It is really as simple as that. They may not win elegantly or cheaply, but still they win. A relevant moral of this analysis is to the effect that when we read expert studies which purport to show the amateurishness and general clumsiness of the British Expeditionary Force (BEF), contrasted with Teutonic military skill and dexterity, what seems not to add up truly does not compute. We need to remember not only what Clausewitz wrote about war being a duel but also that History, unlike some historians, does not award marks for style.

The test of an army is how well it fights. The test of strategy is how well it uses force to meet the demands of policy. Our focus here is upon how, and how well, the major belligerents in the First World War learned the trade of modern warfare. More specifically, across the many dimensions to strategy what choices were made which were intended to exploit areas of relative strength and offset those of relative weakness? The RMA theme itself usefully directs enquiry to military performance overall. The theme of strategic behaviour emphasised here provides a constant reminder that military performance cannot be assessed intelligently save with reference both to the enemy and to the possibly fluctuating political purpose of it all.

Although one needs to be alert to the temptations and sins of patriotic historiography, it is scarcely surprising that the reputation of the BEF of 1914–18 should have grown by leaps and bounds as the result of the close scrutiny it has received by historians of recent years.[8] One would like to say it was inevitable that a new breed of military historians eventually would notice that there was something askew about the orthodox picture. How did upper-class Edwardian bumblers,[9] rigidly and unimaginatively leading a docile mass of wartime amateurs (volunteers and then conscripts),[10] manage to beat the supposedly tactically excellent principal military force of the continental superpower of the period? Obviously, the favourable (im)balance of resources of most kinds was important. But

could it be that among the British 'butchers and bunglers' of 1914–18 were men who were indeed up to their jobs of leading an army which knew its business by 1917–18?[11] Today, the 'butchers and bunglers' image of 1914–18 generalship has been belatedly demolished as the nonsense that it largely is. Nonetheless, some military historians are prone to veer towards judgements which implicitly appear to rest upon a beau-ideal notion of proper generalship for the period,[12] while conceptual rigidities can bedevil historical assessment. Just as the grand idea of a First World War RMA is a long retrospective scholar's invention, so the idea that by 1918 two substantially rival concepts of warfare—traditional infantry and artillery-led, versus mechanical—contended for dominance, also is the product of speculative theory. Tim Travers, the leading advocate of the thesis that two styles of war beckoned the BEF in 1918,[13] commits a classic scholarly error by criticising the British High Command for failing to pursue more consistently a character of combat packaged conceptually by himself in the 1980s and 1990s.

This chapter proceeds schematically as did Chapter 6. The candidate RMA of the First World War is advanced for understanding within the framework of the standard nine-step RMA 'life-cycle' presented earlier. That functional, but also substantially historical and largely descriptive, discussion[14] is succeeded by brief commentary on how this alleged RMA worked as strategic behaviour.

THE GREAT ARTILLERY WAR[15]

The leading edge of military-historical scholarship on the First World War today engages in sharp fire-fights on everything save for the relative significance of its subject. J.P.Harris is not especially controversial when he states as fact that 1914–18 'witnessed the most rapid evolution in the art of war yet known'.[16] Though now near-orthodox among scholars, this claim would have seemed no less than startling as recently as 1980. Needless to add, perhaps, the new tactical and operational scholarship on the First World War has yet to penetrate far into the coffee-table and documentary television markets, or indeed into a general public consciousness educated by the supreme awfulness of the worst day in British military history (after King Harold's defeat in 1066), 1 July 1916, the first day on the Somme.[17] Harris's judicious claim repeats the opinion expressed by Jonathan Bailey in an extraordinarily influential study. Bailey, significantly a very serious artilleryman as well as a bold historian, has asserted that

> Between 1917 and 1918, a Revolution in Military Affairs (RMA) took place which, it is contended, was more than merely that; rather it amounted to a Military Revolution which was that most significant development in the history of war to date, and remains so. It amounted to the birth of what will be called the Modern Style of Warfare with the advent of *'three dimensional'*, artillery indirect fire as the foundation of planning at the tactical, operational and strategic levels of war. This was indeed so revolutionary that the burgeoning of armour, airpower and the arrival of the Information Age since then amount to no more than complements to it—incremental technical improvements to the efficiency of the conceptual model of the Modern Style of Warfare—and they are themselves rather its products than its peers.[18]

Far from Bailey's argument being challenged, the years that have elapsed since he wrote the words quoted have seen his view extensively endorsed. His conceptualisation of what was effected in 1917–18 was, so it seems, just what the world of historical scholarship was waiting for.[19] It required an artilleryman-historian to have the confidence to place the 'revolutionary' label on what widely had come to be appreciated as a period of exceptionally rapid change. So what did occur in the art of war in those terrible four years, and why?

The RMA of the First World War was invented and carried through by great military machines which found themselves baffled and frustrated by the failure of the extant legacies of previous RMAs to deliver tactical and operational, let alone strategic, success. The character of warfare which failed in 1914–16 may be described as Napoleonic with an industrial base. Following the Napoleonic model, 'the German method of strategy' of the second half of the nineteenth century produced swift army-, even regime-, smashing victories.[20] The method embodied excellence in staffwork, in short-range logistics, much hard marching, mobile firepower, and some bold operational artistry (not to mention the good fortune of truly incompetent foes). German military studies believed they had found in classical sources, but above all else in Napoleon's signature *manoeuvre sur les derrìeres*, the magical elixir which guaranteed success. Envelopment, even double envelopment (*après* Hannibal's bloody triumph at Cannae), was vital for annihilation. As was to happen again, in 1940–41, German military planners before the First World War exaggerated the degree to which their (not so recent) victories were achieved by the genius in Prussian method, rather than by luck and enemy folly. However, even if Germany's high military reputation at home and abroad was entirely well merited, a familiar pattern of competitive emulation had asserted itself by 1914.

After 1870 every European army adopted the Prussian formula. They introduced conscription, expanded their railways and telegraphs, procured magazine rifles, machine guns and quick-firing artillery, set their general staffs the task of planning *offensive* wars in painstaking detail, and assigned a recklessly bowdlerised version of Clausewitz to their war colleges… Forgetting that the Napoleonic 'revolution in military affairs' had lost its punch once every other army in Europe adopted it, these generals went to war in 1914 labouring under the 'short war illusion'; they were somehow convinced that their planning, armaments and tactics would defeat the enemy, even though the enemy possessed virtually the same technologies and doctrines that they did.[21]

Geoffrey Wawro, whose words those are, captures most of the relevant context for the military crisis of 1914–18. The problem was not simply that the mainstays of the German method of war had been copied abroad, but also that that method could no longer succeed in the confines of the strategic geography of western Europe, unless, that is, the enemy made *and persisted with* operational level errors of truly Homeric proportions.[22] In August 1914, with its operational and tactical recklessness, France did its best to flatter the potential of a style of warfare which ordinary military competence should thwart without great distress.[23] By imperfect analogy, the mass armies of industrial Europe that marched to war in 1914 (having detrained at their frontiers) were not unlike the armies of 1809–12, or perhaps the great nuclear war machines of the superpowers from the late 1950s to the close of the Cold War. In each of those historical cases, there were reasons

structural to the context why rapid and decisive military victory either could not be achieved at all, or in the nuclear regard could not be secured at tolerable cost. With hindsight-foresight it is child's play for historians to identify solutions to problems which, to the historical actors, were revealed as such only cumulatively, piece by piece. In practice, the RMAs of the early 1800s, 1914–18, and 1945–89, all carried the seeds of their own self-limitation. The Napoleonic RMA could not overcome its technical and human problems of operational-level command in its gigantic, but disaggregated, armies; the RMA of the First World War was limited by technical problems of real-time battlespace command and especially by the absence of robust means for rapid exploitation of initial tactical success; while the nuclear RMA, as we shall see, was substantially confined in its strategic utility by the sheer, excessive, destructiveness of its weapons.

This chapter tells how yet another modern style of warfare was invented, perhaps discovered—since almost all of its constituent elements already were present in 1914–16—when the contemporary model failed dismally in the field in war. As noted already, the dominant paradigm of modern war in 1914 was thoroughly Napoleonic. Field guns laid directly over open sights would soften up the enemy's infantry; friendly infantry in waves or columns would then advance alone to the assault; and finally cavalry would try to exploit the infantry's success and turn the enemy's retreat into a rout (that is, if he was not double-enveloped, i.e., surrounded, and compelled to surrender). By 1918 that paradigm was long lost and buried together with its victims. From spring 1917 to the end of the war, an increasingly mature new paradigm of land warfare had indirect artillery fire enable decentralised combined-arms combat teams of infantry to seize and hold bite-size chunks of the enemy's defended zone. Tanks may or may not be used to crush barbed wire, depending upon the army in question, the task, and the terrain, while aircraft are variably useful, depending upon the weather and time of year (in daylight). This 'modern style of warfare' of 1917–18 vintage has been the model for regular land-air (or air-land) combat until the present day. Such modern war takes as a given the likelihood that the enemy has no flanks to be menaced (which is not always the case, of course). Instead, the mission is to achieve penetration of what amounts to a continually fortified zone.

Unlike some other military historians who are quick to award more points to one, rather than another, variant of this new paradigm of land warfare, Bailey wisely argues that:

> The interaction between the strategic setting and available technology still governs the fundamental choice—discerned in 1918—at the operational and tactical levels of war; between manoeuvre supported by firepower and firepower supported by manoeuvre.[24]

In other words, there was no set formula, no all-cases correct way, to employ the tactical elements in 1918 for superior military effectiveness.[25] Nonetheless, strategic history does record unambiguously that the Allied practice of RMA, inter alia, in 1917–18 as strategic behaviour proved conclusively superior to the rival German effort. One must never forget that history crowns as victor neither the belligerent who achieves understanding of the most elegant style of contemporary war that is feasible, nor even necessarily the belligerent who can best practice that style. War is not only about superior military art.

After all, military art has to serve a political master via strategic direction. The need to emphasise this point is one reason why RMA theory (and practice) is apt to mislead if it is developed in isolation from the theory (and practice) of strategy.

RMA LIFE-CYCLE

Preparation

By way of sharp contrast with the Napoleonic RMA, the RMA of the First World War did not amount to the inspired command of a well-nigh ready-fashioned military instrument. Rather did the parents of RMA between 1914 and 1918 have to make the revolution (in fairly distinctive national variants) in response to the manifest military crisis created by the abject failure of existing ways in war. A wide gulf divided British (maritime) from German (continentalist) strategic history in the century separating Waterloo from First Ypres. In part as a consequence, large differences separated British and German strategic and military cultures. The RMA effected in the First World War nonetheless was to reflect a generally common military enlightenment. A multi-year (we will not say long) war is a great equaliser of military skills. An RMA carried through in wartime enjoys a pace and conclusive realism in field testing that precludes scope for much of the debate that peacetime innovation can attract.

This RMA was not the product of one man, or even of several men (note its lack of eponymity), and it did not have as its centrepiece some arguably 'dominant' new weapon or technology. It did, however, have a dominant category of weapon, albeit not a new one, in the artillery. It would be technically true, but trivialising, to claim that just about every machine and military method or skill that played a significant team role in the RMA of 1917–18 either existed physically in earlier form, or at least had been conceived by fertile imaginations (e.g. the tank), prior to the war.[26] With respect to this RMA, although we can label developments over the course of the preceding century as RMA-preparatory, it would be more correct to see those years as preparation for what occurred in action as a general military crisis in 1914–16. The raw material from which the RMA would be fashioned in the midst of war was of course more or less present as potentialities in earlier years.

