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Cover photo: French Saint-Chamond tanks passing through the village of Conde-sur-Aisne. Photograph probably taken during the 1918 German Spring Offensive. Dr Tim Gale considers the development of French tank doctrine during the war in his article in this issue. Photo © Imperial War Museum (Q 56410)

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ABSTRACT
This introduction to five case studies of military adaptation between 1914 and 1918 reviews how warfare was transformed in the First World War. It examines the experience of the three major western front protagonists – France, Germany and Britain – positing that, having different military cultures, each army adapted differently but that for all the pace of change was rapid and the outcomes appropriate to meet the tactical and operational challenges of the modern industrialised battlefield. It links the historical study of military adaptation between 1914 and 1918 to more recent theoretical explanations of how armed forces innovate in response to changes in warfare. It suggests that these theories have only limited applicability to the circumstances of intensive combat that defined the First World War battlefield.

Those who wish to understand the nature of the twentieth century's wars must engage with the transformative processes inherent in warfare between fully industrialised societies.[1] Perhaps it is the enormity of the socio-cultural phenomenon that the Great War became, or its wide-ranging, prolonged and often iniquitous consequences, that undermine balanced judgment of this key military event. Either way, except among scholars of military history how the war was fought seems nowadays of limited interest compared with how it was experienced and remembered. While equally transformative of the societies that fought it, it was the nature and needs of the battlefield that determined 'home front' developments;

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[1]For a general discussion of its place in wider military transformation down the centuries see the essays in *The Dynamics of Military Revolution, 1300–2050*, ed. Macgregor Knox and Williamson Murray (Cambridge: Cambridge University Press, 2001).

therefore the dynamic military adaptation occurring at 'the front' needs to be factored into understanding of the war's modernising effects.[2] Although the existence of a western front Revolution in Military Affairs (RMA) is now generally acknowledged in studies of the 'trench warfare' that epitomises the First World War,[3] some scholars still position their analysis of the conflict's military developments within a dated meta-narrative of inefficiency and military ineffectiveness,[4] informed by ingrained myths of command incompetence and futile sacrifice that have become a subject of study in themselves.[5] Few scholars would now accept the idea of a slow-witted and poorly managed engagement with modern war. Examination of aspects of evolving military practice, and a comparative approach to the challenges and responses that all belligerents shared in the twentieth century's defining conflict, suggests that rapid, effective and long-lasting shifts in warfare sprang from the apparently stalemated trenches.

The First World War is a striking exemplar of the dictum attributed to Darwin that 'it is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change'. The articles collected in this special edition give examples of how the British, French and German armed forces on the Western Front were 'adaptable to change' in this sense. These suggest that in this all-or-nothing struggle for survival to which each army was adapting, transformation was inherent to military experience, and that its pace and assimilation were factors that would determine the outcome of the military conflict.

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[2]Home front change is studied extensively, but not in explicit relation to events on the battlefield. See, for instance, Adrian Gregory, *The Last Great War: British Society and the First World War* (Cambridge: Cambridge University Press, 2008).

[3]See the discussion in Jonathan A. Bailey, 'The First World War and the Birth of Modern Warfare', in *The Dynamics of Military Revolution,* pp. 132-153.

[4]For a recent example see the chapter 'Complex Adaptation: the Western Front, 1914–1918', in Williamson Murray, *Military Adaptation in War: With Fear of Change* (Cambridge: Cambridge University Press, 2011), pp. 74-118. Of course a suggestion of dynamic and successful adaptation between 1914 and 1918 would have undermined the broader thesis Murray was positing. Nevertheless, his analysis ignores the extensive scholarship since the publication of his seminal co-edited volume, *Military Effectiveness, vol. I: The First World War,* ed. Alan Millett and Williamson Murray (London: Allen & Unwin, 1988). Other works on military change gloss over the war, for example *The Evolution of Operation Art: From Napoleon to the Present*, ed. John A. Olsen and Martin van Creveld (Oxford: Oxford University Press, 2011).

[5]See for example Dan Todman, *The Great War: Myth and Memory* (London: Hambledon and London, 2005) and Gordon Corrigan, *Mud, Blood and Poppycock: Britain and the First World War* (London: Cassell, 2003).

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Most historians no longer need to be told that between 1914 and 1918 lions were not led by donkeys, since military commanders' professionalism, and the growing military effectiveness of their armies in response to the particular challenges of the industrialised battlefield, have been the subject of sustained enquiry for three decades. It has taken a long time. In 1960, Cyril Falls explained that he wrote his history of the First World War because 'I wanted to do all I could to demolish a myth as preposterous as it is widely believed. For the first time in the known history of war, we are told, the military art stood still in the greatest war up to date.'[6] For some reason, static positional warfare had quickly come to exemplify all that was wrong with military science. By the time of the next war scholars could shorthand the British army's catastrophe of 1 July 1916 as 'typical trench warfare operations',[7] although in fact such misfortune was far from typical that year or subsequently: and not even typical of 1 July 1916 if the French army's overwhelming success on that day and the achievements of the bloodied but successful British XIII Corps are acknowledged alongside the British army's upset on part of its front of attack.[8] Certainly First World War battles were always going to be intensive and costly – in General Charles Mangin's oft-quoted words, 'whatever you do, you lose a lot of men'[9] – although that was a consequence of the scale of warfare as much as the style. What had already been lost in simplistic post-war critiques was the complexity, variety and dynamism of the art of war between 1914 and 1918 – a period which saw a terminal break with Napoleonic paradigms of warfare and the emergence of proto-modern tactical and operational methods – because the theatre in which it developed remained in strategic stalemate.

Building on foundations laid in the early 1980s by Shelford Bidwell and Dominick Graham and John Terraine, a generation of archival research on the British army has made great progress where Falls failed.[10] The 'preposterous myth' has been

[6]Cyril Falls, *The First World War* (London: Longmans, 1960), p. xvi.

[7]Harvey A. de Weerd, 'Churchill, Lloyd George, Clemenceau: the Emergence of the Civilian', in *Makers of Modern Strategy: Military Thought from Machiavelli to Hitler*, ed. Edward M. Earle (Princeton: Princeton University press, 1941), pp. 287-305: 290, n. 14. No doubt the author had taken his cue from the anti-military memoirs of his British subjects.

[8]William Philpott, *Bloody Victory: The Sacrifice on the Somme and the Making of the Twentieth Century* (London: Little, Brown, 2009), pp. 175-8.

[9]Charles Mangin, *Lettres de guerre, 1914–1918* (Paris: Arthème Fayard, 1950), p. 112.

[10]Shelford Bidwell and Dominick Graham, *Fire-power: British Army Weapons and Theories of War, 1904–1945* (London: Allen & Unwin, 1982); John Terraine, *White Heat: The New Warfare, 1914–1918* (London: Sidgwick & Jackson, 1982).

demolished and 1914–18 is increasingly being acknowledged as a period of dramatic change rather than stagnation. It should be stressed, however, that despite this intensive revisionism one hundred years afterwards we still only partially understand the 'military machines' of the first industrialised mass war. Moreover, scholarship on the British and Dominion forces, reacting to the cultural misconception mentioned above, has made far greater progress than the study of allied or enemy armies.

The armies that took the field in August 1914 found that the 'principles' of war as defined and debated in pre-war years were only partially applicable to the actual circumstances of mass battles between armies equipped with modern communications, logistics systems and killing technologies. In actual fact, the war broke out at a moment when doctrinal debate in most armies was engaging with the potential changes that industrialisation and mass would bring to the battlefield and to strategy, although no definitive answers had yet been formulated.[11] Thus the war itself became a workshop and proving ground for rapidly developing military doctrine and modernising armed forces. Leaving aside the inherent killing power of modern military technologies, this process of change in itself was liable to lead to false starts, missed opportunities and even the 'blunders' dwelt on by subsequent generations, that would on occasion make 'cannon fodder' of the troops that fought. It would therefore be a difficult four years of warfare, during which military art and science were completely transformed, with armies forced constantly to adapt to new realities as they struggled to master the industrial battlefield.

It can be argued that warfare has probably never witnessed a more rapid and profound transformation than that which occurred between 1914 and 1918. Although fought statically in field entrenchments for most of its course and in most of its theatres,[12] it had a profound impact on military theory and operational practice thereafter which defined warfare until the turn of the twenty-first century. While cultural perceptions of military inflexibility and incompetence persist against the evidence, nonetheless scholarship over the last twenty-five years has done much to redress such misperceptions. We have come a long way towards understanding the changes in warfare and the armies which fought (particularly on the western front),

[11]For relevant discussion see Douglas Porch, *The March to the Marne: The French Army, 1871–1914* (Cambridge: Cambridge University Press, 1981), Robert T. Foley, *German Strategy and the Path to Verdun: Erich von Falkenhayn and the Development of Attrition, 1870–1916* (Cambridge: Cambridge University Press, 2005), and Bidwell and Graham, *Fire-power*.

[12]Even the 'trenches' themselves went through a process of transformation, from the hastily excavated linear positions of 1914 to the deep, strongpoint-based defensive networks that the armies fought over in 1918, indicative of the rapidly evolving dynamic between offence and defence.

although our grasp of the changes which took place remains incomplete, and the investigation of the transformative processes which produced them has not been systematic or sufficiently wide-ranging. The articles here touch on elements of that transformation, presenting snapshots in time and place that give insights into the processes and outcomes of this dynamic change.[13]

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In this introduction we wish to locate the First World War RMA within the wider parameters of contemporary debates on military adaptation and transformation, restoring the tactical, operational and doctrinal shifts of these years to the central place in modern warfare which they should occupy. While widely investigated, the fundamental changes in warfare between 1914 and 1918 remain only partly understood. This is a consequence of limited thematic and geographical focus to date. The tactics of the trenches have long been a subject of historical investigation, by authors such as Paddy Griffith and Martin Samuels.[14] The emergent operational level of war has only been engaged with more recently, by Andy Simpson and David Zabecki primarily.[15] The learning process too, as applied to the British army's traumatic but ultimately successful adaptation to modern warfare, has been a fruitful, if contested, field of enquiry.[16] These defining studies focus on the British and

[13]The articles arise from the work of the First World War Operations Research Group based in the Department of War Studies, King's College London, of which the authors are members.

[14]Paddy Griffith, *Battle Tactics of the Western Front: The British Army's Art of Attack, 1916–18* (New Haven, Ct.: Yale University Press, 1994); Martin Samuels, *Command or Control? Command, Training and Tactics in the British and German Armies, 1888–1918* (London: Frank Cass, 1996).

[15]David Zabecki, *The German 1918 Offensives: A Case Study in the Operational Level of War*_(London: Routledge, 2006); Andy Simpson, *Directing Operations: British Corps Command on the Western Front* (Staplehurst: Spellmount, 2006).

[16]Initially and still colloquially referred to as the British army's 'learning curve', historians have developed a more rounded and nuanced view of the learning process in all armies since the publication of Gary Sheffield's ground-breaking study of the British army's development, *Forgotten Victory: The First World War, Myths and Realities* (London: Headline, 2001). One of its originators, Peter Simkins, has recently suggested, 'first used…among British military historians in the early 1990s, the phrase 'learning curve' was mainly employed as a kind of shorthand to signify that one rejected the 'lions led by donkeys' and 'butchers and bunglers' interpretations of the First World War. …Given the growing consensus on the issue, we should perhaps at last recognise that, at least among serious students of the First World War, this particular battle has now been fought and won and that the term 'learning

German armies, which faced each other on the northern end of the western front. Scholarship on the French army, which throughout the war faced and fought the bulk of the German army, has lagged behind. Until recently Douglas Porch's 1990 study in *Military Effectiveness* was the most accessible, if limited, engagement with the subject. His judgement that on the Great War battlefield the French army put in a 'courageous but unintelligent performance' seems hurried and half-formed in the light of recent scholarship.[17] Moreover, as Porch's own analysis reflects, the study of French experience had been skewed towards the disasters, trials and errors of their war – August 1914, Verdun and the 1917 mutinies – rather than addressing the process of military 'lessons learned' which enabled the French Army to take on and defeat the most powerful military machine of early twentieth-century Europe. Its tactical development has belatedly been considered by Michel Goya, Jonathan Krause and Tim Gale although the processes by which 'the first modern army' thought, learned and acted remain relatively unknown compared with those of its main ally and primary adversary.[18] Other European armies, Russian, Italian and Austro-Hungarian principal among them, were going through their own transformative process during these years, and also deserve systematic study to provide a full picture of the transformative effect of the war.[19]

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curve', when used in this connection, should therefore be laid gently to rest, its duty done.' Peter Simkins, *From the Somme to Victory: The British Army's Experience on the Western Front, 1916–1918* (Barnsley: Pen and Sword, 2014), pp. xiv-xv. See also William Philpott, 'Beyond the "Learning Curve": The British Army's Military Transformation in the First World War' (10 November 2009), RUSI online analysis (https://rusi.org/commentary/beyond-learning-curve-british-armys-military-transformation-first-world-war – accessed 28 February 2018). For recent examples see Robert T. Foley, 'A Case Study in Horizontal Military Innovation: The German Army, 1916–1918', *Journal of Strategic Studies*, 35/6 (2012), pp. 799-827 and 'Learning War's Lessons: The German Army and the Battle of the Somme, 1916', *Journal of Military History*, 75/2 (2011), pp. 471-504.

[17]Douglas Porch, 'The French Army in the First World War', in Millett and Murray, *Military Effectiveness, vol. I*, pp. 190-228: 225.

[18]See Michel Goya *La Chair et l'acier: L'Invention de la guerre moderne, 1914–18* (Paris: Taillandier, 2004); Jonathan Krause, *Early Trench Tactics in the French Army: The Second Battle of Artois, May–June 1915* (Farnham: Ashgate, 2013); Tim Gale, *The French Army's Tank Force and Armoured Warfare in the Great War: The* Artillerie Spéciale (Farnham: Ashgate, 2013).