The political, social, technological, and industrial forces that found expression in the battle-shaped competitive military instruments of RMA of 1917–18 were the same forces which, *guided by a different paradigm of large-scale modern war,* produced the 'trenchlock' of 1914–16. If firepower especially in the forms of indirect artillery bombardment and automatic weapons was key to the unravelling of fortified fronts, it was the developments in firepower that had enabled flankless fortified fronts to be held against the assault craft of the day. It follows that the war waged in late 1917 and 1918 can be traced in its fundamental preparation to the great changes which gave birth to the modern state, to the modern idea of the national security community, and the industrial revolutions of coal and iron, and then steel, oil, and electricity. The Military Revolutions, or RMAs, of *c.* 1600 to *c.* 1900 ultimately found military expression in mass conscript armies, which were mobilised and then supported by rail, were equipped with the best weapons that modern science and technology could devise, and were commanded and

administered by general staffs of variable excellence. Alas, the factors just cited comprised the fuel of military, leading to strategic, and political, crisis. The new weapons and other useful devices (e.g. barbed wire) invented and developed from Waterloo to Ypres, when employed in warfare on a large scale against a fairly symmetrical foe, had the cumulative effect of denying the power of decision to the fight.

Preparation for what, in retrospect, well warrants ascription as the RMA of 1917–18, took the form of three years of trial and error on offence and defence as the belligerents struggled to design, test, and rearm for a practicable paradigm of flankless land warfare. That brief period of wartime preparation provided both new tactics for combined-arms warfare and, no less essential, the quality and quantity of machines and munitions necessary for new tactics to be applied. Focus on the RMA of the First World War must not obscure the significance of mass. By 1918, the two very tired sides in the war in the west were by and large more than competent in the tactical conduct of land warfare,[27] with each national army inventing and practising the form of RMA that best fitted its circumstances. Probably it is no exaggeration to claim that although neither had a notable edge in military prowess after four years of war, that condition of rough equality enabled the superior resources of the Allies to function as an uneven playing field. It would be difficult to exaggerate the importance of the conclusions reached by Ian Malcolm Brown in his path-breaking study of British logistics.

> Geddes's reforms of the winter of 1916 and spring of 1917 [brought in as Director-General of Transportation to reorganise BEF communications] released the constraints on both operations and strategy. From 1917 onwards, and particularly in 1918, the very excellence of the BEF's administration largely freed Haig and his subordinates to innovate and make offensive plans much more rapidly…the impact of administration in 1918 may be called subtly profound—it is not obvious, but it allowed the BEF to launch a series of material-heavy offensives in 1918 that, along with the rest of the allied effort, made clear to the German high command that the allies had become capable of winning the war on the battlefield.[28]

The BEF's logistical and general administrative excellence became deadly as the British Army overall became truly competitive with the Germans in fighting skills.

One should not need to add that the campaigns of 1914–16 were not intended as preparation for an RMA in 1917–18 which would resolve the tactical problems of taking and holding ground in the face of modern firepower. Such teleology is a conceit of the retrospective historian or theorist. In the successive years from 1914 to 1917, either both sides (1914, 1916) or the Allies only (in 1915, France; in 1917, France then Britain) believed that it had cracked the code for strategically decisive military success. Grim though it is to characterise the war in this way, the four years of the conflict can be seen as a race for each belligerent between, on the one hand, the acquisition of education in modern war and the raising of the military instrument to apply that education and, on the other hand, the progressive depletion of the moral and material resources to prosecute the combat. War weariness at home and at the front could impose a lethal enervation upon armies which had, at last, found fairly reliable tactical ways to fight well.

Recognition of challenge

It would be a grave teleological error to work backwards from the new style(s) of land warfare of 1918 to the point of departure in 1914, and interpret the intervening four years of bloody military education as a race to be first to a finishing line called competence in modern war. At first, the armies of 1914 did not know that they were not competent. Moreover, when all parties' ways in warfare failed to deliver even a remote semblance of victory, it was less than self-evident to nearly everyone that the necessary course of instruction and softening up of the foe must extend over three to four years.[29] To clarify that point yet further by analogy: the task of frustrated military men in 1914–17 can be likened to the mission of mountaineers committed to ascend Mount Everest, except that they do not, *and cannot*, know the height of the mountain. By way of an unsettling postmodern thought, *our* Mount Everest for the Great War analogy has no stable altitude. With the inestimable value of hindsight, we can appreciate much of the whole scale and difficulty of the climbs that the military machines were ordered by policy to attempt from 1914 to 1918. Such knowledge is strictly a privilege granted by historical perspective.

Objectively speaking, certainly the German, British, and French Armies recognised and rose as far as conditions allowed to meet the challenge of modern war. But that claim represents an Olympian overview. As late as September 1918, for example, it was less than crystal clear to Allied soldiers just how much of a challenge the German Army still posed (e.g. must we fight on through the winter and into 1919?).[30] Contrary to the argument of some historians, Tim Travers in particular, it is not persuasive to suggest that in the Hundred Days campaign of August-November 1918 the BEF demonstrated a lack of reliable grip on the challenge of modern war.[31] That only modest use of tanks was made by the BEF in the closing three months of the war reflected battle-field conditions and the availability of machines, not an absence of enthusiasm for a properly 'mechanical' style of modern war.

RMA theory has yet to offer much worth reading on the subject of 'revolutionary' behaviour as a response to challenge that is explicitly acknowledged. Writing historically, one size does not fit all cases. It can be difficult to 'get the RMA right', perhaps even to effect the right RMA, if one is not sure of the question. For example, if the atomic bomb was the answer, was there a question worth addressing with respect to German and Japanese atomic weapon research?[32] Recall that although early in the Second World War there had been excellent grounds to be anxious about German (and Japanese) research in atomic physics, the grounds were notably less solid for actually detonating the nuclear RMA in action in August 1945—by which time the Allied policy rationales included military expediency and diplomatic effect, not plausibly possible Japanese atomic bombs. Fast forwarding with the same question, 'if an information-led RMA is the answer today, what is the strategic question?' How well defined, persuasive, and important is the challenge that the makers of a particular RMA acknowledge and strive to overcome?

Of the candidate great RMAs (or MRs) examined in some detail in this book, that of 1914–18 was directed literally at the most concrete of existential challenges. The tactical, and hence the operational and strategic, stalemate on the Western Front presented a clear and all too present danger to political goals. The Napoleonic RMA was pulled full-throttle into life by the ambitions of one man who inherited a military system which did

not need to raise its game very far in order to be in a league of military effectiveness all its own, for a while at least. The nuclear RMA was pushed into reality by political fears which, though rational and reasonable, rested upon evidence and argument about enemy activity of a decidedly speculative kind. In the 1990s, the information-led RMA occurred, if it did, apparently bereft of significant political or strategic propulsion. The RMA of 1914–18 could hardly be more different.

The fundamental challenge in 1914–18 was supremely tactical in nature and scarcely required active probing thought for its recognition. The belligerent armies in the west could not outflank each other laterally, or vertically over-head. It followed that they needed to discover reliable means to penetrate the enemy's front and then exploit the break-in to secure a breakthrough for the achievement of operational-level success. Definition of challenge to tactical success emerged rapidly from the time when Helmut von Moltke issued the order to 'entrench and hold' above the River Aisne on 10 September 1914.[33] Though conceptually constant, the tactical challenge that the RMA of 1914–18 had to overcome was supremely dynamic. As the belligerents learned fitfully how to attack, so also they learned how to defend. Moreover, given that the defence is structurally advantaged in land warfare, and never in modern times more so than when railways could provide operational reinforcement more rapidly than footpower could penetrate deep battlezones,[34] the side typically playing defence (the German on the Western Front) characteristically was playing on a field with a favourable tilt. As the Allies' art in attack improved, impressively if unsteadily, from 1914 to 1918, so—alas—did the Germans' art in defence.

The challenge recognised in late 1914 was to devise ways, and acquire the military means, to break into and through a thinly scraped broken line of trenches. But by spring 1917 the task was to penetrate a three-zone elastic defence averaging seven miles in depth wherein a thinly held forward outpost realm served as a breakwater for a 'battle zone' or main line of resistance (MLR), comprising probably three lines of trenches and other (all around) fortified positions, which covered the artillery and the counterattack divisions which were held in and behind a 'rearward zone'.[35] Where feasible the 'battle zone' would be sited in terrain masked (dead ground) from the Allied attacker, and artillery would be well integrated with the defensive scheme. The Germans' emphasis was on flexibility. By way of a sharp contrast with their expensive tactical practice in 1916 at Verdun, and especially on the Somme, the new German defensive doctrine after winter 1916–17 sought to defeat Allied assaults on the MLR, not to hold on to, or promptly recapture, every last foot of lost territory. Defending infantry could disperse into shell holes to avoid much of the enemy's barrage, if it was of the 'lifting' kind (from one linear target to another). They would hold their positions in the battle zone pending the arrival of counterattack formations, which should be able to defeat an enemy that had achieved an offensive break-in. That enemy would be heavily attrited in numbers, exhausted, and unable to mount a cohesive defence. Such was the core of the theory of defence. Every zone in the defence system would be protected by ever more expansive aprons of barbed wire. As just noted, where geographically practicable the more serious elements of the defence would be sited on reverse slopes, hidden in the remains of woods, or built into the ruins of the urban architecture of the region.

The fact that all war is a duel, and that there is a constant dialectic between offence and defence, meant that the RMA of the First World War was a race to innovate so as to

make strategic progress towards a receding finishing line. The hastily improvised defences of 1914 were a poor joke when compared, say, with what Friedrich von Lossberg designed for the so-called Hindenberg Line in winter 1916–17. But so also was the art of attack of 1914–15 when compared with the complex orchestration of all-arms (sometimes) in 1917 and 1918. While the ignorant armies learned how to prevail, they learned also how to deny victory to the foe.

Parentage

The RMA of 1914–18 was authored by a cast of thousands. The tactical re-education of armies millions strong effected over the course of four years was very much driven 'from below' at what, following a literally Homeric suggestion, might well be called the working level of the war machines.[36] The rival high commands merit respect for not notably impeding innovation, indeed for providing such positive encouragement as their respective military cultures permitted. It should be unnecessary to add that military failure or disappointment on the grand scale yielded a context which proved a great enabler for bold experiment. With more or less assistance from on high, the RMA cumulatively was constructed and implemented by relatively junior officers, rather than by the names familiar to domestic publics from the newspapers (synonymous with 'the media' for 1914–18).

We are not short of names for the honour roll of parents of the RMA of 1914–18, but to provide such a listing risks misleading the reader. In both the German and the British Armies (the twin foci for the purposes of this case study) the process of tactical reform entailed constant dialogue between 'line' and 'staff'. Moreover, that dialogue was hugely decentralised, as regiments/ battalions, divisions, specialised corps, and armies each applied their experience in gargantuan training networks. Behind the static lines, 'trench (-zone) locked' from the North Sea to Switzerland, a complex architecture of battle and other training schools of all varieties proliferated.[37]

The RMA was never pursued according to a clearly articulated unified vision or doctrine. The contribution of no single person, document, or even concept of operations, neatly captures the revolution holistically. The theory and practice of direct *and predicted* artillery fire, preferably delivered unpreregistered (on the real targets), for Jonathan Bailey's three-dimensional way of war, is the closest approximation provided to date to what lies at the heart of the RMA of 1917–18.[38] His artillery-oriented interpretation of the course of the war is by far the most convincing explanation of what changed militarily, and why, in those years. Eighty-plus years of memoirs and scholarship have delivered no better theory than Bailey's.

Following Bailey, we should recognise the leading artillery colonels and generals as most truly the parents of this RMA. Haig and Ludendorff, even such army commanders as Hubert Plumer, John Monash, and Henry Rawlinson, are not the heroes of this revolution. Instead, if names we need, the roll of honour must include, for the Germans, Colonel Georg 'Durchbruch' ('Break-through') Bruchmüller *(Der Durch Bruchmüller)* and Captain Erich Pulkowski,[39] while for the British the names of most note include Generals Birch, Holland, Uniacke, and Tudor. The latter certainly were senior men, GHQ, Army, and corps-level Royal Artillery advisers, but they were not, and have not become, household names.[40] Given that there was an important mechanised dimension to

the British and French version of this RMA, it is appropriate to add to the list of parents of the RMA the names of Ernest Swinton of the Royal Engineers, most plausibly described as the inventor of the 'tank', and J.F.C.Fuller, the leading theorist on the use of the tank.[41] With respect to the increasingly decentralised and combined-arms focus for infantry attack, the best-known name for theory remains Captain André Laffargue of the French Army, whose modest study, *The Attack in Trench Warfare*, probably has been accorded undue significance.[42] The practice of infantry attack, emphasising flexibility in the co-ordination of combined arms from the battalion down to the platoon and even squad levels, is associated most closely by repute with Captain Willi Rohr, the leading spirit in the German development of stormtroop tactics.[43] For the defence, although the initial inspiration (in 1915) allegedly was French, the principal nominee for the hall of fame has to be Colonel Fritz von Lossberg, who as Chief of Staff of the German Third Army in 1915–16, and subsequently wherever his expertise was most needed, served as the quintessential 'fireman', designing and effecting systems of elastic defence in depth.[44] The Hindenburg Line of universal eponymous note should really be known as the 'Lossberg Line'.

The true parents of the RMA of the First World War were thus not commanding generals, or civilian politicians, who demanded the invention of a new, more effective, style of land warfare. Instead, they were the captains, majors, colonels, and one- and two-star generals who developed, or at least encouraged, the best contemporary military practice, as unfolding experience revealed to be the case, and who led intra-war reform by a process of example, laissez-faire and persuasion. However, no matter how widely we cast the net to recognise the vast and diverse scope of this wartime RMA enterprise, it is important not to dilute appreciation of the central, literally essential role of indirect (i.e. unobserved) and increasingly unpreregistered predicted artillery fire, and hence of the men who innovated with that arm of service.

Enabling spark

Artillery was the adjustable tool which, more than any other complementary element, unlocked the linear fortresses of 1917–18. The artillery key required both quantity and quality, and it needed skilful, certainly averagely competent, infantry to exploit its success. However, it would not be correct to argue that artillery was *the* decisive weapon in 1914–18. Artillery did not decide who won the war. But Allied competence, and better, in artillery did decide that their overall advantages in resources could be translated into military effectiveness for a strategically favourable outcome. Such was German and Allied artillery prowess by late 1917 that, ceteris paribus, limited military success became fairly reliably feasible.[45] When gross tactical errors were made, as for example when the French crowded their forward line of defence along the Chemin des Dames with troops (27 May 1918), then the artillery 'enabler' truly could open a dazzling prospect of operational victory. To enable victory to be won is not, of course, to ensure its achievement. British and German artillery in 1917–18 could create an opening for the manoeuvre force to exploit for decisive operational-level advantage, if only that force had been truly able to manoeuvre to win the deep battle.

The artillery of 1917–18 could enable success *if* the best technical practices making for accuracy were followed; *if* it was employed in sufficient mass; *if* it was controlled

flexibly as the shape of battle altered; *if* geographical-tactical circumstances were permissive; *and* if the co-operating arms played their combined combat roles with sufficient skill and adequate weight.[46] In other words, the near-perfection of artillery techniques and material by 1917–18 did not constitute a silver bullet certain to deliver victory. The leading reason was that here, as historically so often, belligerents engaged in a protracted conflict could not unilaterally invent, and then with the element of surprise practise, a devastatingly novel way in war. In wartime the enemy is alert to tactical change and already is mobilised to cope with it. Isolated changes in tactical practice—for example, the German introduction of chlorine gas at Second Ypres in 1915—typically yield only isolated and temporary advantage. The Great War did not follow any discernibly nonlinear course as a result of some individual technical tactical catalyst.[47]

Full demonstration of the belated triumph of comprehensively scientific gunnery was achieved almost serendipitously. The BEF planned a great raid at Cambrai in November 1917 to breach the Hindenburg Line, a raid designed primarily to test the massed use of tanks for the first time. The terrain in front of Cambrai was judged to be good tank country, but only if the ground was not pitted with thousands of shell holes prior to the effort of the tanks to advance. A further reason to eschew any version of the ever more monumental artillery bombardment characteristic of the material 'massification' of the war in 1916–17 was the need to preserve surprise for the tank-led assault. The BEF secretly gathered a total of 478 tanks for the raid. By the close of the first day of the battle, 179 were out of action, though only 65 because of enemy action.[48] The story of the initial success at Cambrai (nearly four miles gained) appeared principally to be the tale of the tank. However, useful though the tank had proved to be when employed in large numbers, particularly for crushing belts of barbed wire, the real story of Cambrai was about combined arms. If any one element threatened to unlock the German front at Cambrai, and show the way 'to the green fields beyond', it was the artillery. The key tactical 'enabler' was the artillery rather than the tank. While Cambrai had been intended to showcase the potential of the tank, in fact it demonstrated—to risk exaggeration—a near perfection of predicted artillery fire. As much by accident as by wise intent, the grand design for Cambrai, shaped to privilege the tank, happened to require the artillery to make a statement about how far it had progressed since the Somme in 1916 in scientific gunnery.[49]

Military effectiveness for strategic effectiveness is made from all of the dimensions of strategy. The argument at this juncture amounts to the claim that certainly British, and generally also German and French, artillery could 'unlock' field-fortified armies by late 1917 and 1918, *other factors permitting*. The qualification is vital, not merely dutiful or decorative. The best gunnery minds, methods, and equipment enabled military success: they sparked what now is known as the RMA of the First World War. But this artillery-led RMA could not succeed in the field by means of artillery knowledge, method, and material acquisition alone. In the same way that some corps in the BEF offered cultural resistance which impeded adoption of German- (and French-) style tactics of defence in depth,[50] so notably large elements in the German Army in the west declined in practice to obey orders and adopt the 'Pulkowski method' to achieve accurate predicted (unpreregistered) artillery fire.[51] It is one thing to know how to wage modern war, it can be quite another actually to be able to do it across the whole army. For another example, the excellence of German infantry assault technique in 1918 is well established: indeed, it

was demonstrated on a modest scale in 1917 at Caporetto (20 October) and in the counterattack at Cambrai (30 November). The problem was, first, that most of the German follow-on infantry attacks in the great offensives of 1918 did not employ so-called stormtroop tactics, and, second, that elite stormtroopers suffered unsustainable losses.

If the artillery revolution of 1917–18 that sparked the RMA was to be allowed to enable victory to be won, then the whole army, and the society and government behind it, had to play their parts also. At least until the age of the nuclear-tipped ICBM (and probably not even then), wars could not be won by artillery conducting deep battle in isolation. With reference to the artillery, it is quite apparent that this 'enabling spark' for RMA taught itself through more than three years of war, 1914–17, how to do the job that the persisting stalemate unexpectedly revealed to be necessary. The artillery required scientific method, the right equipment and ammunition, sufficient quantity for quality to tell, and competence by co-operating arms for success in the whole team endeavour of modern land warfare.

Most of the scientific techniques needed by the artillery in the conditions of 1914–18 were not invented in those years. Nonetheless, it required the necessities of what amounted to siege warfare for theory and what once had been only exceptional practice to be adopted as standard operating procedure. Recall that in 1914

Artillery training was based on the assumption that the normal method of shooting would be over 'open sights'—that is, much as a man would fire a rifle. The gun layer would look along his sights at a target that he could see from where he was standing. Obviously it was expected that the enemy would do the same.[52]

Such practices proved suicidal, even in August-September 1914. 'Direct fire was given up and virtually never used again.' But if the enemy—infantry, guns, or whatever—could not be seen, how could guns be laid upon him? The answer was summarised thus by a superior study-memoir:

In conditions such as those of the last war artillery could only be used *effectively* if they had (1) good maps, (2) their own position accurately located, (3) the position of enemy guns accurately located, and (4) means of laying their guns accurately on these targets without previous registration.[53]

How were these facilities to be provided? The answer, for the BEF, was the 'Field Survey Battalions, R.E.—(1) by the Map Sections, (2) by the Topo. Sections, (3) by the Observation Groups [for gun 'flash spotting'] and Sound Ranging Sections'. As contrasted with the 'open sights' firing at Le Cateau in August 1914, the state of the art in artillery use in 1918 would achieve can accuracy of 80 metres at a range of 4,000 metres through prediction, a similar performance (in terms of accuracy if not range) to modern guns [1987]'.[54] For the perfection of the military instrument, calibration to check for barrel wear on each gun became standard. Ammunition batches were tested for variations in manufacture. Meteorological reports were consulted for changes in air temperature (and hence density) and for wind speed and direction. Gun sites were surveyed scientifically and accurate bearings were taken from known locations in enemy

positions.[55] Accurate maps of enemy-held terrain were drawn and updated as aerial reconnaissance allowed photography from above. Enemy guns—typically not a target in pre-1914 artillery doctrine, and not a priority as late as the Somme in 1916—were located by sound and muzzle flash, as well as by direct observation from the air. The quantity, quality, variety, and sophistication of ammunition (including shell fusing) was a revolution itself in 1914–18, while the number of heavier guns, especially of the howitzer type (for higher-trajectory plunging fire), was increased exponentially.[56] Similarly, the ratio of artillerymen to infantry in armies shifted dramatically, as the artillery's role changed from a useful adjunct to infantry battle to a literally vital enabler if the infantry was to move forward at all or hold its ground.

Whatever the exact character of RMA favoured by different belligerents from battle to battle in 1917–18 (i.e. allegedly mechanised, or infantry-artillery), or stamped with approval by later armchair generals, one feature they all share is dependence upon the artillery fire-plan. In 1917–18, as in any period, there was an abundance of reasons why grand military designs might fail on the day. Distinctively unique to this RMA of the First World War is the fact that if the artillery performance was poor, the prospects for success would hover between improbable and impossible.

Strategic moment

The idea of a strategic moment can sit oddly with a long view that might rather regard such particular instances more as false dawns than as the reliable herald of revolutionary effectiveness through new ways in warfare. The reason for the apparent paradox that a strategic moment can be, indeed usually is, succeeded by military disappointment, resides in the very nature of conflict as a bilateral (or more) struggle. Some of the theoretical writing about RMA misses the Clausewitzian point that 'war does not consist of a single short blow'.[57] Definitions of RMA that require 'a dramatic increase—often an order of magnitude or greater—in the combat potential and military effectiveness of armed forces', in Andrew Krepinevich's words, do not fit well with historical evidence which expresses the paradoxical logic of strategy.[58] Airy generalisations about RMA are prone to mislead theorists into the error of forgetting that technological and tactical transference,[59] as well as more or less parallel discovery,[60] will reduce the longevity of Krepinevich's optimistic 'dramatic increase' in military effectiveness.

Even quite plausible strategic moments can herald military performance which fizzles after a flashy start, rather than continues to dazzle as its executive military instrument matures in prowess. Indeed, because military effort is not autarkic, but is applied in a contest, it is always possible, and sometimes is probable, that a strategic moment genuinely worthy of the title will raise the curtain only on a more modern version of attrition.[61] The merit in this argument is illustrated with unusual clarity in the case of the First World War RMA. Several candidates vie for coronation as the strategic moment in this RMA. There are three German and also three Allied candidates for the strategic moment. The possible German strategic moments were: Oskar von Hutier's attack on Riga (1 September 1917); the attack by Otto von Below's Fourteenth Army (with six German and eight Austro-Hungarian divisions) at Caporetto (24 October 1917); and Ludendorff s great 'Michael' Peace Offensive (opened on 22 March 1918). The Allied candidates were: the attack by General Julian Byng's Third Army at Cambrai (20

November 1917); the relatively modest assault by General John Monash's Australian Corps (under the command of General Henry Rawlinson's Fourth Army) at Hamel (4 July 1918); and Rawlinson's spectacular offensive at Amiens (8 August 1918). Other candidates could include French (and American) performance at the opening of the Second Battle of the Marne (18 July 1918), or the breaking of the Hindenburg Line by Rawlinson's Fourth Army (with the set-piece action commencing on 29 September 1918).