[19]The Italian army is considered in John Gooch, *The Italian Army and the First World* War (Cambridge: Cambridge University Press, 2014). Eastern front campaigns are now being more thoroughly investigated although the armies that fought them await their historians. See for example, Timothy C. Dowling, *The Brusilov Offensive* (Bloomington: Indiana University Press, 2008); J. R. Schindler, *Fall of the Double Eagle:*

Transformation – of material, method and military culture – took place at both the tactical and operational levels of war. What scholarship has definitively demonstrated is that the pace of military change was rapid. The opposing armies co-existed in a dynamic equilibrium of tactical and operational innovation and counter-measure that ironically sustained rather than ended the strategic stalemate. By the end, however, the opposing armies were very different in their organisation, method and understanding of war. It had been transformed into the 'modern style' of warfare through the integrated processes of technological adaptation, institutional learning and conceptual rethinking.

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Military transformation is more than a historical phenomenon. Case studies of military innovation have multiplied over the last thirty or forty years, attracting interest from two rather different traditions: social science and history. A brief review of recent literature, taking these two in turn, will provide useful context for what follows and offers an opportunity to point out some of the strengths and weaknesses of what has been written to date. The last forty years has seen an attempt by social scientists, notable among whom are Barry Posen, Stephen Rosen and James Bradin,[20] to improve present-day decision-making by scouring the past for examples of military innovation. Summarised very broadly, the rapid development of information technology in the 1980s, interpreted in the Soviet Union as constituting a 'military technical revolution' and sometimes touted in the West as constituting a

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The Battle for Galicia and the Demise of Austria-Hungary (Lincoln, NE: Potomac Books, 2015); Prit Buttar, *Collision of Empires: The War on the Eastern Front in 1914* (Oxford: Osprey Publishing, 2014), *Germany Ascendant: The Eastern Front, 1915* (Oxford: Osprey Publishing, 2015) and *Russia's Last Gasp: The Eastern Front 1916–17* (Oxford: Osprey Publishing, 2016).

[20]Barry Posen, *The Sources of Military Doctrine: France, Britain and Germany between the World Wars* (Ithaca: Cornell University Press, 1984); Stephen P. Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca: Cornell University Press, 1991); James W. Bradin, *From Hot Air to Hellfire: The History of Army Attack Aviation* (Novato: Presidio, 1994). See also Thomas C. Hone and Mark D. Mandeles, 'Interwar Innovation in 3 Navies: US Navy, Royal Navy, Imperial Japanese Navy', *Naval War College Review*, 40/2 (1987), pp. 63-83 and Thomas C. Hone, Norman Friedman, and Mark D. Mandeles, *American and British Carrier Development, 1919–1941* (Annapolis: Naval Institute Press, 1999). Earlier examples of similar studies are Harvey Sapolsky, *The Polaris System Development: Bureaucratic and Programmatic Success in Government* (Cambridge, MA: Harvard University Press, 1972) and Edmund Beard, *Developing the ICBM: A Study in Bureaucratic Politics* (New York: Columbia University Press, 1976).

'Revolution in Military Affairs', threw into sharp relief the importance of innovation.[21] In particular, it highlighted the need to predict future requirements, to procure appropriate equipment and to configure force structures to meet novel challenges. The end of the Cold War and the emergence of new threats maintained the pressure. The unexpectedly prolonged conflicts in Afghanistan and Iraq in the twenty-first century further challenged militaries to reflect on what they were for, how they should evolve, and how they were expected to achieve their goals in a rapidly changing world and with a new paradigm of asymmetric warfare. The risk always exists that the urgent operational requirements of the present distort the past, driving analysts to rummage through the lumber room of old wars in the search for apparent precedents that will help soldiers fight the new. The First World War, this volume suggests, does indeed have lessons to teach modern militaries, but only if the decisions of the past are seen in their proper context.

Adam Grissom's 2006 essay 'The Future of Military Innovation Studies' provides an excellent survey of the field.[22] Grissom identifies six basic models of how military innovation is driven: technological determinism; neo-realism; civil-military dynamics; inter-service relations; intra-service competition; and cultural responses.[23] He argues that the first two of these have been discredited and are not worthy of detailed consideration; neither offers a necessary or sufficient explanation of how and why innovation occurs. They may, at best, establish 'permissive underlying conditions'.[24] The other four models differ about the precise drivers of innovation. The 'civil-military' school, for example, best exemplified by the work of Barry Posen, argues that innovation is primarily the result of civilian intervention in military affairs, supported by 'maverick' officers in the armed forces. Thus, according to Posen, it was civilians in interwar Germany and Britain who prompted innovation, in mechanized combined-arms tactics and the integrated defence system of RAF Fighter Command respectively, while in France politicians allowed their army to stagnate in

[21]See Alan R. Millett and Williamson Murray, 'Military Effectiveness Twenty Years After' in *Military Effectiveness Vol. 3*: *The Second World War*, ed. Alan R. Millett and Williamson Murray (Cambridge: Cambridge University Press, second edition, 2010), p. xiv. Millett and Murray's three-volume study *Military Effectiveness*, originally published in 1988, was itself initially commissioned by the Office of Net Assessment, Office of the Secretary of Defense, US Department of Defense.

[22]Adam Grissom, 'The Future of Military Innovation Studies', *Journal for Strategic Studies*, 29/5 (2006), pp. 904-936.

[23] Ibid., especially pp. 908-19. Foley offers a succinct summary of this article in 'Horizontal Military Innovation', pp. 2-4.

[24]Grissom, 'Future of Military Innovation Studies', p. 908.

the tactics of 1918.[25] The applicability of this model to wartime transformation is moot. Between 1914 and 1918 all states struggled to find the correct balance between civilian and military control of the war effort, and how much civil control there should be of military innovation remained an open question to which answers were still evolving. The respective, and contested, roles of First Lord of the Admiralty Winston Churchill and the War Office in the genesis of the tank in Britain furnishes a comparative example.

For those, such as Harvey Sapolsky and James Bradin, who see inter-service rivalry as more important in bringing about change, the 'invisible hand' of competition for scarce resources between the services causes the latter to appropriate new missions and generates innovation. Classic examples are Polaris, born of rivalry between the USAF and USN, and the US Army's embrace of helicopters to reduce reliance on USAF close air support.[26] Certainly in Britain's war military and maritime strategies and service needs competed, but this was less the case in continental France and Germany. (Alongside the military transformation a naval transformation occurred, in response to submarine warfare). This however would also seem to be a model more applicable to the peacetime world of budgetary constraints, than to wartime. Indeed this suggests a weakness of many theoretical approaches to transformation, in that they assess the innovation drivers of peacetime armies, leaving aside the primary wartime driver, the need to defeat the enemy (and not to be defeated oneself).

If also primarily focused on the peacetime military, Stephen Rosen's third explanation has more currency in wartime. He sees intra-service competition for preferment as more important. Rosen suggests that senior officers conceive of a new way of war and begin a debate, characterized as an 'ideological struggle'. The success of their innovation depends on their ability to attract mid-level officer converts and to promote the careers of these disciples. As these disciples rise within the service, power shifts and the innovation does (or does not) become entrenched.[27] Simon House's study of air warfare in this journal suggests that positive developments arise out of the promulgation and battlefield testing of rival theories or innovative technologies. This seems to be the way by which Ferdinand Foch, Philippe Pétain and other pre-war French military intellectuals proposed, tested and established

[25]Posen, *Sources of Military Doctrine*, pp. 222-236. See Grissom, 'Future of Military Innovation Studies', pp. 909-910, for examples of other 'civil-military' studies.
[26]Sapolsky *Polaris System Development*; Bradin, *Hot Air to Hellfire*, Grissom, 'Future of Military Innovation Studies', pp. 911-913 gives further examples.
[27]Rosen, *Winning the Next War*, pp. 20-23. See also, Stephen P. Rosen, 'New Ways of War: Understanding Military Innovation', *International Security* 13/1 (1988), pp. 134-68. Again, see Grissom, 'Future of Military Innovation Studies', pp. 914–16 for further examples.

doctrinal adaptations as they rose in wartime to the top of the army which as staff college lecturers they had educated in peacetime.[28] The dynamic between 'top down' and 'bottom up' learning, explored in Tony Cowan's article, would seem also to engage with this model, although his analysis suggests intra-service debate in the interests of battlefield effectiveness rather than professional rivalry is the driver in wartime.

The final approach, the 'cultural model', is best displayed in the work of Theo Farrell. Here, innovation is not just 'driven' but also 'shaped'. 'Drivers' are typically external and 'give militaries reason to innovate'. The most important are international threats and peer emulation, but he also includes 'new operational challenges' which presumably cover, amongst other things, the impact of new technology. These were certainly all present during the First World War: the enemy in front, allies to the side, and the fortified, firepower-dominated battlefield between. 'But', Farrell points out, 'the process and nature of the innovation that follows are shaped by a number of factors internal to the state in question'. Leaving on one side whether 'the state' is the appropriate level of analysis, the three 'national shapers' are: resource constraints; domestic politics; and military culture. He defines military culture as: 'those identities, norms and values that have been internalized by a military organization and frame the way the organization views the world, and its role and functions in it. Military culture is embodied in (and reproduced through) military training, regulations, routines and practice.'[29] Only innovations compatible with the dominant military culture can succeed. Innovation can thus come about in one of three ways. First, senior leaders can change the culture to bring about planned change. Secondly, external shocks – defeat being the most obvious – can reshape the culture. This certainly happened in the French army, beaten on the frontiers in August 1914 and needing to adapt to a war of attrition on national soil, if less so in the German and British armies whose military cultures seemed more entrenched.[30] Thirdly, a military might choose to emulate that of another nation, perhaps to enhance inter-operability or simply to imitate success. The dynamic of learning from

[28]This is implicit in Claude Franc, *Le Haut-commandement français sur le front occidental, 1914–1918* (Paris, SOTECA, Éditions 14–18, 2012). Franc identifies the pre-war intellectuals who rose to high command on pp. 393-4.

[29]Theo Farrell, 'The Dynamics of British Military Transformation', *International Affairs*, 84/4 (2008), pp. 777-807 (pp. 779-83).

[30]An influential if controversial thesis of cultural conservatism in the highest echelons of the British army was promulgated in Tim Travers, *The Killing Ground: The British Army, the Western Front and the Emergence of Modern Warfare, 1900–1918* (London: Unwin Hyman, 1987). For the reasons for French disaster in August 1914, both cultural and practical, see Simon J. House, *Lost Opportunity: The Battle of the Ardennes, 22 August 1914* (Solihull: Helion & Co., 2017).

ally and enemy, while certainly on-going, remains unexplored and misunderstood for this conflict. Tony Cowan's article, however, indicates that the German army certainly adapted its defensive practices in the face of increasing Anglo-French battlefield effectiveness (which is not the same as learning from the enemy), although gaining no more than short-term advantage as allied offensive methods developed in their turn. When the Allies tried to emulate these German defensive methods in 1918, however, the results were at best mixed.[31] These observations aside, such factors would certainly seem to be relevant between 1914 and 1918, and this model offers much of value when examining innovation and change during this war.

The problem with military culture, of course, is that it is notoriously difficult to nail down. It is empirically unquantifiable; it is not unitary; it constantly shifts shape; and its effects are often tacit and extremely complex. When it comes to innovation, military culture must face the fundamental paradox that, on the one hand, innovation seems to succeed best where open debate and dissent is encouraged while, on the other, hierarchy and obedience to orders must be maintained. This contradictory internal dynamic was certainly operating as Germany adapted her defensive tactics, Cowan's study demonstrates, and did not facilitate the process. How a given military culture strikes that balance is crucial for the success or failure of innovation.

It is reasonable to present broader impressions on how and why the three armies approached the process of transformation differently, founded in military cultures that meant that each army engaged with adaptation to the industrialised battlefield slightly differently. This might also suggest why outcomes, if similar, differed in their details. All three armies too were profoundly reshaped by the experience.

The British army's culture and adaptation is the most studied, within the parameter of the long-running 'learning curve' debate. If a paradigm might be posited, it is of an army undertaking a practical exercise in response to rapid expansion and unfamiliar challenges. British and Commonwealth historians of the western front have built up a considerable body of literature charting the changes in warfare that occurred, and especially the British response to them, primarily in terms of technology, tactics, operations and command.[32] These studies take an empirical approach rather that

[31]Allied defensive adaptation has yet to be explored in the same way that offensive warfare has been.

[32]As well as works already cited, other important contributions include: Robin Prior and Trevor Wilson, *Command on the Western Front: The Military Career of Sir Henry Rawlinson 1914–18* (Oxford: Blackwell, 1992); Jonathan Bailey, *The First World War and the Birth of the Modern Style of Warfare* (Camberley: Strategic and Combat Studies Institute, 1996); *British Fighting Methods in the Great War*, ed. Paddy Griffith (London: Frank Cass, 1996); Ian M. Brown, *British Logistics on the Western Front, 1914–1919*

employing any sort of theoretical framework, and collectively have argued that the British Army was far from being the reactionary institution of myth, led by 'butchers and bunglers', which never got to grips with the realities of modern industrial warfare. Instead, it progressively climbed a 'learning curve', or underwent a 'learning process', which took it from disaster on the first day of the Battle of the Somme to leading the Allied armies to victory over Germany during the 'Hundred Days' campaign of August to November 1918.[33] Within this broader development, a number of sub-themes are identified, such as whether, and if so why, Dominion forces adapted better than metropolitan units,[34] how technology impacted upon innovation and whether learning was driven by doctrinal development or improved command methods.

The French army's culture was rather different. French soldiers approached military matters from a cerebral perspective, more so perhaps than their British and German counterparts. Pre-1914, theoretic debates flourished in military circles and service journals over the nature of modern war and how the army should respond; when war broke out the army was in the grip of unresolved doctrinal debates between the advocates of 'firepower' and 'shock' and struggling to elaborate the newly emerging operational level of war.[35] This left the French army at a distinct disadvantage when war broke out, reflected in its poor performance in the first encounter with the enemy.[36] Harsh experience produced positive outcomes, and the French high command responded appropriately to the unexpected challenges of positional warfare with a firepower-based tactical doctrine and a scientific operational system that employed a modernising and increasingly technological army to ever increasing

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(Westport: Praeger, 1998); Albert Palazzo, *Seeking Victory on the Western Front: The British Army and Chemical Warfare in World War I* (Lincoln, NE: University of Nebraska Press, 2000); Nikolas Gardner, *The Beginning of the Learning Curve: British Officers and the Advent of Trench Warfare, September–October 1914* (Salford: ESRI Working Papers, 2003) and *Trial by Fire: Command and the British Expeditionary Force in 1914* (Westport: Praeger, 2003); *Command and Control on the Western Front: The British Army's Experience 1914–18*, ed. Gary Sheffield and Dan Todman (Staplehurst: Spellmount, 2004); Simon Robbins, *British Generalship on the Western Front 1914–18: Defeat into Victory* (London: Frank Cass, 2005).

[33]See for example Sheffield, *Forgotten Victory* and Simkins, *From the Somme to Victory*.

[34]See for example, Bill Rawling, *Surviving Trench Warfare: Technology and the Canadian Corps, 1914–1918* (Toronto: Toronto University Press, 2nd edn, 2014); Christopher Pugsley, *The Anzac Experience: New Zealand, Australia and Empire in the Great War* (Auckland, NZ: Reed Publishing, 2004).

[35]See Porch, *March to the Marne.*

[36]House, *Lost Opportunity*.

effect, by late 1916 overtaking the German army in its development.[37] The French army's approach to transformation can be characterised as an intellectual or philosophical exercise, a re-conceptualisation of warfare in response to the experiences of battle by pre-war theorists such as Foch, Pétain and Marie-Émile Fayolle. Jonathan Krause's article elaborates one element of this re-education of an army, showing that a re-conception of artillery tactics underpinned the increasingly effective battlefield performance of the French army from 1915. Simon House's complementary look at how the French military met the iconic technological challenge of the war, with the development of their air force, fills a surprising gap in the historiography.[38]

The German army's approach to adaption, in contrast, might be seen as more bureaucratic than intellectual. Uniformity was a, if not the, primary concern. Consequently the army placed considerable weight on the introduction of systems which would disseminate and enforce compliance with common doctrine. The officers of the General Staff, who were the keepers of the doctrinal flame, were arrogant enough to believe they always knew the right answer. In the event of failure, instead of re-evaluating their premises and checking the logic of their conclusions, there was often a tendency to tighten up command structures, often through greater micro-management, to ensure better adherence to instructions. Thus while their adversaries were becoming more thoughtful and flexible in their approach to battlefield challenges, the German army became more sclerotic and authoritarian as the fortunes of war turned against it. (This mirrored developments in German domestic politics, underlining the importance of the cultural model).[39] Therefore, while the German army undoubtedly was capable of important innovations, for example in methods of defence-in depth, in storm-troop tactics and in artillery practices, the allies could generally develop effective counter measures more quickly than the German army could respond to allied surprises. By the last

[37]A process elaborated in William Philpott, *Bloody Victory*. See also Michel Goya, *Flesh and Steel: The Transformation of the French Army and the Invention of Modern Warfare* (Barnsley, Pen and Sword, 2018).

[38] Much of the literature on the war in the air is Anglo-centric. See the articles by Peter Gray, Christopher Luck, Peter Dye, David Jordan, Simon Coningham and Alistair McCluskey in Gary Sheffield and Peter Gray (eds), *Changing War: The British Army, the Hundred Days Campaign and the Birth of the Royal Air Force* (London: Bloomsbury, 2013); John Buckley, *Air Power in the Age of Total War* (London: UCL Press, 1999); John H. Morrow Jr, *The Great War in the Air: Military Aviation from 1909 to 1921* (Tuscaloosa, AL: University of Alabama Press, 1993).

[39]See Jonathan Boff, *Haig's Enemy: Crown Prince Rupprecht and Germany's War on the Western Front, 1914–1918* (Oxford: Oxford University Press, 2018).

months of the war Germany had lost the military innovation race and was being left ever further behind.

When it comes to organizational culture, almost all the existing innovation literature shares a hidden assumption. Armed forces are primarily seen in organizational terms as scientific Weberian bureaucracies, operating optimally and rationally, at least by their own lights, '*sine ira et studio*'.[40] This is potentially problematic on two levels. First, do organizations make decisions entirely rationally? Are there not severe cognitive limits to rationality? The actors within organizations are not emotionless instruments, as classical theory suggests, but humans with their own wants, needs and limitations.

The classical assumption that it is possible to know all possible outcomes and consequences of any given decision is particularly doubtful in wartime, where the fog of uncertainty cloaks everything.[41] As Peter Paret has argued, war 'engages emotion as well as reason… The employment of violence can be rational. And yet violence and its effects are always emotional and subject to the irrational' and war can change 'from a tool of policy to a force that imposes – or seeks to impose – its own emotional demands.'[42] Secondly, bureaucracies are seen as primarily conservative organizations. Militaries, especially, are seen as naturally 'resistant to major change. It is simply not in their nature. Organizations run on routines and standard operating procedures, and depend on stability for functional integrity. Moreover, military organizations, as socially conservative and closed communities (not unlike religious orders), are especially disinclined to innovate.'[43] This is partly the consequence of bureaucracies being power structures with a perceived tendency to perpetuate the status quo.

The contrasting impressions of how the three armies approached the process of transformation might lead one to question whether the objective Weberian bureaucratic machine is the correct model for the militaries of the First World War. Certainly, the more work that is done on the ethos of the British army before and

[40]Max Weber, *The Theory of Social and Economic Organization*, trans. A. R. Henderson, and Talcott Parsons, rev. and ed. Talcott Parsons (London: William Hodge, 1947), pp. 309-312. The authors are grateful to Dr Aimée Fox for raising this point.
[41]James G. March, and Herbert A. Simon, *Organizations* (Cambridge MA: Blackwell, 2nd. ed., 1993), pp. 157-192. Thanks to Professor Jonathan Bendor for discussing this question.
[42]Peter Paret, *The Cognitive Challenge of War: Prussia 1806* (Princeton: Princeton University Press, 2009), pp. 3-4.
[43]Farrell, 'British Military Transformation', p. 777.

during the war, the less appropriate it seems.[44] Christian Stachelbeck's work hints that, even in Weber's homeland, the army was a less rational institution than is sometimes assumed.[45] The French army certainly had its factions and dysfunctions. Partly this was a consequence of the politics of the Third Republic, veering as they did back and forth between republican anti-militarism and patriotic citizen service, especially in the pre-Great War era of Dreyfus, the *affaire des fiches* and the nationalist revival, as Eugen Weber has suggested.[46] It was also the outcome of an unresolved dispute between the advocates of 'firepower' and 'élan' as the army tried to determine the nature of future warfare and how traditional *furia francese* might yet triumph on a technological battlefield. Indeed these continued to hamstring the army once war was declared. Perhaps, if we saw these armies instead as evolving organisms, working subjectively as best they could in remarkably trying conditions, we might be more understanding of the obstacles in the way of, for example, developing and inculcating appropriate doctrine, better grasp the processes involved, and get closer to what it meant to seek mastery of the industrial battlefield.

Many historians have over-simplified the nature of innovation itself, too. Consciously or otherwise, they cling to the influential Unfreeze–Change–Refreeze model of innovation originally proposed by Kurt Lewin in 1947.[47] The organization is first seen as being in an equilibrium position. As a result of some stimulus, this equilibrium is disturbed, the organization identifies the need to change, innovates, and moves to a new steady state, until it receives the next stimulus. This greatly underestimates the dynamism of the process, which is ongoing and unending. In the 1970s Donald Schön and Chris Argyris developed the concept, later fleshed out and popularized by Peter Senge, of the 'learning organization' capable of handling non-stop change.[48] The

[44]See, for example, Palazzo's work on 'ethos' in *Seeking Victory on the Western Front:* or David French, *Military Identities: The Regimental System, the British Army, and the British People, c. 1870–2000* (Oxford: Oxford University Press, 2005).

[45]Christian Stachelbeck, *Militärische Effektivität im Ersten Weltkrieg: Die 11. Bayerische Infanteriedivision 1915 bis 1918* (Paderborn: Ferdinand Schöningh, 2010).

[46]Eugen Weber, *The Nationalist Revival in France, 1905–1914* (Berkley, CA: University of California Press, 1959).

[47]Kurt Lewin, 'Frontiers in Group Dynamics: Concept, Method and Reality in Social Science; Social Equilibria and Social Change', *Human Relations* 1/1 (1947), pp. 5-41 (pp. 34-5).

[48]Chris Argyris and Donald A. Schön, *Organizational Learning: A Theory of Action Perspective* (Reading, MA.: Addison Wesley, 1978); Peter M. Senge, *The Fifth Discipline: The Art & Practice of the Learning Organization* (New York: Doubleday, 1990). A short summary of the key ideas can be found in Diane Worrell, 'The Learning Organization: Management Theory for the Information Age or New Age Fad?', *Journal of Academic Librarianship* 21/5 (1995), pp. 351-7 (pp. 351-4).

Pentagon Quadrennial Defence Review of 2001 picked this idea up, pointing out that military transformation is 'a continuous process and "not an end point"'.[49] One of the questions that remains to be answered is the extent to which First World War armies were 'learning organizations' *avant la lettre*, 'skilled at creating, acquiring and transferring knowledge, and at modifying [their] behavior to reflect new knowledge and insights'?[50] When we actually look at what was transformed, and how rapidly, it suggests that such a model was appropriate. In only three campaign cycles modern warfare was conceptualized, adopted and applied: in 1915 basic 'all-arms' tactical concepts were tested; by 1916 materially-based 'scientific' operational methods were conceived;[51] and in 1917 these were inculcated into the armies which were trained and equipped to fight modern combined-arms battles. In 1918's last campaign these armies and their commanders applied these methods to fight the war to a decision.

Another common factor uniting most of the work done to date, Grissom argued, is that it concentrates only on innovation driven from the top down. He suggested we need more case studies which pay attention to change which works from the bottom up.[52] In practice the dichotomy between the two is often a false one. Much innovation is actually born of a dynamic relationship between top and bottom, with demand-led and supply-led change interacting. Elsewhere, Robert Foley has recently introduced a paradigm of what he calls 'horizontal innovation', where lessons learned in the front line of the German army in 1916–18 were passed sideways around the institution, or went up and then sideways, rather than straight up or down.[53]

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The range of work on military innovation and transformation in recent years notwithstanding, much remains to be done. Much of the literature specifically

[49]US Department of Defense, *Quadrennial Defense Review Report*, 30 September 2001, p. 32. The British army has adopted the same jargon: General Sir David Richards speaks of 'transformation in contact' in 'Twenty-first Century Armed Forces: Agile, Useable, Relevant', presentation to the RUSI Land Warfare Conference, 23–25 June 2009, referenced in Robert T. Foley, Helen McCartney, and Stuart Griffin, '"Transforming in contact": learning the lessons of modern war', *International Affairs* 87/2 (2011), pp. 253-70 (p. 253, n. 1).

[50]David A. Garvin, 'Building a Learning Organization', *Harvard Business Review,* 71/4 (1993), pp. 78-91 (p. 80).

[51]The term is Ferdinand Foch's. See 'De nos dernières attaques', 6 December 1915, reproduced in Maréchal Foch, *Oeuvres complètes* (Paris: Economica, 3 vols, 2008), ii, pp. 439-47.

[52]Grissom, 'Future of Military Innovation Studies', p. 930.

[53]Foley, 'Horizontal Military Innovation'.

focused on innovation is programmatic, designed to solve the problems of peace or limited war, and so most of it concentrates on peacetime change.[54] It therefore does not engage with a series of interesting questions which arise during unlimited conflicts. Is innovation easier, or harder, during total war? Does the existential threat to national survival clarify the changes required and make it easier to build consensus for innovation? Are resource constraints less of a concern? How do the changed civil–military dynamics of wartime impact upon innovation? Do 'rat-catchers', to use Andrew Gordon's phrase, tend to replace 'regulators' in command in wartime and thus introduce the 'maverick' element Barry Posen considers helpful for innovation?[55] To what extent do inter- and intra-service rivalries help or hinder change? Does the influx of civilians into the armed forces inevitably bring with it a willingness to innovate which alters military culture? On the other hand, do civilians find their creative tendencies stifled by this military culture? (Paul Harris's recent study of the expanded British General Staff indicates that civilians only penetrate so far into the military culture even in a rapidly expanded mass army: 'the staff, unlike the wider army, remained an enclave of regular soldiers'.)[56] More obviously still, how does the intervention of the enemy affect change?

Most of the innovation literature discussed so far has been written by social scientists interested primarily in the phenomenon of innovation itself and mining history for case studies which shed light on that. Contrastingly, historical revisionism, while soundly based in archival research and offering a useful corrective to previous lazy stereotypes, is not free of shortcomings of its own. First, the concepts and methods of learning and adaptation remain amorphous. The precise mechanisms by which change came about have yet to be fully drawn. Aimée Fox has recently shown in detail how the British army absorbed and implemented lessons learned, but little comparable work exists on the other armies.[57] Second, it is sometimes too focused on the formal and theoretical, neatly tracing developments in published doctrine, without always analysing how closely praxis cohered to theory and the extent to which learning went on informally: one of the many important points to emerge

[54]One exception is Stephen Rosen, who looked at tanks in 1914–1918, the U-boat war and American strategic bombing in the Second World War. The recent collection, *A Military Transformed? Adaptation and Innovation in the British Military, 1792–1945*, ed. Michael LoCicero, Ross Mahoney and Stuart Mitchell (Solihull: Helion & Co Ltd, 2014), adopts a broader timescale and multi-service perspective.

[55]Andrew Gordon, *The Rules of the Game: Jutland and British Naval Command* (London: John Murray, 2005), p. 597.

[56]Paul Harris, *The Men Who Planned the War: A Study of the Staff of the British Army on the Western Front, 1914–1918* (Farnham: Ashgate, 2016), p. 192.