The relative abundance of supportable candidates for election as the strategic moment of the First World War RMA is of no particular significance. Indeed it would be a trivial endeavour to devote space and energy to a detailed comparison of the merits in each candidate. What really does matter for our analysis is that fact that each side had a strategic epiphany. Unfortunately, the approximately parallel strategic epiphanies meant that neither side was likely to be able to exercise and then exploit its particular versions of the RMA *du jour* into the zone of decisive military effect. For the Allies (in this case, the British), the balance of argument supports the consensus among RMA theorists that Cambrai was the moment, notwithstanding the painful disappointment suffered with the successful prompt German counterattack and then the temporary, albeit frightening, defeats of spring 1918. For the Germans, the most plausible strategic moment was the enormous, though ultimately empty, victory at Caporetto.[62] These choices are not only historically persuasive in the light of long hindsight, but they endorse dominant contemporary opinion also, which is much more gratifying. The BEF's tank-led, but artillery enabled, brief triumph at Cambrai, following the undisguisable failure of Third Ypres, prompted the British prematurely to ring their church bells for the first time since 4 August 1914. As for Caporetto for the Germans, in Bruce Gudmundsson's telling judgement: 'The successful exploitation of the breakthrough at Caporetto proved to Ludendorff that the German Army had developed a tactical system capable of breaking the deadlock of trench warfare and thus permitting the resumption of manoeuvre at the operational level.'[63]

Operationally reviewed, Caporetto and Cambrai in October and November 1917 led nowhere directly. But both events showed the way forward to responsible soldiers at the time. They showcased new styles in land warfare which, with the errors of novelty reduced, might (perhaps should) deliver the overly long-anticipated strategic victory. Whereas von Hutier's success at Riga over-whelmingly was an operational-level triumph[64]—albeit with the vital assistance of sound artillery technique centrally directed by Bruchmüller—both Caporetto and Cambrai were, for the time, quite extraordinary tactical victories. They can be seen as dress rehearsals for the main event that was to be Ludendorff 's four-step grand offensive in 1918. However, such teleology would be unwise. These two German successes were both shaped vitally by unique circumstances. Caporetto, for all its impressiveness, was a success in mountainous terrain against an Italian Army, which, though adequately equipped, suffered from appalling leadership. To defeat a demoralised Italian Army, led by one of the war's least competent commanding generals (General Luigi Cadorna), offered no guarantee of later success against the Anglo-French legions in France. At Cambrai, on 30 November, General von der Marwitz's Second Army applied the best in current artillery and infantry practice to pinch out the salient (five and a half miles) seized by Byng's Third Army between 20 and 29 November. Whereas the German artillery on the Isonzo at Caporetto had been

concentrated in counter-battery duties against the extensive Italian artillery,[65] at Cambrai the principal task was to provide a creeping barrage in direct support of the infantry. Between them, Caporetto and the Cambrai counterattack told the German High Command that at last they had a winning ticket. Specifically, they had found and practised a method of offensive war with centralised, but tactically flexible, artillery prowess and decentralised infantry assault skills. It seemed probable to the Germans that, working well together, their new infantry and artillery tactics, when effected in the necessary mass, should reliably produce so significant a level of tactical success as to deliver operational victory. Strategic and political triumph logically and inexorably should follow.

The great British Cambrai tank raid on 20 November 1917 was the Allies' strategic moment, even though it showcased a more mechanised vision of future land warfare than would be the general experience in 1918.[66] If the German use of artillery at Riga, Caporetto, and then in the Cambrai counter-attack, was typically excellent, then the BEF's artillery performance at Cambrai was awesome. With no preliminary bombardment, or even registration firing, which could alert the enemy, British artillery secured a firepower dominance that allowed the tanks and infantry to advance further, and more cheaply, than had been possible in the war to date on the Western Front. This limited attack, and the German counterattack, encouraged both sides to dream and plan for success tomorrow. However, the operational, strategic, and political context of 1917–18, as well as the very nature of strategy, would limit the scope of practicable achievement.

Institutional agency

The military instrument that conducts an RMA at the sharp end in the face of battle is the product and expression of organisations with cultures which both help and hinder the effective conduct of warfare. The temporal and human dimensions of strategy and war impact upon strategic performance in ways that historians frequently neglect to notice. The RMA of the First World War showed institutional and intellectual-doctrinal adaptation in the face of temporal and human constraints unprecedented before or since.

In order to rate the strategic performance of German and British Armies in 1914–18, it is important to recognise how steep was the learning curve they had to ascend, how short a time they had in which to adapt, and how severe were the impediments of all kinds which generated friction for them. On the temporal front, it is sobering to appreciate that the executors of this RMA had only two to three years in which to complete their task. The agents for RMA in the French Revolutionary/Napoleonic and nuclear cases enjoyed respectively 23 and 42 years in which to adapt to modern war. The information-led RMA of current controversy is today a story with an active life of more than a decade, and is still running. The contemporary RMA debate may be suffering from terminal enervation, but its real-world referents are very much alive.[67] What is so impressive about the organisational and tactical-doctrinal adaptations of 1914–18 is that they were implemented under duress in wartime conditions.

It is true, of course, that large-scale intensive battle was not continuous, and that the two sides showed different (though naturally interlocking) patterns in primary operational and tactical focus upon offence or defence. Nonetheless, innovation had to be effected

either in the actual, or in the anticipated, shadow of battle. The states, societies, and military organisations with their preferred doctrines were allowed the better part of two decades to learn how to wage modern war in the 1790s and 1800s. They had a similar span of years to identify the requirements of what was hoped to be 'safe (enough) nuclear strategy'.[68] Moving on, states have now had a decade and still counting to comprehend the information-led RMA. By way of contrast, the leaders in 1914–18 had to perform literally while under the gun (that was firing). Even when we turn to the mechanised RMA(s) of the Second World War, we find that the German Army enjoyed two potentially useful 'time-outs' for doctrinal second thoughts, in 1939–40 and 1940–41.[69] The British Army in that war was not tested on the grandest of scales between June 1940 and June 1944, notwithstanding the educational traumas experienced in north Africa and Italy.[70] The US Army, and especially the US Army Air Forces, were granted ringside seats to observe the dos and don'ts of modern war as perpetrated by others. In the Second World War, only the Soviet Red Army was obliged by an unforgiving temporal necessity to adapt, borrow, and innovate, much as had the armies of 1914–18.[71]

An important consequence of the temporal dimension of the First World War shows itself also in a human dimension which registers as a cumulatively enervating, even operationally disabling, level of casualties. The armies of 1914–18 had to adapt organisationally and doctrinally while under extreme time pressure and with an instrument that was suffering transformative casualties.

Readers must judge for themselves where they pitch their opinions between admiration and criticism for the strategic performance of the military profession in 1914–18. The experience of the Second World War and then the nuclear-shadowed Cold War can promote an unhistorical loss of perspective. In less than four years, in the Great War, the principal belligerents effected a scope and scale of societal and economic mobilisation for as total a war effort as it was judged social stability could stand. Looking to the sharp end of the effort, the military institutions of state had to adapt to a character and style of war for which they were utterly unprepared. Then, having discovered the awful facts of mass warfare, they had to innovate a style of combat to break out of the stalemated box of that mass warfare. It is amazing that both sides succeeded in large measure.

The fact that the Allies won attests more to a nature of strategy and war that commands respect for quantity, than it does to any inherent superiority in the Allied, as contrasted with the German, way in war. Dennis Showalter is almost exactly correct when he argues that '[n]one of the combatants succeeded in establishing a clearly decisive, clearly superior style of war by November 1918.'[72] We must say 'almost', because wars cannot be won by style, superior or offensive. Indeed, many historians believe that the German Army waged tactically the better war, if one may so express it, even though it lost in the end. It is a vital theme of this book that strategic behaviour is a holistic undertaking and can be assessed properly only in that way. The Allied, especially the BEF's (of 1918), way in land warfare was not always elegant, but it did express a style that their total resources could support satisfactorily, while the German way did not.

The institutions and ideas needed to wage the Great War, as the character of that conflict revealed itself sequentially in 1914–16, were invented in improvised fashion from organisations and cultures that set out in August 1914 to wage a quite different kind of war.[73] Although much of the administering and tactical behaviour was the product of

initiatives at local working and fighting levels, states and armies had to adapt to the prolonged conduct of war on the grandest of scales judged feasible. Jerky newsreel film of quaint uniforms, suicidal-looking linear infantry assault, and well-fed senior generals—in the context of the terrible casualty statistics—is frequently deployed to illustrate a commentary alleging monumental incompetence by nearly all those in charge. With an omniscient hindsight, latter-day would-be Haigs and Ludendorffs rush to negative judgement. Notwithstanding the passage of more than 80 years since 1918, it is noticeable that no-one as yet has been able to identify practicable short-cuts to victory in 1914–18. Some scholars argue that victory, and defeat, should have been served at lower cost. It is claimed that the Allies ought to have made more regular and extensive use of a 'mechanical' style in combat, and should have limited their offensive ambitions to try to 'bite and hold', rather than effect a breakthrough for deep exploitation.[74] The former was doable in 1917–18, while the latter was not.

It is no part of this analysis to engage directly with today's critics of German and Allied performance in the war. However, it is our purpose to show that both sides effected an RMA, perhaps a military revolution, and that their strategic behaviour was impressive by any plausible historical standard. Dennis Showalter is persuasive when he argues that

European systems…adjusted rapidly, comprehensively, and successfully to the demands of mass warfare. States and armed forces manifested throughout 1915 a palpable sense of wonder that conscripts were reporting, factories were producing, and fighting was continuing, at least for the moment. They projected as well the image—and to a great degree the reality—of *a culture of competence*.[75]

A BEF scheduled to contribute six divisions to co-operate with the French, if the Cabinet agreed, grew to comprise 60 (British and Empire) divisions. French and German armies, anticipating an operational level replay of the swift campaign of 1870, had to recover their balance after the definitive failure of their (pre-) war plans in 1914 and adjust to the certainty of action for another campaigning year. We must be alert to the historians' trap of, in this case, judging leaders in 1914–15 in the light of our knowledge that the war lasted until 11 November 1918. First 1914 was to be the year of decision (for both sides), then 1915 (for France and Britain, and Germany in the east), then 1916 (for both sides), then 1917 (for the British, at least), then 1918 (for the Germans, and ultimately the British), and even 1919 (for the French and Americans).

Both sides adjusted to the extended conduct of mass warfare, and then they adjusted impressively to the limitations of mass, of sheer quantity, and had to learn how to manage, integrate, and use the new technologies and tactics by the mass armies that had been created. It is true that the German Army was always infantry-led in its style of war, notwithstanding wide recognition of the artillery expertise of Bruchmüller (and his methods).[76] Also, it is true that the Allies adjusted to the stalemate of mass versus mass with a more machine-led style of combat.[77] November 1918 tells us who adjusted most effectively to the realities of modern war: in other words, whose strategic *(means-ends)* behaviour was superior. That point aside, each principal belligerent performed prodigies of military, inter alia, innovation while under fire.

Although there were notable differences between the German and British variants of the RMA of the First World War, they both coped plausibly and generally effectively with the novel common tactical problems of the era. Both learned: how to use machineguns in large numbers (even to the point where a machinegun barrage would fire indirectly for unobserved effect, creating a 'bullet storm' to protect an advance);[78] how to use (and oppose) tanks; how to conduct trench and counter-bunker warfare entailing the development of mortars, 'bombs', hand and rifle grenades, flamethrowers, and light machine-guns; how to use gas cylinders and then gas shells; how to lay artillery indirect fire, preferably without prior local registration; how to conduct air warfare of all kinds, and much more. Both sides taught themselves decentralised combined arms tactics (with many new weapons) at platoon and section levels, and how to combine infantry, artillery, and aircraft in offence and defence. In addition, to mention dimensions frequently taken for granted by historians of tactical, operational, and strategic art, the entire enterprise of *grande guerre* had to be financed and efficiently supplied with the necessary human and material resources. Needless to say, perhaps, the requisite administrative and logistical skills for the war which unfolded in real time for the belligerents, had to be invented, borrowed, or discovered near-instantly.[79] We also should note that political leadership of a high order of competence was necessary to keep the combatant societies up to the mark for a trial which, even as late as early autumn 1918, appeared to have no end.

Instrumentality

The previous, current, and next steps in our RMA life-cycle (institutional agency, instrumentality, and execution) may be likened successively to sword-making, large-scale sword production, and swordplay. It was suggested immediately above that the institutional agents on both sides for the First World War RMA performed miracles of organisation, administrative innovation, and doctrinal adaptation. However, miracles take time. No matter how generally praiseworthy were the organisational agents of RMA, and regardless of the military merit in the new ideas discovered and honed in 1915–16, not until quite late in 1917 did either side on the Western Front begin to command a plausibly potentially winning scale of military power *of requisite combat competence*.[80]

It would be foolishly reductionist and therefore misleading to claim that the technological dimension of war was decisive in the conflict. It would not be misleading, though, to refer to the First World War as the great artillery war, at least in the sense that artillery proved to be the only key that reliably opened the tactical door to tactical success (and any operational success, should that prove feasible). Technology for superior artillery performance was by no means synonymous with that performance. The guns of 1914–18 certainly needed technological support from metallurgy, chemistry, electronics (for communication), meteorology, survey, and aviation. They also needed rigorous industrial quality control for consistency in high-quality manufacture, technical competence in gunlaying, and tactical excellence for the devising of fire plans which would work synergistically with the other elements in the combined-arms team (infantry, tanks, cavalry, aircraft). Knowledge and technology, though vital, could not produce tactical success. To win, the armies also needed numbers (of everything).

The German and Allied military instruments which carried through the First World War RMA demonstrated time and again in 1914–17 that they were not (yet) instruments

for victory. Although one can point plausibly enough to poor, even some plainly awful, tactical and operational performances year after year in 1915, 1916, and 1917, it is extremely unlikely that either side all but threw away by incompetence a genuinely glittering opportunity to win. On the geography of the Western Front, neither side enjoyed a net military effectiveness between 1914 and 1917 such that victory was reasonably probable. Battles, even campaigns, could be lost, certainly drawn, but tactical gain and loss had no immediately major operational, let alone strategic, consequences. Attritional warfare is like that.[81] The Germans were beaten on the Marne in September 1914, but they retired in good order and dug in for four years. They failed to turn, or break through, the left of the Allied line around Ypres in October-November, but the outcome was a stalemate born of exhaustion, not any significant German retreat. Franco-British offensives were entirely repulsed in 1915; they tested most expensively the solidity of the territorial status quo in the war. In 1916 on the Western Front, everybody failed in their sundry objectives; the Germans and French at Verdun; the British, French, and Germans on the Somme. In 1917, the French failed miserably on the Aisne, while the British did well at Arras and Messines, but fought themselves to a standstill in the mud at Third Ypres in the autumn. Cambrai in late November saw tactical success, first for the BEF's surprise tank raid, and then for the Germans' counterattack; but again brief tactical success for each side led precisely nowhere, operationally and strategically—or at least so it seemed. Since decisive operational manoeuvre was not possible on the flankless Western Front, it is hardly surprising that dramatic evidence of military progress was not easy to find in the phase that Douglas Haig called 'the wearing out fight'.[82]

It took both sides three years to learn sufficient of what they needed to know about the changing character of modern war so as to have ready to hand a method, actually methods, to win. That comprehension was bought with the casualties and material resources expended from 1914 to 1917. The RMA of this great war, as applied in the conditions of the period by its authors (i.e. not as it can be assessed today for the quality of its lasting contribution to the art of war),[83] could deliver in the west strictly tactical-level success which could only cumulate by attritional results to show operational, and then a clear strategic and political, outcome (an armistice reflecting the fact of German military defeat). The essential quality in military method necessary to win was of course dynamic, as both sides learned comprehensively the trade of modern war. The rival armies improved in their absolute military prowess from 1914 to 1917, but unfortunately for the prospects for swift decision, military effectiveness in war is always a relational variable. As military solutions evolved, so alas did the military problems.

Properly holistic appreciation of how and why the war was won (lost) in 1918 underlines how essential it is to approach an RMA as strategic behaviour. It is necessary, but not sufficient, to argue that the Allied armies, led by the BEF,[84] won because they had mastered the art of war for 1918; neither is it sufficient to claim that the BEF was the leading military instrument of victory because of the relative material abundance behind it. Nonetheless, J.P.Harris is right to remind us that 'British artillery in 1918 also had the luxuries of seemingly limitless quantities of ammunition and an abundance of guns.'[85] The superiority of mobilised resources was strategically significant because by late 1917 Allied armies were 'proficient enough', or better, in the skill with which those resources were used in battle. On the 'adversary' dimension of strategy, in 1918 the Allies fought not only with a German Army effecting an infantry-artillery (i.e. unmechanised) version

of the common RMA of the time, but also, critically, with an enemy increasingly short of manpower and eventually increasingly low in fighting spirit. Morale will not defeat steel, as the campaigns of 1914 and 1915 demonstrated, but if it is in short supply it lowers the quantity and quality of performance required of an enemy for victory. Manpower and morale were in perilously short supply in all armies on the Western Front in 1918, save only for the Americans (who had other problems—lack of skill and equipment in particular). The outcome in November speaks eloquently to many of the critics of the Anglo-French 'way of war' who forget that war is about the entirety of strategic effect and its consequences. Victory in 1918 was achieved by the overall superior raising and combat direction of military means.

The 'German RMA' of the First World War, for all its much lauded elegance in stormtrooper infantry tactics and the 'Pulkowski method' in silent artillery registration, unarguably failed the strategic test when exercised in 1918. Between March and November of that year the German Army literally bled to death. That massive haemorrhage was not the result of ill-fortune, rather was it the inevitable consequence of the adoption of a style of infantry-led assault in a tactical context that predictably did not allow for operational exploitation for victory by manoeuvre. On top of the butcher's bills from the hideous attritional struggles of the first three years of the war, 'the German RMA' squandered the surviving strength of the army. It is worth quoting Tim Travers at some length on the fate of the German military instrument of RMA in the last nine months of the war.

It is not always recognised how depleted the German Army on the Western Front had become by late 1918. The German Official History estimated that from 18 July to the Armistice, the German Army had lost 420,000 dead and wounded, and a further 340,000 as prisoners of war, for a total of 760,000 casualties, plus an unknown number of desertions or refusals to serve, which may have been as high as 750,000 to 1 million. This was on top of the 1 million or so lost between March and July 1918, during the German offensives, so that the German Army suffered a possible total loss of some 2,760,000 casualties and deserters during 1918. Moreover, the highest losses occurred in the Mobilisation or Attack divisions, containing the elite of the German Army.[86]

Ludendorff committed his army to a desperate offensive with what amounted to reckless abandon in 1918, transferring a million men in 62 divisions from the East (though leaving half a million second-line troops), to give himself a temporary numerical advantage on the Western Front before the Americans could arrive in war-winning numbers.[87] He demonstrated conclusively, if inadvertently, that when military means and ends are out of balance, defeat must ensue if the enemy is good enough at modern war to stay on its feet and weather the initial storm. Germany's lack of depth in mobilisable manpower in 1918 rendered its preferred style of infantry-heavy RMA a desperate adventure, given the tactical conditions of the time (including the particular strengths of the enemy).[88]

Execution and evolving maturity

The British and German Armies were both, in their distinctive ways, highly competent and adaptable organisations. On the British side, prewar, the embarrassing early errors in

South Africa in 1899–1900 were rapidly corrected and the Boer republics were decisively defeated militarily in 1901–02.[89] As a generalisation, the quaint notion that the British Army in the early years of the century was officered by professionally slothful amateurs, more interested in gentlemanly sporting pursuits than the theory and practice of war, is an absurd canard. This allegedly ill-officered army, comprising large numbers of hard-case regulars who were all-but civilian unemployable, successfully waged continuous small-unit warfare around the globe against a bewildering array of military cultures. Zulu warriors in Natal, Waziri tribesmen along India's north-west frontier,[90] Boer irregulars on the high veldt, fanatical Dervishes in the Sudan—the British Army took on these, and scores of others, and almost invariably won. It mastered mountain, desert, high-plains, littoral (amphibious), and jungle warfare.[91] If these were military incompetents, they must have been extraordinarily lucky to emerge victorious as often as they did.

Of course, the British Army, the principal military instrument of one version of the First World War RMA, had some signature weaknesses. In point of fact it had the kind of weaknesses one would expect from an 'army' that year in and year out did not operate as such. It functioned by regimental garrison around the Empire, only occasionally needing to concentrate force at a divisional (let alone multi-divisional) level. The army was parochial, in-bred, and so ridden by 'cap badge' loyalties as seriously to inhibit inter-arm co-operation. Nonetheless, it was a flexible and effectively economical instrument of imperial rule. It is worth repeating some facts central to our story. First, this British Army between 1906 and 1914 prepared an expeditionary force for possible European continental employment comprising six all-arms (primarily infantry) and one cavalry division, approximately 120,000 men.[92] On mobilisation in August 1914, the BEF initially was composed of just 110,000 men. For some comparison, in November 1918, notwithstanding suffering two and a half million total casualties (world-wide)—dead (723,000), wounded (1,662,625), and POW's (170,389)—Sir Douglas Haig commanded a BEF ration strength of 1,794,000.

The bare statistics are startling enough, but it is worth noting that this BEF of 1914–18 which '[i]n technical, tactical, operational and administrative terms…developed into an army of great sophistication, more advanced in some respects than any of its contemporaries',[93] had to be rebuilt comprehensively after the opening rounds of fighting. The Official History tells us that '[i]n every respect the Expeditionary Force of 1914 was incomparably the best trained, best organised, and best equipped British Army which ever went to war.' Unfortunately, as it notes also, '[w]here it fell short of our enemies was first and foremost in numbers.'[94] Both British and Germans (and, of course, French, Russians, and Austro-Hungarians) suffered grievous loss in 1914, but the impact was disproportionately severe upon the much smaller army. That BEF which deployed to France with only 110,000 men in mid-August suffered casualties totalling 86,237 by 30 November (official close of the First Battle of Ypres).[95] German losses naturally were much higher,[96] fighting as they were all along what had become a Western Front, as well as in the east, but then the German Army mobilised nearly four million men in early August. The German Aufmarsch towards the west was effected by no fewer than 1,600,000 men.[97] In 1914, the Germans were defeated operationally, and noticeably bloodied, but most of their prewar regular army was intact: not so for the BEF.

Both the BEF and the German Army had to learn how to wage land warfare on the greatest of scales, and in so doing they carried through different variants of an RMA. The

benefit of a wartime context is the prompt feedback on relative effectiveness of new tools and methods, and the self-evident urgency of military need for change. A downside of wartime is that real-time pressures to do well enough today, especially when—as in the BEF case—one is learning for the first time how to provide for and run a mass army, can leave little time or inclination to think systemically. In other words, while an RMA is likely to require the reconceptualisation of military problems, the pressures of real-time war encourage getting on with the familiar job (e.g. if 500 guns firing for two weeks were insufficient, let us try 1,000 guns for three weeks). Also the problem of conceptual innovation, and then detailed execution, is compounded if the limited stock of the most effective people continually suffers from combat attrition on a large scale.