[57]Aimée Fox, *Learning to Fight: Military Innovation and Change in the British Army, 1914–1918* (Cambridge: Cambridge University Press, 2017).

from Fox's work is the importance of the latter. Third, the dynamism of the challenge of mastering the industrial battlefield is often understated. The problem is portrayed as the search for a single key to unlock stalemate, where a better analogy might be a wrestling match with a protean monster which continually changes shape to frustrate its attacker. Fourth, it remains Anglo-centric. Only recently has the measure/counter-measure dynamic between the British and their enemy been considered, and there remains much scope for studying other armies and comparative analysis.[58]

The articles collected here do not pretend to address all the problems with the existing literature, both social scientific and historical; but they will, perhaps, enable us to view the First World War transformation more broadly. Each army had to confront the transformation of war which took place (primarily) on the Western Front, and each learned, adapted and innovated during those four years. British, French and German armies all passed through the cycle of innovation and counter-innovation and contributed to the remodelling of warfare between 1914 and 1918. One hundred years later we can safely claim that warfare was profoundly changed then, that armies were the instrument of change and commanders its facilitators: how, why and with what consequences are fitting themes for consideration during the war's centenaries and beyond.

[58]Jonathan Boff, *Winning and Losing on the Western Front: The British Third Army and the Defeat of Germany in 1918* (Cambridge: Cambridge University Press, 2012) assesses the denouement of this dynamic process rather than its development.

Two Battles at Le Cateau, 1914 and 1918: The Transformation of War

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ABSTRACT
This article compares two battles for the town of Le Cateau, in August 1914 and October 1918, to highlight the changes in the character of war which had occurred over the four years of the First World War. These changes, it argues, extended beyond the technological, tactical, and operational ones often discussed by military historians. For instance, the kind of men doing the fighting, and the objectives for which they contended, were both radically different by 1918, with important consequences for the way the war was fought.

Gary Sheffield has pointed out that while Napoleon might have felt at home on the battlefields of August 1914, he would not have recognised the way war was fought a mere four years later.[1] That the First World War transformed the nature of warfare is in no doubt. It was certainly clear at the time that much had changed. In his preface to the first edition of the first volume of the British official history of the army on the Western Front, written in 1922, James Edmonds speaks of his desire 'to leave a picture of what war was like in 1914, when trained soldiers were still of greater importance than material, and gas, tanks, long-range guns, creeping barrages and the participation of aircraft in ground fighting were unknown.'[2] A considerable body of literature has grown up charting the technical changes that occurred, and

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[1]Gary Sheffield, *Forgotten Victory: The First World War: Myths and Realities* (London: Headline, 2001), p. 107.

[2]James E. Edmonds, *Military Operations France and Belgium, 1914* Volume I: *Mons, the Retreat to the Seine, the Marne and the Aisne August–October 1914* (3rd Revised edition, originally published 1933, reprinted London: Imperial War Museum, 1996) (hereafter *BOH 1914* Vol. I), p. vii.

especially the British response to them, primarily in terms of technology, tactics, operations and command.[3] By December 1945, however, when his last volume dealing with 1918 finally began to move towards publication, Edmonds seems to have moved towards a broader view of the Western Front, seeing it as 'the opening stage of a great phase of transition in land warfare… from wars of manoeuvre, conducted with professional armies of medium size, to a war of attrition with million-strong armies lined up without a gap… [it shows] the change from wars of soldiery opposed to soldiery to wars of material.'[4] In other words, alongside technical change went social and cultural transformation. This essay attempts to address both aspects. It first compares two battles at either end of the war and draws out the technical differences between the two. It then goes on to suggest that there were important changes in the composition and nature of the armies, and the purposes for which men fought, which not only contributed to the transformation undergone in 1914-1918 but also set the tone for the rest of the twentieth century. This cultural and

[3]Some important contributions include: John Terraine, *White Heat: The New Warfare 1914–18* (London: Sidgwick & Jackson, 1982); Shelford Bidwell and Dominick Graham, *Fire-Power: British Army Weapons and Theories of War 1904–1945* (London: Allen & Unwin, 1982); Robin Prior and Trevor Wilson, *Command on the Western Front: The Military Career of Sir Henry Rawlinson 1914–18* (Oxford: Blackwell, 1992); Paddy Griffith, *Battle Tactics of the Western Front: The British Army's Art of Attack 1916–18* (New Haven: Yale University Press, 1994); Jonathan Bailey, *The First World War and the Birth of the Modern Style of Warfare* (Camberley: Strategic and Combat Studies Institute, 1996); Paddy Griffith (ed.), *British Fighting Methods in the Great War* (London: Frank Cass, 1996); Ian Malcolm Brown, *British Logistics on the Western Front 1914–1919* (Westport: Praeger, 1998); British Commission for Military History, *'Look to your Front': Studies in the First World War* (Staplehurst: Spellmount, 1999); Albert Palazzo, *Seeking Victory on the Western Front: The British Army and Chemical Warfare in World War I* (Lincoln: University of Nebraska Press, 2000); Jonathan Bailey, 'The First World War and the birth of modern warfare' in MacGregor Knox and Williamson Murray (eds), *The Dynamics of Military Revolution 1300–2050* (Cambridge: Cambridge University Press, 2001); Nikolas Gardner, *The Beginning of the Learning Curve: British Officers and the Advent of Trench Warfare, September–October 1914* (Salford: ESRI Working Papers, 2003); Gary Sheffield and Dan Todman (eds), *Command and Control on the Western Front: The British Army's Experience 1914–18* (Staplehurst: Spellmount, 2004); Simon Robbins, *British Generalship on the Western Front 1914–18: Defeat into Victory* (London: Frank Cass, 2005); Andy Simpson, *Directing Operations: British Corps Command on the Western Front* (Stroud: Spellmount, 2006).

[4]Sir James E. Edmonds and R. Maxwell-Hyslop, *Military Operations France and Belgium 1918* Volume V: *26th September–11th November The Advance to Victory* (first published London: HMSO 1947; reprinted London: Imperial War Museum 1993) (Hereafter *BOH 1918* Vol. V), p. 580.

strategic shift, it will suggest, is crucial to a rounded understanding of the transformation in the nature of war on the Western Front.

The First Battle of Le Cateau, fought on 26 August 1914, is well known, at least in Great Britain.[5] Retreating from its first clash with the Germans at Mons, General Sir Horace Smith-Dorrien's II Corps of the British Expeditionary Force (BEF) turned and stood against *Generloberst* von Kluck's *First Army* on a low ridge west of Le Cateau. German attempts to envelop both British flanks were prevented by an early afternoon withdrawal and the BEF was able to continue its retreat relatively undisturbed thereafter. The battle has long been controversial, not least due to an unseemly and long-running dispute between the BEF's Commander-in-Chief, Field Marshal Sir John French and Smith-Dorrien.[6] Nonetheless, John Terraine described it as 'not only the most brilliant exploit of the BEF during the Retreat, but one of the most splendid feats of the British Army during the whole war.'[7] The first attempt at a professional history of the battle was A. F. Becke's *The Royal Regiment of Artillery at Le Cateau* of 1919, based on war diaries and interviews with survivors.[8] An artillery officer himself, although unfit for active service, Becke had published a study of the Waterloo campaign in 1914 and drew many parallels between the two battles in his account.[9] He later joined the team under James Edmonds compiling the official history of the Great War. The first volume of this likewise picked up on the parallels between combat in 1914 and that of earlier eras. On the Aisne in September, for instance, 'the fighting resembled that of Waterloo or Inkerman, except that the combatants, instead of being shoulder to shoulder, controlled by their officers, advanced in open order and in small parties, and fought usually behind cover or lying down.'[10] Edmonds, himself a veteran of Le Cateau, where he had served as chief of staff of 4th Division, covers the battle in considerable detail over nearly sixty pages. Briefer, but useful summaries can be found in John Terraine's *Mons* and David

[5]Nigel Cave and Jack Sheldon, *Le Cateau: 26 August 1914* (Barnsley: Pen and Sword, 2008) offers an excellent tactical account of the battle.

[6]See Viscount French of Ypres, *1914* (London: Constable and Company, 1919); Richard Holmes, *The Little Field-Marshal: Sir John French* (London: Jonathan Cape, 1981), pp. 223-5; Ian F. W. Beckett, *The Judgement of History: Sir Horace Smith-Dorrien, Lord French and 1914* (London: Tom Donovan, 1993).

[7]John Terraine, *Mons: The Retreat to Victory* (Barnsley: Leo Cooper, 1991; first pub. 1960), p. 143.

[8]Archibald F. Becke, *The Royal Regiment of Artillery at Le Cateau, Wednesday 26th August 1914* (Woolwich: Royal Artillery Institution, 1919).

[9]Archibald F. Becke, *Napoleon and Waterloo: the Emperor's campaign with the Armée du Nord, 1815; a strategical and tactical study* (London: Kegan, Paul & Co., 1914).

[10]*BOH 1914* Vol. I, p. 395.

Ascoli's *The Mons Star*.[11] Terence Zuber's *The Mons Myth* offers a more modern account, particularly valuable for its painstaking reconstruction of German movements during the day. Its depiction of the confusion in British ranks on the morning of 26 August rings truer than Edmonds' neat and possibly sanitised version. Unfortunately, these strengths are partly compromised by unrealistic assumptions about the ability of armies to reproduce training-field tactics under fire, a failure to apply the same critical eye to German sources as British ones, and an over-exuberance of argument which can become wearisome.[12]

The Second Battle of Le Cateau, in contrast, never happened – officially, at least. On 8 October 1918 the British Fourth and Third Armies, together with the right wing of First Army, attacked German positions in the Beaurevoir–Masnières Line, the rearmost fortifications of the vaunted Hindenburg Line, into which the British had broken in a series of operations beginning on 27 September. The German defenders, men of *Second* and *Seventeenth* armies, were quickly overrun and over the next few days fell back over the 1914 battlefield and behind the River Selle, up to which the British had closed by 12 October. This fighting is what Field Marshal Sir Douglas Haig referred to as the Second Battle of Le Cateau, although the official historians later chose to designate it instead as 'the Battle of Cambrai 1918' and 'the Pursuit to the Selle'.[13] The town of Le Cateau itself was cleared by 198th Brigade (66th Division) on 17 October, and the east bank of the Selle was captured on 20 October.[14]

The first and most obvious contrast between 1914 and 1918 was an increase both quantitative and qualitative in the use of mechanical means of warfare. Take motor transport, for instance. The BEF of September 1914 had 1,200 lorries, or about 60

[11]*BOH 1914* Vol. I, pp. 152-211; Terraine, *Mons*, pp. 140-55; David Ascoli, *The Mons Star: The British Expeditionary Force 5th August-22nd November 1914* (London: Sidgwick & Jackson, 1981), pp. 95-114. For a German account, see Reichsarchiv, *Der Weltkrieg 1914–1918* Band I *Die Grenzschlachten im Westen* (Berlin, E. S. Mittler & Sohn, 1925) (Hereafter *GOH 1914* Vol. I), pp. 517-32. Note the discrepancy between the attention paid to the battle between the two official histories.

[12]Terence Zuber, *The Mons Myth: A Reassessment of the Battle* (Stroud: History Press, 2010), pp. 211-259.

[13]John H. Boraston (ed.), *Sir Douglas Haig's Despatches (December 1915 – April 1919)* (London: J. M. Dent, 1919), p. 287; *BOH 1918* Vol. V, pp. 185-247; H. Stewart, *The New Zealand Division, 1916–1919: A Popular History Based on Official Records* (Auckland: Whitcombe and Tombs, 1921) also refers to a Second Battle of Le Cateau (pp. 517-63).

[14]See Peter E. Hodgkinson, *The Battle of the Selle: Fourth Army Operations on the Western Front in the Hundred Days, 9–24 October 1918* (Solihull: Helion, 2017) for a detailed account of the fighting in and south of the town of Le Cateau itself.

per mile of front. By November 1918, there were 26,809, or 450 per mile.[15] The weight of firepower available grew exponentially too. BEF infantry divisions in 1918 had 64 Vickers and 336 Lewis machine guns, compared with just 24 Vickers in 1914. While the original BEF had no mortars, by the end of the war divisions had 36 each.[16] Smith-Dorrien commanded a total of 216 Royal Field Artillery (RFA), and 12 Royal Garrison Artillery (RGA) medium, artillery tubes. The heaviest were 60-pounder guns and 6-inch howitzers.[17] Four years later, the attack of the 6th Division alone was supported by 254 RFA and Royal Horse Artillery (RHA) pieces plus 144 8-inch and 9.2-inch howitzers and a further five siege batteries of 6-inch and 12-inch guns.[18] The artillery density of II Corps in 1914 was thus 21.6 field, and 1.2 medium, pieces per mile of front, while that of Third Army in 1918 was 76.8 and 42.5 respectively, with 425 heavy guns and howitzers, and another 768 field pieces.[19] The front in both cases was about ten miles long. Artillery became a much more flexible, efficient and accurate instrument as the war went on, aided by new techniques in manufacture, calibration, survey and meteorology. For instance, on 26 August the field artillery of 5th Division, mainly deployed in close support to the infantry on the forward slopes of the ridge, fired primarily shrapnel in close support. The guns were positioned as little as 2–400 yards in rear of the infantry.[20] The 108th Heavy Battery 'took up positions of observation' only slightly to the rear and also fired on advancing German infantry. The only aid to counter-battery fire was the enemy's muzzle flashes.[21] In October 1918, on the other hand, the artillery carried out a variety of roles, largely by indirect fire, and displayed considerable flexibility. On 6 and 7 October field artillery cut wire, before firing a creeping barrage to cover the attack on 8 October. When resistance proved light, as on 10 October in the 37th Division sector, the creeping barrage was cancelled impressively quickly, within forty minutes.[22] A smoke screen was fired to protect the left flank of XVII Corps, and