In some opposition to the argument advanced immediately above, it can be argued that radical change into the RMA zone is greatly facilitated by the fact that armies can be transformed by heavy casualties in a prolonged conflict (not that the First World War was a long war by *grande guerre* standards). One can suggest that although the BEF temporarily lost much of its erstwhile (highly professional) tactical skill in 1915–16 because of 'massification' by the sudden huge civilian influx, the exponential expansion of 1914–17 did create opportunities for new men to learn new skills for a new context.[98] The Official History quoted above concedes that the British Army of 1914, for all its virtues, could not stand comparison with the Germans 'in the matter of co-operation between aeroplanes and artillery, and use of machineguns'.[99] By summer 1918 the BEF was probably the most skilful army on the Western Front at the combining of arms in the offensive mode in land warfare. It is well worth noting that the most justly celebrated element in the German RMA of this period, the raiding style of stormtrooper infantry tactics, was developed by the Pioneers (each corps had a Field Pioneer Battalion), who were not unduly burdened by prior notions of proper infantry tactics and weapons.[100]

The Allied and German RMAs of the First World War were invented and applied, piece by piece, including some steps backwards, throughout the war. Scholarly efforts to compare the quality of, say, the British and German ways in war of 1917–18, let alone to consider in isolation how well each did absolutely, are thoroughly misconceived. Just as no country (except possibly the United States today) is likely to be equally militarily proficient on land, by sea, and in the air, so the BEF and the German Army had distinctive areas of relative strength and weakness. Those areas could change somewhat over time with mobilisation, experience, casualties, and the performance of the foe. For maximum clarity, let us identify the most salient facts.

By 1918, both sides in the west had learned by the most painful of educational experiences all that they could realistically be expected to know about the 'grammar' of modern land warfare.[101] Each knew the contemporary trade of war. The BEF and the German Army of 1918 had mastered the contemporary art of the offensive, while the BEF was still improving in its grasp of how best to defend. With British defensive weakness admitted, and plainly demonstrated (March and May 1918), still German military effectiveness on the offensive was insufficient to turn tactical into operational success. Each national army implemented as generically common an RMA as its geopolitical, material, and military-cultural contexts allowed. Finally, viewed properly as strategic behaviour, the Allied, especially the BEF's, RMA, better matched available means to desired ends than did the German variant.

Year after year from 1914 to 1918 the two sides were learning roughly in parallel how to attack and how to defend. Because the Germans had seized so large and important a fraction of French territory (and virtually all of Belgium), they enjoyed the tactical and operational advantages of being, as it were, in possession. The Allies had to attack if the Germans were to be expelled, and they had to attack frontally because there were no operationally exploitable flanks to the Western Front. It is unsurprising that by necessity the Germans became true masters of the defence; they launched great offensives in the west only in 1914 and 1918.[102] The attack at Verdun in 1916 was designed to seize easily defensible terrain that would oblige the French Army to bleed itself to death trying to recapture. Unfortunately for their performance according to the grand means-ends equation of strategic accounting, for two years (1914–16) the German Army adhered to a tactical doctrine of prompt counterattack to recover all lost ground, a doctrine which had the inexorably nasty consequence of roughly equalising the levels of casualties suffered. From 1915 until early 1918 the German experience on the Western Front tended to the defensive, while the Allies were primarily on the offensive. This contrast mattered, and never more than in what transpired to be the year of decision, 1918. The way in which it mattered most was with respect to artillery. German artillery was good and better than good, especially when directed centrally by Bruchmüller, but it was not as good on the offensive as was the artillery of the BEF, and neither was it as numerous (though of course it was assembled to provide local superiority to support attacks). Everything matters in combined-arms warfare, but in the First World War artillery for the side on the offensive mattered more than anything else.

As indicated much earlier, strategic performance is the product of the values on all of strategy's dimensions. As with the belligerents coping with the Napoelonic RMA discussed in the previous chapter, and the leading participants in the nuclear RMA in the next one, the contestants in 1914–18 were working fungibly with substitutions. Neither side wanted or needed strictly the best infantry, or artillery, or air corps, rather did it require sufficient military effectiveness to secure strategically significant advantage. In greater or lesser measure, with few exceptions both sides engaged in, or at least attempted, the same activities. This is not surprising. After all, in all significant respects, the belligerent great powers were members of the same 'civilisation'. The 'German way' in military matters had been extensively, even slavishly, copied abroad between 1871 and 1914. What were the most significant features of the RMA of the First World War which were executed by trial and error over such a short span of years? In summary form they were as follows.

1. Infantry tactics devolved from centralised synchronised movement by battalions, down to company, platoon, and even section (squad, in US terminology) levels.[103]

2. The decentralised 'combat team' platoons of late 1916 to 1918 were microcosms of combined-arms warfare.[104] Rifle platoons were yesterday's story. The platoons of 1917 and 1918 had cross-trained specialists in the (light) machinegun (Lewis gun), rifle-grenade and hand grenade, and rifle. Infantry tactics in theory differed little among the armies on the Western Front. Both sides employed linear 'waves' and columnular 'worms' as tactical conditions mandated, while an insistence on low density in attack and also in the outpost zone of a multi-zone elastic defence system was common to all armies.

3. The artillery that prior to 1914 was regarded as, and shaped to be, a useful precursor to infantry action on an infantry-dominated battlefield was by 1917–18 transformed into

'queen of the battlefield'. It was the artillery, vastly augmented in numbers and improved almost beyond recognition in its effectiveness against all kinds of targets (especially other artillery), that functioned as the key to the tactical breaking opens of the Western Front for both sides. However, no matter how improved it became by 1918, artillery could not open the front to decisive operational-level manoeuvre. Much of the artillery's effectiveness in 1917–18 depended upon care in set-piece preparation which could not be achieved in the real-time flow of battle, beyond the initial assault. Even if the ground was not too boggy for the artillery to advance in support of the infantry, time was required for preparation and co-ordination of each new fire plan for the guns in combined-arms combat. The time needed to bring up the field artillery and to prepare fresh fire plans was time that the enemy generally could employ to even better effect improvising new defences and bringing up reinforcements (including the advance of locally held counter-attack formations). The logic of this tactical situation was that, given the absence of any practicable means of speedy mobility in exploitation by assaulting infantry, offensives could only proceed step by halting step, or by 'bite and hold', as the method of the limited offensive came to be known.

4. Finally, the RMA of the First World War depended vitally upon the large-scale acquisition of new, or greatly improved, weapons and weapon support systems.[105] Although this RMA was about the skilful combination of arms and the competent administration of huge armies and their infrastructure, it was all enabled by achievements on the technological dimension of war. The artillery needed the right kinds of ammunition to deny mobility to enemy troops, to neutralise hard targets, and (with the '106' instantaneous surface 'graze' fuze available in 1917) to be effective against resilient surface objects (e.g. barbed wire). Even if the ammunition were appropriate, the artillery had to be able to hit targets that it could not observe directly; moreover, it needed to be able to do so at the first attempt, without the registration firing which revealed operational intentions. The accurate maps, the ability to locate enemy batteries (from the ground and the air) and take accurate bearings on them, and the means and methods for centralised (at division, corps, and army levels) command and control of the guns simply did not exist early in the war. Suitably sensitive microphones for the crucial task of sound-ranging on the noise of enemy firing, for example, were available only late in 1917. For the all-important infantry platoon, *the* building block of manoeuvre by 1918, this RMA provided new LMGs, new hand grenades and rifle-grenades, and flamethrowers. Battalions acquired the new three-inch 'Stokes' mortar, a vital aid to the infantry against an enemy which often could be reached only by a plunging trajectory of fire, and which could not be supported in follow-on assaults by howitzer-type guns, because the soft or cratered ground precluded their rapid forward movement. In addition, we must note the development of air power for all purposes,[106] generically the invention and application of modern chemical warfare, the invention and exploitation of the tank, the (very incomplete) process of motorisation of army transport, and the extraordinary—but still modest—development of radio.

German failure to develop the tank is not difficult to explain, but it was to prove costly. It is scarcely surprising that a Germany typically on the defensive in the west from November 1914 until March 1918, acutely disadvantaged in the contest of mobilisable resources and strongly confident in the skills of its infantry, should have decided not to try to emulate Allied efforts to construct large numbers of tanks. However, given that

Germany's gun park was none too abundant, the absence of tanks meant that imprudently heroic performance was required of the infantry and the artillery. Tanks crushed barbed wire; in their absence the wire barrier zones had to be overcome either by prolonged bombardment—which sacrificed surprise and impeded mobility in the infantry assault and forward advance of field artillery—or by the infantry themselves, which cost time and unsustainable casualties (as the offensives in 1918 were to demonstrate).

With the exception of the tank, the Allied and German variants of this RMA showed a persuasive parallelism. Intellectual and technological transfer, as well as independent near-simultaneous discovery, meant that both sides came to share a generally common understanding of how modern land warfare had to be waged for successful offence and defence. By preference and in part by necessity, the Germans were relatively more dependent on the tactical skills of their infantry than were the British or French. But both sides waged a style of war in which new weapons and new technical skills with older weapons were literally essential. By 1918, elite assault infantry in all the armies in the west, well down to the platoon level, carried their own diverse fire support forward into the attack. As noted earlier, the winning margin for the Allies in 1914–18 lay not in development of an inherently superior style in warfare, a 'better' variant of RMA. Rather did the Allies win because in their refinement of an RMA they enjoyed a decisive edge in mobilisable resources which enabled them to press on to the point of military victory.

Feedback and adjustment

Simple models of RMA have to be so reductionist as to be simply misleading. In one of the wisest brief commentaries on the process of innovation, Vice Admiral Arthur K.Cebrowski advises that 'transformation is a journey, not a destination—a process, not a goal—a continuum, not an achievement'.[107] That statement conceals its profundity under a cloak of apparent banality. When applied to the historical experience of RMA in the First World War, Cebrowski's rhetorical dictum rapidly shows its mettle. The RMA of the period truly was a journey without a predetermined, or pre-determinable, destination. Although the leading belligerents had mastered the art of war of their day by 1918, that day evolved as conditions moved on. Moreover, if there is merit in the long retrospective view of some historians that by mid- to late 1918 the BEF had created, indeed had become, 'an entire weapons system' of all arms (with the emphasis upon firepower),[108] RMA and strategic performance can be disjoined. Only experience could teach the armies of 1914, 1915, 1916, 1917, and early 1918 that they had yet to 'get it right enough'. Elegance in combat style does not guarantee success. A considerably flawed (by what standard?) way in warfare might have produced sufficient military effect in 1916 or 1917 to meet the strategic requirement for victory.

The perspective I am contesting is that which reflects a characteristically teleological historians' fallacy: specifically, that the belligerents invented and all but perfected the modern style of warfare in 1916–18. The Commander in Chief of the BEF, Sir Douglas Haig, certainly believed that his forces were good enough at fighting for expansive goals to be envisaged for 1916, 1917, and 1918. In common with social scientists attempting to peer into the future, historical figures cannot know where the winning tape is for achieving full maturity in a contemporary RMA. Indeed, since that RMA is apt to appear seriatim in real time, it may even be less than self-evident to its contemporaries that

revolution is not evolution and that there is a winning tape in a military contest of finite duration. Conflicts are only exactly finite to historians, who can look and note how long they lasted. It is useful both to think of some historical experiences as cases of RMA, and (as here) to postulate a life-cycle to those cases. But also it is necessary to soften the categories of such analysis with recognition of the sense in Cebrowski's reminder that 'transformation is a journey'.

The RMA journey explored in this chapter was pursued under the active discipline provided by a competent enemy which itself was embarking on that RMA quest. In Chapter 6 we showed how the grand French rampage of 1792–1815 in part was thwarted militarily by the fact of eventually offsetting RMA behaviours. Such also is the story of 1914–18. Both sides learned how to conduct modern warfare, and neither enjoyed a sufficient lead in overall military effectiveness (for strategic effectiveness) as to be able to short-circuit a process of cumulative decision by attrition. Whether or not German infantry and combined-arms skills were superior is an issue of no real moment. The unarguable fact is that the Allies were always good enough in the totality of military effectiveness to ensure that their military quality and quantity remained tolerably competitive with the enemy. In due course, the Allies evolved a modern style of warfare that was good enough, or better, to make conclusively effective use of their superior mobilisable resources.