[15]A. M. Henniker, *Transportation on the Western Front* (London: HMSO, 1937), p. 148; War Office, *Statistics of the Military Effort of the British Empire during the Great War: 1914–1920* (London: HMSO, 1922), p. 595.
[16]*BOH 1918* Vol. V, p. 596.
[17]*BOH 1914* Vol. I, pp. 476-80. 246, according to Becke, *Royal Regiment of Artillery at Le Cateau*, p. 17.
[18]*BOH 1918* Vol. V, p. 189.
[19]*BOH 1918* Vol. V, pp. 622-4.
[20]The National Archives (TNA), WO 95/1521A, 5th Division CRA War Diary, General Account of the Work of the 5th Divisional Artillery from its Concentration in France to the Battle of Le Cateau, dated 2 October 1914, p. 19; Becke, *The Royal Regiment of Artillery at Le Cateau*, pp. 27-33.
[21] *BOH 1914* Vol. I, pp. 154, 159-60.
[22]TNA WO 95/2515, 37th Division General Staff War Diary, Narrative of Operations, 29 September–13 October 1918.

heavy artillery provided counter-battery and interdiction fire into enemy rear areas.[23] Use of gas was relatively light. VI Corps heavy artillery fired just 545 gas shells on 8 October 1918 (less than five per cent of the total) compared with 2,850 (22 per cent) on 21 August. As the Germans fell back, each infantry battalion also had a battery of 18-pounders moving up with it to provide close support.[24] Likely German strongpoints in villages were bombarded with incendiary shells.[25] Table 1 below shows the broad range of uses to which was artillery was put on 8 October.[26]

Table 1: Artillery Ammunition Expended, 8 October

	Total Shells Fired	Percentage Shrapnel	Percentage High Explosive	Percentage Smoke	Percentage Gas
Field	58,077	39	48	13	0
Heavy	13,243	14	82	0	4

In addition to increased use of old and upgraded technology, of course, another obvious difference between the two battles was increasing deployment of new technologies such as the aeroplane and the tank. In 1914, the BEF had four squadrons of the Royal Flying Corps (RFC) attached, totalling 48 unarmed machines. Their role was reconnaissance and liaison. On 26 August II Corps had one aircraft attached to it for reconnaissance, while another five performed the same function for GHQ and two others were used for carrying messages.[27] By 1918, on the other hand, the Royal Air Force (RAF) had over 1,700 aircraft carrying out a wide range of roles.[28] David Jordan has concisely described the broad development of British air

[23]TNA WO 158/422, XVII Corps Operations, Narrative of Operations, 27 September–11 November 1918.
[24]TNA WO 95/1200, Guards Division CRA War Diary, Narrative of Operations from Artillery Point of View, 8–22 October 1918.
[25]TNA WO 95/1381, 3rd Division General Staff War Diary, Report on Operations, 8–9 October 1918; TNA WO 95/775, VI Corps General Staff War Diary, VI Corps Artillery Narrative August 21st to November 11th 1918, 'The incendiary shell fired on Seranvillers did not set fire to the village but provided a useful line to the infantry and is said to have caused considerable moral effect on the enemy'.
[26]TNA WO 95/775, VI Corps General Staff War Diary, VI Corps Artillery Narrative, Appendix 3, Approximate Expenditure of Ammunition, 21 August to 11 November 1918.
[27]TNA WO 95/1, GHQ General Staff War Diary, Air Reconnaissance, August 1914, August–December 1914.
[28]H. A. Jones, *The War in the Air: Being the Story of the Part played in the Great War by the Royal Air Force*, Appendices Volume (Oxford: Clarendon Press, 1937), p. 123. Figure for 8 August.

power.[29] On 8 October itself, Third Army was supported by III Brigade RAF with 261 aircraft in fifteen squadrons, plus a special flight of three Bristol fighters equipped for long-range artillery observation. One squadron was directly attached to each corps for contact patrols, reconnaissance and artillery observation.[30] Of the rest, one squadron of Sopwith Camels was directed to drive down enemy balloons and then join three others in a ground attack role.[31] Other fighters flew air superiority missions, while a squadron of day bombers targeted enemy headquarters and road junctions behind the lines. In all, in the week ending 10 October III Brigade flew over 2,800 hours of combat missions, took 613 photographs, dropped 2,312 25-pound and 129 112-pound bombs, and claimed twelve enemy aircraft and four balloons downed.[32]

A striking feature of 8 October was the use of tanks, not only by the British, but also by the Germans. Third Army was allocated 32 Mark IV and Mark V tanks, of which 28 made it to the start line.[33] In the V Corps sector, their use proved very helpful: 115th Brigade (38th Division) successful attack was 'due to prompt action and glorious co-operation of the tanks, great praise is due to them.'[34] VI Corps, however, faced a German counterattack spear-headed by some ten captured and reconditioned British Mark IV tanks, which achieved considerable surprise and temporarily broke up the advance of 2nd, 3rd and 63rd Divisions near Niergnies. Four German machines fought a tank duel with 12th Battalion Tank Corps, knocking out two British machines for the loss of one. A British-operated, but captured German, anti-tank gun knocked out a second German tank, whereupon the survivors withdrew. Another two German-operated female Mark IVs were destroyed further south.[35] The use of both

[29]David Jordan, 'The Royal Air Force and Air/Land Integration in the 100 Days, August–November 1918', *Air Power Review* 11/2 (Summer 2008), pp. 12-29. For more detail on the RAF in late 1918, see Jonathan Boff, 'Air/Land Integration in the 100 Days', *Air Power Review* 12:3 (Autumn 2009), pp. 77-88.

[30]TNA AIR 1/677/21/13/1887, The Western Front – Air Operations May–November 1918, p. 244.

[31]TNA AIR 1/1518/204/58/75, III Brigade Operation Order, 7 October 1918.

[32]TNA AIR 1/1518/204/58/65, III Brigade Weekly Summaries of Work 28 December 1917–11 November 1918.

[33]TNA WO 95/95, Tank Corps General Staff War Diary, Report on Operations, 8–10 October 1918.

[34]TNA WO 95/2560, 115th Infantry Brigade War Diary, Entry for 8 October 1918.

[35]TNA WO 95/95, Tank Corps General Staff War Diary, Report on Counterattack by Anglo-German Tanks, 8 October; TNA WO 95/1370, 99th Infantry Brigade War Diary, Narrative of Events, 7–9 October 1918; TNA WO 95/1381, 3rd Division General Staff War Diary, Report on Operations, 8–9 October 1918; TNA WO 95/1431, 4th Royal Fusiliers War Diary.

tanks and aircraft in these manners by 1918 had been barely imagined four years previously, much less a century before.

Technology is only useful in so far as it is properly used, which leads us on to a comparison of the tactics of 1914 and 1918. The first and most obvious impact of technology was that firepower emptied the battlefield. A German staff officer, Major Alfred Wirth, described the first battle of Le Cateau as 'like being on manoeuvres; one could actually still see the troops taking part. In the later fighting that all disappeared.'[36] When II Corps wrote up lessons learned from the fighting of August–September 1914, it stressed the importance of being positioned out of sight on reverse slopes. Due to the 'most unexpected feature of the present war… the arresting power of modern artillery, and especially of howitzers and heavy artillery' the choice of defensive positions 'is now almost entirely governed by this artillery question'.[37] By 1918, consequently, 'in daylight the battlefields themselves seemed nearly empty; for it was fatal for bodies of troops or tanks to be seen'.[38]

In both offence and defence, successful integration of new weapons into combined-arms tactics could greatly increase combat efficiency. Greater complexity, however, made this considerably more difficult to achieve. At the First Battle of Le Cateau both sides made use of artillery and machine guns to support their infantry both directly and by neutralising enemy guns.[39] German infantry advanced by bounds using fire and movement tactics.[40] German cavalry fulfilled a dismounted infantry role, while the British Cavalry Division played no part at all. There were problems, of course, especially caused by communication difficulties. For example, the 1st Battalion East Lancashire Regiment complained that they received insufficient artillery support from guns which were too far back and out of touch with the situation.[41]

At the second battle, artillery again operated in a close support role. Some British battalions, such as those in the Guards Division, had a battery of 18-pounders attached to be used against enemy strongpoints.[42] Others, however, even in the

[36]Quoted in Richard Holmes, *Riding the Retreat: Mons to the Marne 1914 Revisited* (London: Pimlico, 2007; first published 1995), p. 167.
[37] TNA WO 95/629, II Corps General Staff War Diary August–December 1914, Notes based on the Experience gained by the Second Corps during the Campaign, 12 October 1914, pp. 3-4.
[38]*BOH 1918* Vol. V, p. vii.
[39]See, for example, TNA WO 95/1528, 52nd Battery Royal Field Artillery War Diary
[40]TNA WO 95/1510, 5th Division General Staff War Diary.
[41]Zuber, *The Mons Myth*, p. 225.
[42]TNA WO 95/1195, Guards Division General Staff War Diary, Orders No. 223, 224, 8 and 9 October 1918.

same corps, did not: 2nd Battalion Suffolk Regiment, for example, complained that artillery was kept under brigade control and hence was not available when required.[43] Debate continued also about the precise nature of combined arms in the context of 1918. By now, although some saw infantry platoons as themselves combined-arms units capable of independent action using integral assets if higher level combined arms broke down, others remained unconvinced. For instance, 115th Brigade pointed out that the best way to cross the fire-swept zone was to follow a creeping barrage. Second best was a standing bombardment, but even in this case, or if there was no artillery support at all, 'it remains for the infantry to fight their way forward under cover of their own weapons and the principles laid down in *Infantry Training* [*1914*] hold good, except that now infantry have light machine guns, rifle grenades and trench mortars to assist as well.'[44] The 13th Battalion Royal Fusiliers put this into practice when they lost the barrage in front of Hurtebise Farm: aided by covering fire from four machine guns: 'the last 300 y[ar]ds, however, were crossed without the assistance of artillery, sections and platoons giving each other mutual support with rifle and Lewis gun fire'.[45] According to Major-General Cyril Deverell, commanding 3rd Division,

> it is not practicable to provide elaborate artillery barrages for every operation – rifles, Lewis guns and machine guns must be used. Subordinate commanders must learn to use ground intelligently and dismiss the idea for ever from their heads that the only thing to do is to go forward to a direct attack following an artillery barrage. It is often possible to engage a troublesome position with fire from the front and at the same time to use the bulk of the force available to move round and engage the position from the flanks or rear – capturing it with small loss of men and time.[46]

On the other hand, however, 5th Brigade (3rd Division) on 11 October argued that when facing strong resistance from enemy machine gun strongpoints,

> in theory the way to deal with them is for the company, or platoon, concerned to make a small attack employing the different arms at their own disposal – rifle grenades, smoke grenades and Lewis guns. In practice I have

[43]TNA WO 95/1437, 2nd Battalion Suffolk Regiment War Diary, Report on Operations, 8 October 1918.
[44]TNA WO 95/2560, 115th Infantry Brigade War Diary, BM 1429, 11 October 1918.
[45]TNA WO 95/2538, 13th Battalion Royal Fusiliers War Diary, Narrative of Operations, 7–11 October 1918.
[46]TNA WO 95/1381, 3rd Division General Staff War Diary, Lessons, 19 October 1918.

> been convinced that the better way is for the infantry to stick tight to their barrage – which I assume – and to go straight for the M[achine] guns.'[47]

IV Corps went further, formally laying down that 'infantry cannot successfully attack organised resistance without the combination of either artillery or tanks…. The attack… against a properly consolidated enemy will always be carried out by the combination of artillery, machine guns and infantry, and frequently with tanks.'[48]

In fact, effective artillery support was often considered crucial. The failure of the attack of 99th Brigade (2nd Division) on 8 October, for instance, despite being accompanied by British tanks, was partly due to the German armoured counter attack mentioned above, but partly, according to one of its battalions, because 'the barrages throughout the operations were below the usual standard, being of uneven nature and not thick enough to meet the opposition.'[49] In general, 'it was found impracticable to advance by day against organised resistance without the support of an artillery barrage.'[50] Such creeping barrages could by now be arranged relatively quickly: 19th Division reckoned that three hours would suffice for arranging a simple barrage, if phone communications were in place, whereas a more complex one might take eight, although inevitably short-notice barrages were more prone to error than those carefully planned in advance. [51] Further, in the relatively mobile warfare of the Hundred Days, counter-battery fire became harder, since it was more difficult to maintain an updated intelligence picture of enemy gun positions and to move up heavy artillery and ammunition.[52]

Other arms could, as we have seen, prove helpful but they were optional extras rather than essentials. Edmonds tended to dismiss the cavalry: '…the cavalry had done nothing that the infantry… could not have done for itself at less cost'.[53]

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[47]TNA WO 95/1346, 5th Infantry Brigade War Diary, G.S. a/40/18a.
[48]Liddell Hart Centre for Military Archives, King's College London (LHCMA), Montgomery-Massingberd 7/33, IV Corps Notes on Tactics and Training, September 1918, p. 4.
[49]TNA WO 95/1370, 1st Battalion King's Royal Rifle Corps, 99th Infantry Brigade War Diary, Narrative of Events, 8 October 1918.
[50]TNA WO 95/719, IV Corps General Staff War Diary, Notes on Recent Operations by the IV Corps, 25 October 1918.
[51]TNA WO 95/2057, 19th Division General Staff War Diary, Narrative of Operations, 20–24 October 1918.
[52]Albert Palazzo, 'The British Army's Counter Battery Staff Office and Control of the Enemy in World War I', *Journal of Military History* 63 (January 1999), pp. 55-74 (pp. 73-74).
[53]*BOH 1918* Vol. V, p. 235.

However, they seem to have played a useful role following up the German retreat.[54] Tank support declined as 1918 wore on. Heavy losses in personnel and machines, increased demand across the whole front for tanks, logistic difficulties, and the growing realisation that the use of armour required extensive pre-planning and liaison, all came together to limit the numbers of tanks available for operations.[55] The average Third Army division, which in August might have been supported by twelve machines, could expect only five by October. Some formations, such as 42nd Division, employed no tanks at all in the autumn of 1918.[56] In addition, deteriorating autumn weather reduced the impact of air power, increasingly preventing operations.

The increased complexity of combined-arms warfare in 1918 relative to 1914, and the co-ordination required, is summed up in a comparison of II Corps' orders for its advance during the Battle of the Marne in September 1914 with those of the Canadian Corps for attacking the Hindenburg Line on 27 September 1918. The former briefly outline the situation, gives objectives and timings, allocates roads to divisions and sets supply and reporting points. A reproduction of the order occupies less than two pages of the official history.[57] The equivalent four years later takes up no less than thirteen, including sections on bridging, artillery, tanks, machine guns, the RAF and signalling.[58]

So, just in terms of the range of tools to be integrated, the British army of 1918 faced a more complex tactical problem than the original BEF. The changed nature of the defence also made things more difficult. The linear defences of 1914 had been replaced by a flexible defence in depth. The attacker's impetus would be sapped in a firepower-swept killing zone, several thousand metres deep, studded with barbed wire, machine guns, pillboxes and dug-outs, covered by pre-registered artillery. Once weakened, he would be thrown back to where he started by counterattacks. British offensive methods by late 1918 were geared to, and most of the time capable of,

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[54]David Kenyon, 'British Cavalry on the Western Front 1916–1918' (unpublished PhD thesis, Cranfield University, 2007), pp. 270-8; Simon M. Justice, 'Behind the Lines: Sir Douglas Haig and the Cavalry Corps, September–October 1918', *Records: The Journal of the Douglas Haig Fellowship*, 14 (November 2010), pp. 36-55.

[55]On this, see also Tim Travers, *How the War was Won: Command and Technology in the British Army on the Western Front, 1917–1918* (London: Routledge, 1992), pp. 140-143 and John P. Harris with Niall Barr, *Amiens to the Armistice: The BEF in the Hundred Days' Campaign 8 August–11 November 1918* (London: Brassey's, 1998), p. 296.

[56]TNA CAB 45/185, Official History Correspondence: Third Army, Letter from A. Solly-Flood, 15 November 1937.

[57]*BOH 1914* Vol. I, pp. 549-50.

[58]*BOH 1918* Vol. V, pp. 625-37.

overcoming this style of defence. As it happens, by 8 October the German army was too weak to operate a flexible defence effectively. The Beaurevoir–Masnières Line itself was incomplete: merely a single line of trenches, incompletely wired, with no tank obstacles.[59] Front-line units were much reduced in numbers. The average *Seventeenth Army* battalion ration strength on 11 October was 450 men, down from over 800 in February. Fighting strengths were lower still.[60] Merely to prevent enemy infiltration required the deployment of a disproportionate number of companies in the Forward Zone, but as *II Bavarian Corps* told *Seventeenth Army*, 'one cannot count on battalions which retreat from the Forward Zone under enemy attack coming back fit for combat. Divisions must remain strong enough to ensure a successful defence discounting those elements deployed in the Forward Zone. This was not the case'.[61] The morale of forward garrisons, widely dispersed in small groups with little supervision and, if attacked, less prospect of relief from non-existent counterattacking comrades, inevitably suffered and contributed to high surrender rates.

Operationally, indeed, in some ways 8 October 1918 marked the end of a phase of the First World War. With the fall of the Beaurevoir–Masnières Line, the days of the British having to fight their way forwards through fixed fortifications were left behind for good. The war became more open, and there were several similarities between the nature of operations in 1918 and 1914. For example, German defensive positions after 8 October were exclusively improvised at short notice. They were linear and static, with few available reserves, much as Smith-Dorrien's had been in 1914. The aim of defence in both cases was primarily to buy time. II Corps hoped to force the Germans to deploy and to inflict casualties to cover a further British retreat. In late 1918 German attempts to stand similarly were designed to: cover the evacuation of sick, wounded and rolling stock; buy time for demolition of infrastructure and the construction of rearward defences; if possible force the Allies to a negotiated peace; and certainly to try to maintain control of a rapidly unravelling domestic political situation. A second similarity was that communications, despite technological advances for example in wireless, remained extremely poor. Not only did this lead to high levels of Clausewitzian 'friction' in both battles, but it also greatly limited the role senior commanders could play. In 1914, for example, Smith-Dorrien's orders to stand and fight rather than retreat, issued at about 03.00 on 26 August, arrived at 4th

[59]Bundesarchiv-Militärarchiv, Freiburg (BA-MA) PH 5 I/48, *Heeresgruppe Boehn* War Diary, Ia/Ie Nr 1646, 4 October 1918.
[60]Bayerische Kriegsarchiv, Munich (BKA), *Heeresgruppe Kronprinz Rupprecht* Bund (Bd) 112 Zusammenstellung der Gesamtstärke an Offz., Uoffz. und Mannschafter der Armeen, 11 October 1918.
[61]BKA *II. bayerische Armee-Korps*, Bd 20/2, Erfahrungen aus dem Großkampf bei 17. Armee, 10 September 1918.

Division headquarters six miles away at 05.00, at the same time as the Germans opened fire. 1st Battalion King's Own Royal Lancaster Regiment was surprised by German artillery and machine-gun fire and lost 'some four hundred casualties'.[62] That afternoon, 1st Battalion Gordon Highlanders never received orders to withdraw with the rest of II Corps and was consequently cut off with 500 men taken prisoner. The battalion ceased to exist.[63] German *First Army* headquarters, set up in a cottage north of Solesmes, had no communications links with its corps in the evening of 25 August and only received news of action next morning at 10.00., five hours after fighting began.[64] Things were better by 1918, but problems continued. As Brian Hall has observed, 'even though the BEF was employing a much more robust, flexible and sophisticated communications system than it had ever done before, tenuous communications were still having a detrimental impact on its operations'.[65] In particular, the shift away from trench warfare, with its established wire networks, after August 1918 caused problems. As 188th Brigade remarked, 'accustomed as we are to the telephone, when removed from it we become somewhat helpless'.[66] In semi-open warfare, the median time taken for a message to reach division from a battalion, by whatever means of transmission, was 64 minutes.[67] This introduced a long, and highly unpredictable, lag into decision-making. Indeed, Major-General Torquil Matheson (GOC, Guards Division) observed that:

> During the last two days I have noticed that information regarding the situation in front has been sent in only at long intervals, and when it is sent in it is two or three hours old. I have often received information about the position of the Guards Division from flank divisions long before I have heard the same information from my own brigade commanders.[68]

On 21 August, in the midst of a major set-piece attack, Lieutenant-General Sir Aylmer Haldane commanding VI Corps had so little to do while he awaited reports

[62]*BOH 1914* Vol. I, pp. 143-9, 164-5. Becke times the message's arrival to 07.20.
[63]*BOH 1914* Vol. I, pp. 194-6.
[64]*GOH 1914* Vol. I, pp. 520-523.
[65]Brian N. Hall, *Communications and British Operations on the Western Front, 1914–1918* (Cambridge: Cambridge University Press, 2017), pp. 270-97 (p. 270).
[66]TNA WO 95/3109, 188th Infantry Brigade War Diary, Narrative of Operations, 1–8 September 1918.
[67]Samples from 33rd Division on 29 September 1918: TNA WO 95/2407, 33rd Division General Staff War Diary; TNA WO 95/2429, 100th Infantry Brigade War Diary.
[68]TNA WO 95/1195, Guards Division General Staff War Diary, GD No. 1/813/G, 10 October 1918.

from the front that he spent much of the day reading the memoirs of Marshal Oudinot.[69]

At the operational level, however, in at least four respects the 1914 and 1918 models of 'open warfare' were very different. First, and most technically, long-range artillery and airpower had increased the depth of the battlefield. Heavy artillery, controlled at Army level and guided by long-range Bristol fighters equipped with wireless, targeted enemy headquarters and communications from 10,000 yards to twenty miles behind the German front line, while the RAF attacked targets up to twelve miles deep.[70]

Secondly, the nature of the intelligence problem had changed. In August 1914 simply finding the enemy was tricky. The Germans spent much of 25 August zig-zagging across country in pursuit of contradictory cavalry and aerial reconnaissance reports of the direction of British retreat, and the next day's efforts to cut off that retreat were prejudiced by poor information.[71] In 1918, for the British at least, the standard of operational intelligence was considerably improved and, although touch was occasionally lost during pursuit phases, in general enemy positions were clear from RAF reports and small-scale cavalry patrols. Strategic intelligence, such as how many divisions the enemy held in reserve, was also detailed and good.[72] What was most needed now, however, was tactical intelligence about enemy front-line strengths, morale and intentions, and these were the focus of British intelligence work. On 9 October, for instance, Third Army discovered from prisoner-of-war interrogations that *6th Division* had a total fighting strength of only 459 men.[73] The previous week, it had circulated a captured German document, dated 21 September, which spoke of poor morale and riots behind the lines in Cambrai.[74] On 6 October, based on 'reports', the intelligence branch estimated (correctly) that the Germans would hold in the Beaurevoir–Masnières Line for as long as possible before pulling back twenty

[69]National Library of Scotland (NLS), General Sir Aylmer Haldane Diary, Entry, 21 August 1918.
[70]TNA AIR 1/677/21/13/1887, The Western Front – Air Operations May–November 1918, p. 9; TNA WO 95/783, VI Corps CRA War Diary, Third Army Artillery Instructions No. 42 (G 3/338), 14 September 1918; *BOH 1918* Vol V, p. 200.
[71]*GOH* Vol I, pp. 517-9, 525-7.
[72]Jim Beach, *Haig's Intelligence: GHQ and the German Army, 1916–18* (Cambridge: Cambridge University Press, 2013), pp. 303-19.
[73]TNA WO 157/166, Third Army Intelligence Summaries October 1918, Third Army Intelligence Summary No. 1177, 9 October 1918.
[74]Ibid., Third Army Intelligence Summary No. 1170, 2 October: Annexe: Order of *187th Infantry Regiment*, 21 September 1918.

kilometres to a new defensive position.[75] This was a level of detail neither necessary nor possible four years earlier.

Thirdly, more complex armies required more logistic support. The BEF went to France in 1914 about 160,000 strong all told. In August 1918, half as many, nearly 80,000 men, were employed merely keeping the railways moving to support the British army in France.[76] The pre-war assumption had been that the maximum practical distance from supply railheads at which armies could operate was 50 miles. In fact, Kluck, by dint of improvisation and living off the land, was able to maintain his advance and fight 60–80 miles forward for a time.[77] By 1916, with greatly increased needs for supplies of all kinds, the British reckoned that the maximum had fallen to 25 miles.[78] In the autumn of 1918, railway and road construction struggled to keep up with the British advance. By 8 October, supply railheads which had been fifteen miles back in August were now up to 25 miles behind the front, and the attack had to be postponed 24 hours because of ammunition supply problems.[79] Third Army was unable to launch its assault crossing of the River Selle before 20 October as it had to wait for supplies to come forward. The follow-up breakout operation, originally planned for the 22nd, then had to be put back a further 24 hours 'owing to the arrival of ammunition trains being delayed by accidents on the line'.[80] The material-intensive warfare of 1918 compromised operational mobility.

This leads us on to a fourth difference between 1914 and 1918. The open flanks which permitted a war of movement in August and September 1914 were long gone. The First Battle of Le Cateau was typical of operations in a war of movement: a meeting engagement characterised by both operational and tactical attempts at envelopment. The Germans not only tried to drive in both flanks of the overall British position in the course of 26 August; at the tactical level they also successfully took the defenders in flank and enfiladed them on several occasions.[81] By 1918, although movement had returned to the battlefield, increased force to space ratios (and the logistic constraints discussed above) ensured that operational manoeuvre

[75]Ibid., Third Army Intelligence Summary No. 1174, 6 October 1918.
[76]War Office, *Statistics of the Military Effort of the British Empire during the Great War: 1914–1920* (London HMSO 1922), p. 598.
[77]Martin Van Creveld, *Supplying War: Logistics from Wallenstein to Patton* (2nd ed., New York: Cambridge University Press, 2004), pp. 123-140.
[78]J.E. Edmonds, *Military Operations France and Belgium 1916*, Volume I, *Sir Douglas Haig's Command to the 1st July: Battle of the Somme* (London, Macmillan, 1932), p. 274.
[79]TNA WO 95/727, IV Corps AQMG War Diary, entry for 1 October; TNA WO 256/37, Field-Marshal Sir Douglas Haig Diary, entry for 6 October 1918.
[80]TNA WO 158/228, Third Army Operations, GS 76/294, 20 October 1918.
[81]Most obviously, 14th Brigade from the high ground above Le Cateau station.

did not. Smith-Dorrien deployed ten brigades (40 battalions) to defend a ten-mile-long position. Third Army in October 1918 used 48 brigades (144 battalions) to attack along a similar frontage. Warfare now primarily consisted of serial, set-piece, direct frontal assaults which resulted in a form of rolling attrition, aimed at killing and capturing large numbers of enemy. As Brigadier-General Hanway Cumming wrote in his memoirs:

> There had been little scope for tactical manoeuvring during these last three months. Big movements were certainly made, but they appertained more to strategy than to tactics, and the role of the fighting troops could hardly be called open warfare as flanks were still, in the big sense, "un-get-at-able".[82]

Any psychological dislocation of the enemy was a desirable, but secondary consideration, to be achieved by presenting him with multiple high-tempo frontal threats which overloaded his capacity to react, rather than by administering J. F. C. Fuller's 'shot through the brain'.[83]

We shall return to this shift from a war of movement to one of rolling attrition below. First, the change in who was fighting the war needs to be examined. One striking contrast between the British armies of 1914 and 1918, which reflected the changed nature of the war, was the global nature of the manpower pool drawn on. In 1914 almost all the men of the BEF had been born in the British Isles. In 1918, one New Zealand Division served in Third Army. 66th Division contained a South African brigade. Three companies of 1st Battalion King's Royal Rifle Corps were commanded by Rhodesians.[84] The Canadian Cavalry Brigade took part in the pursuit to the Selle. The Australian Corps had just been pulled out of the line and replaced in Fourth Army by II American Corps. Other Americans flew in the skies above Le Cateau or worked as medical officers in British battalions, and the Chinese Labour Corps worked behind the lines. The British army, as did the French, pulled in manpower from all over the world: a source of strength on which the Central Powers could not draw.