It is true, as Robin Prior and Trevor Wilson argue in their pathbreaking biographical study of contemporary operational art, that military learning could be erratic.[109] This is attributable to individual human flaws, certainly to weaknesses in how armies process new information, but it is also the result of the very structure of war. Manifest failure in the field, as by the BEF in 1915 and 1916, revealed readily enough what did not work in particular cases. However, that failure is less likely to reveal what should work well enough tomorrow. For the BEF, the principal military lesson of 1915, and even 1916, appeared to be that it needed more of everything: more men, more guns, more shells (at least more shells that exploded). Although the value of new technologies and improved methods was not at all discounted, the quantitative deficiencies, particularly the need for higher material quality (for example, in shell reliability), were so apparently obvious as to risk overshadowing the relative significance of the need for an RMA keyed to better methods in warfare.

Both sides had to adjust to changing military conditions not only as post-combat assessment suggested to be optimal, but as resources and changes by the enemy allowed. The conduct of an RMA in battle experience therefore required adjustments in two directions. German and Allied strategic behaviour each had to express a dynamic adjustment to the behaviour of the other. In addition, each side's strategic behaviour expressed a dynamic adjustment between its evolving 'warcraft' and its domestic context. The BEF in particular adjusted to its growing manpower crisis in 1917–18 by adopting a style of firepower-led, sometimes mechanised, warfare which played to Allied industrial strengths. Germany, under Ludendorff's strategic misdirection, adjusted to the conditions of 1917–18 by adopting a style of elite infantry-led warfare which lacked the quantity and even quality of firepower (given the lack of mechanisation) to hold casualties down to a bearable level.[110]

STRATEGIC BEHAVIOUR

Table 7.1 reveals the case for thinking about RMA on the one hand in the contexts of particular time and place (i.e. historical agent), and on the other hand in the context of strategy and war as a whole. The table asserts the strengths and weaknesses not so much, at least not primarily, of the generic RMA of the First World War, but rather of that RMA as developed and executed by Germany and Britain. Some of the strengths and weaknesses signalled in the table were not inherent in this RMA, but instead were endemic to the particular condition of Britain or Germany as historical agents of revolutionary military change. For example, Germany's debilitating weakness in the dimension of organisation for strategy-making and conduct did not derive in any sense from the character of the RMA. Germany simply did not possess policy-making, policy-advising, or policy-reviewing machinery worthy of the name. German policy, and grand and military strategy, such as they were, emerged from the shaky personal choices of the Kaiser as Supreme War Lord as shaped, and by mid-1916 as definitely bypassed, by whichever military faction was on top of the High Command. The appalling performance of imperial Germany in high policy and grand strategy must not be confused with the merit or otherwise in the German variant of the contemporary RMA. Our insistence upon examining RMA experience as strategic behaviour protects us against the twin fallacies of RMA analysis pursued either free of the contexts of actual historical agency, or innocent of strategy's nature. That nature to which, for example, organisation for strategy-making is vital, always has the potential to explode the nominal promise in RMA.

As in Chapter 6 the discussion here highlights the story coded in the table. Seven points serve to explain the judgements expressed in the table.

First, both German and British societies proved remarkably adaptable to the unprecedented demands of what became near-total war.[111] Both had large, industrially disciplined workforces, and as the character of the war altered in favour of technology under the pressure of RMA, so the peasants and other country lads who had been regarded as prime soldier material before 1914, were overtaken in desirability by those more familiar with machinery. The efficacy of social control was certainly strained by the experience of (fairly) protracted war, but it did not fail significantly until summer 1918 for Germany, and it never did fail for Britain. Notwithstanding anti-nationalist socialist ideology, increasingly severe civilian economic hardship, sharp military disappointments, and general war-weariness, the domestic truce *(Burgfriede)* of August 1914 just about held through the 'turnip winter' of 1916–17 and into the following year.[112] Germany did not lose the war because its army was stabbed in the back by traitors at home. It is true that the Allied blockade, and poor official handling of the prolonged food crisis, in the context of a seemingly endless and unwinnable war, caused domestic demoralisation. Also, it is true that many soldiers returned from the east after the winter 1917–18 more than a little infected with Bolshevik slogans and attitudes. Nonetheless, insofar as one can distinguish cause from consequence, both German society and its army (and navy) suffered a crippling blow to their morale not because of a general war-weariness, but rather because the hopes and even expectations for final victory in the unfortunately named *Kaiserschlacht* (Kaiser's battle) of the great Peace Offensive of 1918, were so cruelly and unexpectedly dashed.

Table 7.1: The RMA of the First World War: Strategic Dynamics

Dimensions	*Britain*	*Germany*
People	S	S
Culture		
Politics	S	W
Ethics		W
Economics and logistics	DS	W
Organisation	W	W
Military administration	S	S
Information and intelligence	S	S
Theory and doctrine		DS
Technology	DS	S
Military operations	S	DS
Command	W	DS/W
Geography	S	W
Friction		
Adversary		
Time	S	W

Key: DS Defining strength of this RMA
DS/W Both relative strength and weakness
S Strength in this dimension
W Weakness in this dimension

Evidence of societal unrest is easy to locate, but less easy to interpret. For example, an undoubtedly war-weary Britain lost six million working days to strike action in 1918; the comparable figure for Germany was only 1.452 million. Niall Ferguson claims on good evidence that '[w]ith the exception of Russia, British labour relations were quite simply the worst in the war: neither Germany, not Italy, nor France suffered as many strikes.'[113] But what is unarguable is that both German and British societies proved willing enough to take the strain necessary to see through the conduct of their particular contemporary variants of RMA. As also had been the case with the Confederate States of America, the belligerent that lost suffered a truly combat-damaging loss of morale only as a result of military failure in the field. The rival armies were allowed ample scope by their respective societies to show what they could and could not do.

Second, although the political, ethical, and organisational weaknesses of Germany tell us nothing about this RMA per se, they do reveal a great deal both about why Germany was obliged to implement the RMA at all, and why it was unable to exploit the

consequent military effectiveness to the point of victory. The principal belligerents of 1914–18 were obliged by military necessity to discover and give very large-scale expression to 'the modern style of warfare'. This RMA occurred, certainly occurred when it did, because of the bilateral campaign failures of 1914. We can trace the duration of the First World War to many causes, but the poor quality of German policy- and strategy-making assuredly merits high ranking among them. German policy created a truly strategic conundrum. Its high ambitions overshot its military means, while its ability to improve those military means in the course of the fighting was never sufficient to bridge the strategic gap. Germany attempted to do too much with too little, and then proved unable or unwilling either to adapt policy to military reality or to shift military effectiveness to meet the political demand. This is what strategy is all about.

The operational expedient of the invasion of France through Belgium in the so-called Schlieffen Plan all but guaranteed that Germany would add the global sea power that was the British Empire to the list of its active enemies. Such an addition translated as a foe that Kaiser Wilhelm's Grande Armée could not defeat in continental warfare (recall Napoleon's like dilemma and, later, Hitler's).[114] As if that were not strategic peril enough, in 1917 the operational expedient of unrestricted U-boat warfare brought into the enemy's column the extra-European great power which could restore an Allied cause that was financially bankrupt, short of moral uplift, and becoming desperately pressed for manpower for soldiering and war industries.

Although Germans could be confident that their belt buckles were right to assert *Gott mit uns*, repeatedly they placed themselves ethically on the back foot by, to give the leading examples: invading neutral Belgium; behaving initially with exemplary brutality in that invasion; introducing poison gas to the battlefield; initiating the 'strategic' bombing of civilian centres; and sinking merchant (including passenger) ships without the warning required by international maritime law. German self-description as 'huns', on top of the kinds of misbehaviour just cited, greatly aided Allied efforts to demonise the foe. Nonetheless, it is worth noting that except in the Balkans and the Turkish Empire, the First World War never became the kind of ideologically sanctioned total war to which the Second World War in the East (and the Pacific) descended.[115] The doctrine of strategic (and military) necessity has some practical authority, but appeal to its grim sanction imposes moral costs, that then become material costs, on strategic performance.

Third, in a war that operational art cannot win in one or two smashing campaigns, logistical-economic and administrative excellence is likely to be promoted to the status of key enablers of victory. Prussian, then German, war planning was rightly widely admired in the nineteenth century. As the saying goes, the Prussian/German way in war preparation was the market leader, because the market follows success. Indeed, to be competitive in the front rank of belligerents in European land warfare, states and their armies often had no other practicable choice than to copy the Prussian/German example. Employing railways, the telegraph, and new small arms (rifles, generically—and field artillery), general staffs learned how to conscript, train, equip, feed, and move as much of the male population of the nation as political culture and social anxiety could tolerate.

Unfortunately, 'the battle is the payoff'. The whole object of the military expressions of the industrial and political nationalist revolutions that were the armies of 1914, was to serve as the instrument of swift operational decision. The general, if modest, superiority of German logistical skills for mobilisation and the organisation of the *Westaufmarsch*

(and much smaller eastern),[116] was negated by much multi-level ineptitude (political, strategic, operational). It transpired that logistical planning for the great war-winning offensive in the west was a geographical and military absurdity. As Martin van Creveld argued, German logistics was 'the wheel that broke'.[117] To its cost, Germany learned that although modern Britain had no experience in continental warfare on the largest of scales, in its civilian society that great commercial and industrial empire had all the skills necessary for the mobilisation and administration of a quite extraordinary war effort.[118] As British military skills improved in 1916–18, so the strategic significance of superior economic strength asserted itself.

Fourth, to list information and intelligence as a relative strength of both sides is probably the most debatable of all the judgement calls in this comparative assessment. There were operational-level surprises in August 1914: the advance of the German armies on the right wing across the Meuse and Sambre (and the deployment of reserve with regular divisions),[119] and the German decision not to hazard the nominally greatly outnumbered battle line of the High Seas Fleet in the southern North Sea.[120] Subsequently, however, both sides prosecuted their RMA variants with typically increasingly accurate information about the enemy. This was to be expected, given that the principal battlespace comprised a near-static condition of siege warfare for four years. Variably aggressive trench raiding (particularly to take prisoners for interrogation), aerial reconnaissance by tethered balloons and aircraft, and signals interception (of telegraph, telephone, and radio),[121] as well as enemy activity of all kinds, eventually yielded a minutely detailed picture of the foe. Operational surprise was attainable (e.g. by the BEF at Cambrai on 20 November 1917), but more often than not the best that could be achieved was tactical.

Intelligence could be poor, as when Douglas Haig was misled by his senior intelligence adviser in 1916–17, Brigadier General John Charteris, into believing that the morale of the German Army was critically fragile. Vital tactical information could be erroneous, as when the BEF's infantry advanced on the Somme on that fatal 1 July 1916, confident that the unprecedented quantity (but alas not quality) of the preceeding artillery bombardment had erased much of the German wire.[122] Considered overall, however, the structure of land warfare in this period was strongly resilient to the effect of advantage and disadvantage in the intelligence arena. Both sides performed well enough in this dimension of war. Even when they performed poorly, the ability of a defender to recover tactically and operationally from a setback, or to exploit an advantage, was so limited by the contemporary deficiencies in cross-battlespace mobility and communications that defeat was not likely.

Fifth, if intellectual superiority in 'warcraft' could assure victory, then Germany should have won the First World War (and then a Second World War, which of course it would not have needed to wage) in short order. If we bracket for unified consideration theory and doctrine, military operations, and command, we have in view the core of German military excellence. It was Germany's performance on these three among strategy's dimensions which enabled it to stand off close to the rest of the world *in both wars*, all the while allied to junior partners who were a net strategic liability. German military culture encouraged a happy marriage between centralised military theory and doctrine and decentralised discretion in command. That discretion, expressed as

Auftragstaktik, or mission command, was prudent because the army was educated by and in authoritative doctrine and tactical battle drills.

The German Army had planned to win the Great War by excellence in operational art.[123] Operational envelopment was not merely the leading method, it was close to an article of faith. In practice, when the grand envelopment in the west attempted in August-September 1914 failed, the Germans had to discover how to wage and win the war tactically. This they did, with an imagination and determination that many recent historians have judged impressive indeed. The German Army excelled in combined-arms tactics, especially in infantry-led methods for effective attack and the defence in depth, while it was second to none in its grasp of artillery methods (though the BEF actually practised those methods better).