The men who fought the first battle of Le Cateau were trained peacetime soldiers. Both armies at this stage consisted exclusively of peacetime trained soldiers brought up to strength by the mobilisation of recent reservists. In the BEF, reservists

[82]Hanway R. Cumming, *A Brigadier in France 1917–1918* (London: Jonathan Cape, 1922), pp. 264-5.
[83]J. F. C. Fuller, *Memoirs of an Unconventional Soldier* (London: Nicholson & Watson, 1936), p. 325.
[84]TNA CAB 45/185, Official History Correspondence: Third Army, Letter from Charles Howard, 23 June 1938.

constituted up to 60 per cent of the strength of some infantry battalions.[85] All men were of course originally volunteers. In the largely conscript German Army, the proportion of reservists was lower in active infantry battalions (39 per cent) although two of *First Army's* six army corps were reserve formations with a much higher proportion of men from the Reserve and the *Landwehr 1st Ban*.[86] Not surprisingly, by 1918 few of the original men were still serving. Benjamin Ziemann points out that in the Bavarian Army the average length of active service during the war was fifteen months and only 2.7 per cent of those applying at Munich after 1918 for pensions for nervous ailments had been on active service all the way through.[87] Of 16,470 German soldiers taken prisoner by Fourth Army in August 1918, just 9.7 per cent were active soldiers of the classes of 1913 or before who would have been with the colours in 1914. A further 7.4 per cent had been Reservists of the classes of 1907-11 when war broke out and so would have been called up at once. Over half (54 per cent) of the 1918 army was under 24 years old: their only military experience, therefore, was in wartime.[88] Most officers, too, were wartime appointments. Thus, in *24th Infantry Regiment* for example, men who in 1914 had led half-sections were commanding companies by 1918. Battalion commanders at the end of the war had been section leaders at the beginning, and the regimental commander had gone to war leading a company.[89] Of the 87 officers of *1st Guards Reserve Regiment* in August 1918, 18 (21 per cent) had been with the regiment since 1914, although only six had been officers then, with the balance promoted from the ranks. 28 had served since 1915, 7 from 1916, 14 from 1917 and 20 had joined in the course of 1918.[90]

The British Army, of course, was in a similar situation by 1918. Some regular formations, such as 3rd Division, managed to retain a kernel of 1914 regulars: 9.2 per cent of its August 1918 all-ranks strength had been members of the original BEF.[91] Territorial and New Army formations, however, are unlikely to have had such high

[85]Entry for 8 August 1914, John Terraine, ed., *General Jack's Diary 1914–1918: The Trench Diary of Brigadier-General J. L. Jack, D.S.O.* (London: Cassell, 2000; first published 1964), p. 22.
[86]Strachan, *To Arms*, p. 174; *GOH* Vol. I, pp. 667-9.
[87]Benjamin Ziemann, *War Experiences in Rural Germany, 1914–1923* (Alex Skinner, trans.) (Oxford: Berg, 2007), pp. 31-2.
[88]TNA WO 157/197, Fourth Army Summary of Information, 22 August, Data from an analysis of 16,470 German prisoners captured in August 1918.
[89]Cordt von Brandis, *Die vom Douaumont: Das Ruppiner Regiment 24 im Weltkrieg* (Berlin: Tradition Wilhelm Kolk, 1930), p. 451.
[90]Brederlow, *Geschichte des 1. Garde-Reserve-Regiments*, pp. 351-60.
[91]Imperial War Museum (IWM), IWM 71/13/3, Colonel John H. Boraston Papers, Northern Division Report to GHQ, G. 8269, 28 April 1919.

levels of pre-war regular representation. In the (Kitchener Army) 6th Battalion the Dorsetshire Regiment on 28 August 1918, for example, the longest serving officer had gone to France in August 1915. By 30 September, nineteen of the twenty-two officers on regimental duty had joined the battalion within the previous five months, and the other three dated back only to 1917.[92] As Gary Sheffield has said, 'by January 1918, although many wartime volunteers and even a few pre-war Regulars and Territorials remained with the colours, the British army was largely a conscript force' and heavy casualties in the course of the year only increased the proportion of conscripts.[93] In 1914 the average age had been 27; in the last months of the war it fell to 25, with 36 per cent of the dead 21 or younger.[94] Although at higher levels there was greater continuity, the old BEF had largely faded away.[95]

This was of more than statistical significance, because it meant that a different generation was doing the fighting in 1918, one composed of men which had, in some cases personally, in others at second hand, been exposed for up to four years to what Alan Kramer has called the 'dynamic of destruction', the vicious cycle whereby ever more unlimited objectives spawned new ways of fighting which themselves led to increasingly extreme war aims.[96] If there was any chivalry on the 1914 battlefield, it did not last long amongst reports of atrocities against both combatants and civilians. John Horne and Alan Kramer have shown that German violence against civilians began at once.[97] Captain Sir Edward Hulse's letter home of 21 September 1914 contains an apparently convincing description of German soldiers shooting

[92]TNA WO 95/2001, 6th Battalion Dorsetshire Regiment War Diary.

[93]Gary Sheffield, 'The Indispensable Factor: The Performance of British Troops in 1918', in Peter Dennis and Jeffrey Grey (eds.), *1918: Defining Victory: Proceedings of the Chief of Army's History Conference held at the National Convention Centre, Canberra 29 September 1998* (Canberra: Army History Unit, Department of Defence, 1999), pp. 72-95 (pp. 75-6).

[94]Data based on a sample of men named Roberts, Robertson and Robertshaw on the Commonwealth War Graves Commission website. http://www.cwgc.org/debt_of_honour.asp?menuid=14, accessed 6 November 2008. 120 such men died. The ages of 59 are known. Field-Marshal Lord Roberts, who died aged 82, is excluded.

[95]In Third Army in 1918, for example, commands at brigade level and above were almost exclusively held by pre-war regulars and nearly three-quarters of battalion COs, likewise, had seen service before 1914: *Army List*, July 1914 and December 1918.

[96] Alan Kramer, *Dynamic of Destruction: Culture and Mass Killing in the First World War* (Oxford: Oxford University Press, 2007), pp. 2-5, pp. 328-9.

[97]John Horne and Alan Kramer, *German Atrocities, 1914: A History of Denial* (New Haven: Yale University Press, 2001), pp. 13, 435.

over 30 wounded and helpless British soldiers.[98] It is not easy to reconstruct what motivated the men of the original BEF. Most of them did not have the self-consciousness or articulacy of the later recruits who have so coloured our perceptions of the inner life of the First World War British soldier. For many, no doubt 'the common denominator may… be described as passive acceptance, a willingness to do one's duty'.[99] There were some for whom 'war was their job. Active service was to be welcomed as a picnic change from the monotony of soldiering in England. Also, to the man keen on his profession… it meant the chance of promotion and of showing what he was made of.'[100] Perhaps patriotism, honour and glory played a part for some. By 1918, though, 'a willingness to do one's duty' seems to have predominated as other illusions faded away. As Hubert Essame, a subaltern in 1918, put it, the war poets' outlook was unrepresentative of the men with whom he fought, who 'saw their situation in a different light: admittedly war was evil; nevertheless it was their duty to their country to fight, if necessary to the end, hoping rather pathetically, that this would be "the war to end all wars"'.[101] War was in no sense their job. In fact, the war was getting in the way of their jobs and lives. If grinding patiently through the German lines offered the quickest route home, then that was the way Tommy would go.

War in 1918 was also very different because the objectives for which it was being fought had changed. In part, this was driven by the terrible logic of war itself, where heavy sacrifice could only be justified by further sacrifice and violence could only be trumped by yet greater violence.[102] As Stéphane Audoin-Rouzeau and Annette Becker have asked, 'could the term "field of glory" be applied after Verdun or the Somme? An aesthetic and ethical code of heroism, courage and battle violence

[98]Edward Hulse, *Letters written from the English front in France between September 1914 and March 1915* (privately published, 1916), p. 14, http://archive.org/details/letterswrittenfr00hulsrich, accessed 6 April 2012.

[99] Strachan, *To Arms*, p. 162.

[100]Arthur Corbett-Smith, *The Retreat from Mons: by one who shared in it* (London: Cassell, 1916), pp. 1-2.

[101]Hubert Essame, *The Battle for Europe 1918* (London: B.T. Batsford, 1972), pp. 107-8.

[102]The extent to which this was entirely predetermined remains disputed: for Isabel V. Hull, fault lines within the German military and state made radicalisation inevitable, while Alan Kramer emphasises that humans retained the power of choice: Isabel V. Hull, *Absolute Destruction: Military Culture and the Practices of War in Military Germany* (Ithaca, NY: Cornell University Press, 2005); Kramer, *Dynamic of Destruction*.

vanished in the immense cataclysm of 1914–18.'[103] This cultural change, however, was closely related to strategic developments. Germany went to war possessing inchoate objectives in 1914. In so far as she had a coherent strategy, it was to knock France out of the war quickly to enable concentration on the threat in the east. The army's planning gave much attention to the mechanics of defeating the French army but little if any consideration to the strategic aim of doing so.[104] 1870, however, had shown the danger involved in bringing down the whole French regime. To do so would risk tying up troops needed against Russia in a long and frustrating *Volkskrieg*. It would be better by far to win fast, decisive victories, leaving in place a government with whom to negotiate French non-intervention and, perhaps, access to the resources of the industrial north-east and Longwy-Briey basin. The German assault in 1914 was as violent as it was, both in the field and against non-combatants, not because its objectives were unlimited – if anything, the opposite was the case – but precisely because speed was of such essence. From the German perspective, the opening battles *must* be decisive and therefore must be fought without restraint. Germany had to beat France in 1914, while the British and French had merely to stay in the game. This would allow their economic and naval muscle to wear down the Central Powers as they struggled to keep up a two-front war. This was most obviously true for Britain, but also applied to France. Of course, there was a political and economic imperative to minimise the amount of French territory occupied by the enemy. This restricted Joffre's freedom of action. Nonetheless, he could – and indeed after the defeat of his eastern offensives, must – trade space for time as Moltke and Falkenhayn could not. All three belligerents were fighting for essentially limited objectives in 1914.

By 1918, this had all changed, and both time and space had become less critical than numbers. President Wilson's Fourteen Points of January 1918 were seen as relatively moderate because they made no claims for reparations or directly on the territory of the Central Powers beyond the return of lands occupied since 1914 and Alsace-Lorraine. Nonetheless, by speaking of independence for Poland, for ethnic minorities in Austria-Hungary and the non-Turkish parts of the Ottoman Empire, they threatened the integrity of Prussia, Austria-Hungary and Turkey and would have required a German admission that all the sacrifices of the war were for naught. The treaties of Brest-Litovsk and Bucharest in any case went against the Fourteen Points and showed how little quarter any country defeated by Germany could expect. It was also increasingly clear that neither the German army nor the *Kaiserreich* would

[103]Stéphane Audoin-Rouzeau and Annette Becker, *1914–1918 Understanding the Great War* (Catherine Temerson, trans.) (London: Profile, 2002), p. 28.

[104]The best recent study is Robert T. Foley, *German Strategy and the Path to Verdun: Erich von Falkenhayn and the Development of Attrition, 1874–1916* (Cambridge: Cambridge University Press, 2005).

survive anything perceived as a defeat. The inability of Ludendorff and Hindenburg in October 1918 to admit that, even if her army had not yet been finally destroyed at the operational level, Germany nonetheless strategically had been defeated, gave rise to the possibility of incorporating a *levée en masse* into an *Endkampf* which threatened heavy Allied casualties and the self-immolation of the Fatherland.[105] From the Allied point of view, the best way both to break down conventional resistance and to forestall any possible new *Volkskrieg* was to round up – or kill – as many German soldiers as possible while using material superiority to minimise British and French casualties. The only time constraint in 1918 was that the longer the war continued, the greater American influence at the peace negotiations would be. A manoeuvrist proto-Blitzkrieg along the lines of J. F. C. Fuller's 'Plan 1919' was not only never considered as seriously as Fuller liked to pretend, and was technologically impossible with the tanks and transport available; it also would have done little to prevent a German insurgency. The campaign of rolling attrition fought by the Allies in the last months of 1918 was the result. It destroyed the enemy's will to fight in the most direct manner possible, by destroying his citizen army. It was, in the event, the most appropriate means of achieving Allied ends, much as it would be at the end of the next war, too.

This article has considered the transformation of war between 1914 and 1918 by comparing the two battles of Le Cateau and drawing out the similarities and differences between them in terms of technology, tactics and operations. The pace and scale of technical transformation was remarkable. There has not been space here to consider how armies on both sides managed to adapt, but the ability to do so was clearly central to battlefield outcomes. This essay has also argued, however, that by 1918 a largely new generation of soldiers, tempered in the crucible of war itself, were in the line. They brought to the task a grim determination which was reflected in the way they fought and which proved well suited to the kind of war it had become.

Napoleon might have recognised the First Battle of Le Cateau. But by the second, not only the face of battle, but also the shape of war, would have been beyond him.

[105]See Hull, *Absolute Destruction*, pp. 309-319 and Michael Geyer, 'Insurrectionary Warfare: The German Debate about a Levée en Masse in October 1918', *Journal of Modern History*, 73/3 (September 2001), pp. 459-527.