In some contrast to the Germans, the preferred British way in war was characterised by the fairly *ad hoc* and local development and adoption of such theory and doctrine as experience revealed to be useful, and by the rough equation of command with centralised control at the operational level. As David French, among others, has observed, the British were far less tolerant, and were far more fearful, of the prospective chaos of battle than were the Germans.[124] Whereas the German Army's answer to the systemic challenge of chaos was devolution in command discretion for well-trained soldiers,[125] the British answer was an attempt at firm control from above (division, corps, and army levels). Given the persisting strength of the German Army in doctrinal development, hard training, and tough selection for troop leadership positions, there can be no doubt that its style of decentralised military operations yielded a systematic advantage in the conduct of continental military operations. The German problem, of course, is that victory in war is not awarded by an impartial judge to the belligerent that fights most elegantly. War is waged both holistically, on all dimensions simultaneously, and most probably against an enemy which, though inferior in some respects of style in warcraft, still is competent enough almost to hold its own, ceteris paribus. So it was with the belligerents and their rival RMA variants in the First World War. The relative weakness of the BEF in its style of battlefield command found ample compensation in material and financial strengths. Neither side's personnel in truly high command (military *and political*) qualifies for elevation to the history's Hall of Fame of Great Captains. Nonetheless, German political-military leadership repeatedly proved itself singularly strategically incompetent, while Allied leaders were adequate. That difference was decisive.

Sixth, the armies that had gone to war in 1914 comprised essentially a riflearmed infantry mass lightly assisted by field artillery and cavalry. The technology then applied to the task of securing military decision was only modest. No army was ignorant of the tactical implications of the technological changes of the previous half-century for modern war, though all were found severely wanting when the great test came. Each army believed that it had found a good enough solution to the age-old structural problem of combining fire with movement. This terrain has been well ploughed by historians. Suffice it to say that the advent of breechloading magazine-fed rifles using smokeless powder, machineguns, quick-firing (i.e., recoilless) field artillery, and barbed wire, appeared to point to a solution lying in the synergy between decisive operational (flanking) manoeuvre, and, once fire superiority was established, offensive spirit in tactical dash (when frontal assault could not be avoided).[126]

Both sides were obliged by 'trenchlock' evident in the west by the winter 1914–15 to invent or refine both light, infantry-portable weapons suitable for the assault and also the heavy plunging firepower necessary to destroy—later, to neutralise—bunkers and concrete blockhouses. Similarly, both sides had to acquire the heavy artillery capable of conducting 'deep battle' against the enemy's artillery and counterattack formations (held well to the rear). Bailey summarises thus:

A *'rule of thumb'* developed, that reserves should be held 9 kilometres to the rear, capable of counter-attacking within two hours of the start of the attack. The shape of the battle-field thus came to be determined by the range of artillery.[127]

As noted already, the artillery had to learn not only how to fire accurately at targets it could not itself observe directly, but also—for surprise effect—how to fire accurately without prior registration shots against those targets. British military organisation, technology, and methods achieved a modest level of superiority in artillery effectiveness over the Germans by late 1916 (the close of the Battle of the Somme), an advantage that grew in weight and significance in 1917 and in 1918.

Although the Great War was an artillery war, perhaps the artillery war, still there were significant limits to what even excellent artillery could achieve. No matter how modern the artillery technology and technique in 1917–18, the guns could only strike reliably with precision when they knew exactly where they themselves were, and where the enemy was. Advancing infantry, no matter how well supported by artillery, must soon outdistance the range of that support. While the infantry consolidates its limited gains, waiting for the artillery to advance so it can support the next phase of attack, the enemy has time to move troops up by train to reinforce the crumbling sector of its front (tanks were not an adequate substitute for artillery). Both sides employed aircraft in the ground attack role. The Germans were especially systematic about it, using 'battle flights' *(Schlachtstaffeln)* literally in waves, wingtip-to-wingtip, as a form of flying assault artillery at Cambrai in 1917 and in spring 1918 to help punch holes in the British front.[128]

German and British performance on strategy's technological dimension is recorded here respectively as a strength and a defining strength. Although the Germans did well, the BEF did better. Given that the BEF had to expand from six to sixty divisions, enjoyed no recent tradition of excellence in the conduct of large-scale continental combined-arms warfare, and lost most of its 'regular' military expertise with the casualties suffered in the battles of 1914–15, it is unremarkable that it settled upon firepower in its several variants as the key to unlock the German front. The German Army did not despise firepower, but the combination of relative disadvantage in material resources and a great tradition of victory through operational (largely infantry) manoeuvre in combined-arms combat, led to a style of warfare rather less dependent upon firepower than that of the BEF. This generalisation ceased to hold as summer turned to autumn in 1918. Infantry losses in the offensives of March-July meant that the fighting power of the German Army depended more and more upon the artillery and machinegun assets of a defence starved of troops (certainly starved of troops willing to stand and die).

From rifle-grenades through light machineguns, to sensitive microphones for sound-ranging on enemy artillery, to gas shells, (fairly) mobile radio sets, and specialised combat aircraft—to cite but a handful of items from the short list—the First World War

was a conflict of invention.[129] The most obvious technological differences between the belligerents in the west lay in the (near-) absence of tanks on the German side. This deficiency mattered tactically, but it does not even begin to explain why the Allies won the war. The outcome of the conflict was not determined technologically; both sides performed well enough, or better, in that regard. It was the case, however, that the modest Allied advantage in artillery skills, wedded to the greater depth of their resources pockets, enabled them to persist with a style of combat that must win by attrition—always provided their societies would be willing to continue paying the bill.

Seventh and finally, the strategic geography of the First World War translated as a playing field systematically tilted to the German disadvantage. Germany's geostrategic constraints had unfortunate temporal implications for its prospects of success. The location of Germany, that yielded the nominal advantage of the central position (or interior lines)—Napoleon's preferred situation, as interpreted by Jomini[130]—also meant actual or potential war simultaneously (and geometrically eccentrically) on two fronts. To compound the problems created by a statecraft which failed to prevent a Franco-Russian alliance (1891, 1894), Germany proceeded to pursue a hollow *Weltpolitik* in part via the grand-strategic instrument of a High Seas Fleet, which had the obvious potential to add Britain to its list of enemies.[131] Shackled to the 'corpse' that was its Austro-Hungarian ally,[132] Germany in 1914 required of its military machine a quite extraordinary performance if its comparative structural weakness in strategic geography was not to have lethal consequences when exploited over time by its enemies. The strategic geography of the war allowed Germany close to a single-front focus only in August-September 1914, and then in 1918 after the Russian collapse. Even in those contexts, Germany lacked the military weight to win in the west. Selectively superior military skills could not deliver victory in 1914–18, unless, that is, the enemy buckled from within or committed egregiously awful operational-level errors. The truth is that from 1914 to 1918 Germany either did not know how, or was unwilling, to extricate itself from a multi-front war that it could not win against a stronger coalition, which, courtesy of its dominance of the sea lanes, commanded access to most of the world's economic assets.

Jonathan Bailey is right: the RMA of the First World War was the birth of the modern style of warfare.[133] But novel as the truly combined-arms combat of 1918 was when compared with the largely sequential use of artillery, then infantry in 1914, the rules and lore of strategy applied to both. It is true that the national variants of the RMA as practised by the German Army and the BEF in 1917–18 were each absolutely militarily more effective than the older combat style. The significance of that claim is much diminished, though, by the recognition that each belligerent needed to be more effective in the field, given the near-parallel improvements scored by the enemy. The German way of war arguably was more elegant than the British, as these matters might be marked by a military purist, but such a claim would be a double absurdity. First, we know that the British (and Allied) RMA worked best *strategically*, because the Allies won. Second, the German and the British Armies did not really pick a preferred form of RMA; rather did each side's distinctive social-cultural and economic-material contexts settle upon the form of accessible RMA that it found fitted best its geostrategic and military-cultural conditions. It was no accident, as Marxist writers used to observe, that the British style in land warfare—cautious, centrally controlled, firepower-led, and heavily mechanised—showed marked similarities between the two world wars. A similar claim for the Germans

also is persuasive. As the belligerent weaker in resources of all kinds, yet enjoying the central position in Europe, Germany showed little more than commonsense in its dominant desire to win wars by dazzlingly swift and decisive operational manoeuvre.

We have seen how the RMA of the First World War, in common with its Napoleonic predecessor, did not confer decisive strategic advantage. Both of the historical studies presented thus far support the proposition that RMA, defined in Chapter 1 as a radical change in the character or conduct of war, is governed by strategy. Napoleonic France and Ludendorff's Germany failed to innovate in ways that would allow a new style in war to dominate the total means-ends nexus of strategy. We turn next to our third and final case, the nuclear RMA, to see if the strategic meaning of its life-cycle has been as revolutionary in practice as half a century of theory and commentary typically has asserted.[134]

NOTES

1. See Luigi Albertini, *The Origins of the War of 1914*, 3 vols (Oxford: Oxford University Press, 1952–57); H.W.Koch (ed.), *The Origins of the First World War: Great Power Rivalry and German War Aims*, 2nd edn (London: Macmillan, 1984); James Joll, *The Origins of the First World War* (London: Longman, 1984); and R.J.W.Evans and Hartmut Pogge von Strandmann (eds), *The Coming of the First World War* (Oxford: Clarendon Press, 1988).
2. For contrasting views of probably the most controversial of reputations of the 'Great Captains' of the war, see John Terraine's classic defence, *Douglas Haig: The Educated Soldier* (London: Hutchinson, 1963), and the effort at professional demolition in Denis Winter, *Haig's Command: A Reassessment* (London: Viking, 1991). There is considerable merit in Robin Neillands' sympathetic popular treatment, *The Great War Generals on the Western Front, 1914–18* (London: Robinson, 1999); while the essays in Brian Bond (ed.), *The First World War and British Military History* (Oxford: Clarendon Press, 1991), cover the British ground admirably, if not always persuasively.
3. Williamson Murray, 'Armoured 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. 8 n. Murray cites Timothy Lupfer, *The Dynamics of Doctrine: The Changes in German Tactical Doctrine During the First World War*, Leavenworth Papers 4 (Fort Leavenworth, KS: Combat Studies Institute, US Army Command and General Staff College, July 1981); Timothy Travers, *The Killing Ground: The British Army, the Western Front and the Emergence of Modern Warfare, 1900–1918* (London: Allen & Unwin, 1987); and idem, *How the War Was Won: Command and Technology in the British Army on the Western Front, 1917–1918* (London: Routledge, 1992). To that short list of outstanding innovative studies, one should add the following: Shelford Bidwell and Dominick Graham, *Fire-Power: British Army Weapons and Theories of War, 1904–1945* (London: George Allen & Unwin, 1982); Bruce I.Gudmundsson, *Stormtroop Tactics: Innovation in the German Army, 1914–18* (New York: Praeger, 1989); Robin Prior and Trevor Wilson, *Command on the Western Front: The Military Career of Sir Henry Rawlinson, 1914–18* (Oxford: Blackwell, 1992); idem, *Passchendaele: The Untold Story* (New Haven, CT: Yale University Press, 1996); Bill Rawling, *Surviving Trench Warfare: Technology and the Canadian Corps, 1914–18* (Toronto: University of Toronto Press, 1992); David T.Zabecki, *Steel Wind: Colonel Georg Bruchmüller and the Birth of Modern Artillery* (Westport, CT: Praeger, 1994); Paddy Griffith, *Battle Tactics of the Western Front: The British Army's Art of Attack, 1916–18* (New Haven, CT: Yale University Press, 1994); Jonathan Bailey, *The First World War and the Birth of the Modern Style of Warfare*, Occasional Papers 22 (Camberley: Strategic and Combat Studies Institute,