Three-dimensional Warfare – The Invention of Aerial Combat

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ABSTRACT
On 24 September 1910 the British Flight magazine published as its lead article ('The New Arm') a piece on the recent Grand Autumn Manoeuvre of the French Army in Picardy. For the first time in history, military aircraft had been deployed on both sides in a reconnaissance and artillery spotting role. The article stated that 'the aeroplane, even in its present stage of development, has already resulted in an urgent need for the entire revision of all accepted schemes of tactics in warfare.'[1]

Introduction

The purpose of this article is threefold: firstly to remind readers of the startlingly rapid development of early air power prior to the start of the First World War. From the first 59-second powered flight on 17 December 1903 to the establishment of the world's first military air force (the French *Aéronautique Militaire*) on 22 October 1910, a mere six years and ten months had elapsed; during which technological development was matched by tactical innovation to a point that a whole new arm of the military had (literally) added a third dimension to warfare. The second point, briefly, is to remind readers of Anglo-Saxon military history that the first 100 days of the Great War witnessed a war of movement on the largest scale hitherto seen; furthermore it was a period dominated by immense clashes between large French and German armies, both using aeroplanes as their third arm. The very small British Expeditionary Force arrived three weeks after the start of the war; by which time three major Franco-German engagements had already been fought – in Alsace, Lorraine and the Ardennes – and the innovative tactical use of aeroplanes on

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[1] https://www.flightglobal.com/pdfarchive/view/1910/1910%20-%200768.html, a digital copy of Flight Magazine, accessed 4 April 2018.

the battlefield had already started its development. Finally, it will reveal how the French squandered a significant military advantage following their early dominance of the development of aviation generally, and allowed the Germans to field a larger and more useful air force in August 1914.

This paper examines the birth and early development of aerial warfare, starting with the first powered flight in December 1903 and ending on 1 April 1915, the day that French pilot Roland Garros became the first man to shoot down an enemy plane using a machine gun firing through the propeller of his aircraft; the moment at which most histories of aerial warfare start. The choice of this period is driven by the argument that it was the true and most radical period of innovation, after which the issue became one of developing bigger and more powerful engines capable of driving aeroplanes that were more powerfully armed and better protected – at least until the development of airborne radar. For convenience the period under discussion will be examined in three chronological sections. During the first, from December 1903 to July 1909 when Blériot crossed the Channel, the military was only marginally engaged; flying was the preserve of pioneering aviators (some of whom were incidentally army officers) determined to sustain powered flight for ever longer periods of time. The second stage encompasses the period from July 1909 to July 1914, during which aviation was developed as a weapon of war and preparations were made for the use of primitive aircraft above the battlefield. The third stage, from August 1914 to July 1915, will examine the use of air power in the very early stages of the war, comparing differences between the French and German armies on the Western Front.

Early Days, 1903–1909

The Wright Brothers' aeroplane, *The Flyer,* flew what is generally recognised as the world's first powered and manned heavier-than-air flight on 17 December 1903. It achieved a distance of 852 feet in 59 seconds on its fourth and last flight of the day.[2] Barely five-and-a-half years later, on 25 July 1909, Louis Blériot flew 23 miles to cross the Channel in 37 minutes, winning the English Lord Northcliffe's £1,000 prize and immortality in the history of aviation.[3] The period between the Wright brothers' pioneering flight in 1903 and Blériot's cross-channel flight in 1909 was dominated by one simple technological issue in which the emphasis was simply on getting an aeroplane to sustain flight. The key to success was the power-weight ratio of the aircraft and therefore the power and weight of the propulsion system. Here the French achieved an immediate and sustained advantage through their pioneering

[2]J. E. Walsh, *First Flight: The Untold Story of the Wright Brothers* (London: George Allen, 1975) p. 144.

[3]W. Raleigh, *The War in the Air, Volume I* (Oxford: Oxford University Press, 1922) p. 106.

research and development of the aero-engine. Furthermore the French Ministry of War was secretly funding this research.[4] Indeed, even before the beginning of the age of powered flight, France had been the leading proponent of military research into aviation. According to John Morrow, 'The French army had been interested in heavier-than-air flight before it was practical.'[5] From 1892 to 1894 the French War Ministry subsidized Clement Ader with 550,000 Francs to develop a steerable flying machine capable of carrying passengers or explosives at a speed of 55kmh at an altitude of several hundred metres – 'a performance which was some 15 years in advance of aviation technology.' But they stopped in 1898, defeated, according to Morrow, 'by the absence of a light, powerful, and reliable engine.' Ader's first experimental plane was called *avion,* and years later he was honoured when the name was adopted into the French language as the general term for 'aircraft'.

In 1902, even before the Wright Brothers' flight, French engineer Leon Levavasseur started work on developing a lightweight aero-engine that, he claimed, would 'conquer the air'.[6] Levavasseur had calculated that a maximum ratio of about one kilogram (kg) per unit of horse-power (hp) was required, and indeed his first production model weighed 1.25kg per hp. This was the 'light, powerful, and reliable engine' that Clement Ader had lacked and that now enabled sustained powered flight; soon demonstrating that the aeroplane was on the verge of becoming a practical revolutionary weapon of war. By 1903 Capitain Christman, of the French government's Puteaux armaments factory, had become interested in Levavasseur's research and development and, recognizing the military potential of the project, wrote to advise the War Ministry. This led to a meeting in 1904 between Minister of War General Louis André and Levavasseur and his business partner Jules Gastambide; the outcome being the recommencement of secret military funding in order to support the project. Within twelve months, Levavasseur had produced his V8 24 horsepower (hp) and soon afterwards 50hp *Antoinette* engine, fitting it to an airframe of his own design. By 1906 the Voisin Brothers were building an aeroplane around the *Antoinette* engine, which first flew on 13 January 1908, piloted by Henri Farman.

The breakthrough in military aviation came on 30 October 1908 when Farman's *Voisin* made the world's first cross-country flight (as opposed to circuits of an airfield), flying 30km from Bouy to Reims.[7] Not only did this show civilian flyers that

[4]C. Carlier, *Sera maître du monde, qui sera maître de l'air: la création de l'aviation militaire française* (Paris: Economica, 2004) p. 39.
[5]J. H. Morrow Jr., *The Great War in the Air* (Washington DC: Smithsonian Institution Press, 1993) pp. 7-8.
[6]Carlier, *Sera maître du monde,* p. 6 & pp. 38-41.
[7]Morrow, *The Great War in the Air,* pp. 7-8.

the 23 mile Channel crossing was at last viable, but it also demonstrated to the military that practical reconnaissance missions could be undertaken, and that aircraft were now ready to perform a valuable military role. Further proof of French dominance of aerial innovation lies in the fact that Britain's first military aircraft, the British Army Aeroplane No 1, failed to fly until an *Antoinette* engine was purchased to power it.[8]

The French can claim the credit for the breakthrough into sustainable long-distance flight afforded by the *Antoinette* aero-engine; but even as that power plant was gaining its reputation, its successor was in development. In 1906, Louis Seguin formed the *Société des moteurs Gnôme*, which two years later in 1908 produced the world's first production rotary engine. With its outstanding power-to-weight ratio of 1 hp per kg, the *Gnôme* rotary engine was a world-beating piece of engineering.[9] This was the power unit with which, in various upgrades, France went to war and which sustained the allied air forces for the early years of air fighting and beyond.

Meanwhile German development of military aviation had initially gone down a different path. On 2 July 1900, Graf Ferdinand von Zeppelin launched his first airship, LZ1, on its maiden flight over Lake Constance in southern Germany. The flight lasted eighteen minutes and covered five-and-a-half kilometres. Progress was swift: in 1907 Zeppelin LZ3 flew 350km in under eight hours. By 1907–1908, flights of eight to twelve hours, covering ever longer distances, were being regularly achieved with a reliable and technologically proven product, and the German War Ministry and General Staff committed itself to these dirigibles for long range strategic reconnaissance; a commitment that was manifested by government funding and sponsorship and culminated in early 1909 with Zeppelin LZ3 being bought by the War Minister and rechristened 'army airship Z1'.[10] Despite this high-level focus on dirigibles rather than aeroplanes, a certain Captain Hermann von der Leith-Thomsen of the German General Staff – later to be Germany's 'Chief of Field Air Forces' in 1915 – tried in early 1907 to kick-start a military aviation programme, but his chosen option – to buy aeroplanes from the Wright Brothers – was rejected because of their price.[11] Although by the autumn of 1908 there were ten small German private enterprises experimenting with and building aeroplanes, there was no official backing from the military for a focused programme.[12] The German War Ministry had taken a

[8] www.gracesguide.co.uk , accessed 16 August 2019
[9] J. Murphy, *Military Aircraft, Origins to 1918* (Santa Barbara, Ca: ABC-Clio, 2005) p. 32; Morrow, *The Great War in the Air,* pp. 12-13.
[10] Morrow, *The Great War in the Air,* p. 3.
[11] Morrow notes on p. 6 that France similarly declined the Wright Brothers' expensive offering, and decided to build her own.
[12] Ibid., p. 8.

conscious decision not to sponsor the development of a heavier-than-air craft, preferring to wait until private industry had produced an acceptable aeroplane.

Much of the early German design and production was based on – sometimes copied from – the French. In August 1908, August Euler, an Austrian living in Germany, founded Germany's first aircraft factory in Darmstadt and started building French *Voisin* aeroplanes under licence, before developing his own designs. LVG (*Luft-Verkehrs-Gesellschaft*) built Farman-type aeroplanes before branching out on its own designs. Against the trend, an innovative design (an elegant monoplane called the 'Dove' (*Taube*) built in 1909), by Igo Etrich, another young Austrian working in Germany, was based on the pioneering work on gliders by Otto Lillienthal. Edmund Rumpler opened his factory in Berlin in November 1908 and copied Etrich's *Taube*. An engineer called Ernst Heinkel was chief designer for Etrich before moving on to Albatros and (after the war) setting up on his own. Hugo Junkers, aged fifty in 1909, in that year joined with Hans Reissner (the designer of the first all-metal airframe) to build successive experimental aircraft, culminating in the J1 all-metal, 2-seat, armoured aircraft of 1915. The purpose of this roll-call of early German pioneering aviators is to show that, when the time came for the German War Ministry to jump aboard the heavier-than-air craft bandwagon, there was sufficient progress within the home-based civilian aviation industry for the military to buy in quickly to a competitive position in the race to build an air force.

Genesis of Military Aviation, August 1909–July 1914

On 22 August 1909, barely a month after Blériot's flight, the world's first air show was held - in France. At the Reims Air Meeting the first international gathering of aviation pioneers competed for various prizes and showed off their innovations.[13] Of course, there was a significant military presence; the Meeting had attracted the attention of both Colonel Estienne of the Artillery Directorate at the Ministry of War and of General Pierre Roques, Director of Engineering. Both saw immediately that the military potential of the aeroplane could at last be exploited. It was the beginning of an internal power struggle between the artillery arm and the engineers; harbinger of the bureaucratic rivalry that would ultimately cause France to lose its early dominance in the race towards effective use of aeroplanes over the battlefield. General Roques, a friend and former colleague of General Joffre (commander-in-chief designate from January 1911), moved first and fastest. He started to purchase aeroplanes and arranged for aeronautics to be the technical theme of the 1910 Grand Autumn Manoeuvre in Picardy. There he provided an *escadrille* of four

[13]Carlier, *Sera maître du monde*, pp. 132-134.

aeroplanes for each side, as well as two others for the umpires.[14] The aircraft were a great success, attracting the attention of all the Great Powers and catalysing programmes aimed at catching up with the French. But General Roques was determined to drive the French military aviation programme forward and maintain France's early lead. As early as 22 October 1910 - immediately after the conclusion of the manoeuvres - he had decided to pin his career and future prospects on air power, setting up an Inspectorate of Military Aviation within the Engineering Directorate, with himself as Inspector. Over the next two years he used his political skills to fight off the challenge from the Artillery Directorate for ownership of the use of aeroplanes, whilst at the same time manoeuvring within the War Ministry to split aviation from the Engineering Directorate and to set up a new Military Aviation Directorate with himself at its head – an objective that he met in the autumn of 1912.[15] As a result of the progress made in 1910–12, the French army forged ahead in its use of air power, gaining a significant advantage over both Germany and Britain.

In October 1911 Lieutenant Ralph Glyn, an officer attached to the newly-formed British military Air Battalion submitted 'a very full and illuminative report' on the state of continental military air power to the British Government.[16] In it he recorded that the French War Ministry:

> had at its disposal, so far as could be ascertained, something between two hundred and two hundred and twenty aeroplanes. The biplanes were all Farmans. The monoplanes, which were on the whole preferred by expert opinion to the biplanes, were of many types, all famous for their achievement – Nieuports, Blériots, Deperdussins, R.E.Ps, Antoinettes, and others. The methods of training were elaborate and complete, and the air corps was continually practiced in co-operation with all other arms – infantry, cavalry, and artillery.'[17]

He went on to comment particularly upon 'French aeronautical exercises carried out by the French air corps at the Camp de Châlons during the previous August' adding that 'the Germans have suddenly realized that the French Army, since the general employment of aeroplanes with troops, has improved its fighting efficiency by at least twenty per cent'. Of the state of German military air power Glynn said that:

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[14]*Ministère de la défense/État-major de l'armée de terre/Service historique* (AAT), 7N1927, *Manoeuvres de Picardie 1910* (Paris: Imprimerie Nationale); and Carlier, pp. 129-192.
[15]Carlier, *Sera maître du monde,* pp. 223-247.
[16]Raleigh, *The War in the Air, Volume I,* p. 177.
[17]Ibid.

> For the last five years the Germans have concentrated their whole attention upon the building, manoeuvring, and employment with troop, of dirigibles. They have gained a slight advance of France, in fact, in this branch of aeronautics; but they have quite dropped behind in the question of heavier-than-air machines.[18]

The German Great General Staff led by General Helmuth von Moltke (the Younger) took this deficiency very seriously. Reports of the success of aviation at the French Picardy manoeuvres in 1910, together with the prospect of war in 1911 during the second Moroccan crisis, proved to be the spur that the German War Ministry needed. Lieutenant Glynn's report was accurate; at the end of 1911 the German army possessed just 30 aeroplanes. These were used for the first time during the 1911 Autumn *Kaisermanöver*, after which chief-of-staff General von Moltke became a strong sponsor of the rapid expansion in the number of heavier-than-air machines. He lobbied for extra funding for aviation to be put into the 1912 Army Bill, and called for an additional 112 aircraft to be purchased.[19] However the reactionary element in the War Ministry decided to buy just 34, chiefly one suspects because they had the Zeppelin.[20] The Germans were also initially disadvantaged by their lack of an aero-engine to rival the French *Antoinette* and *Gnôme* rotary. They resorted in the end to buying, in 1911, the Austrian Daimler automobile engine and building it under licence.[21] In 1912 they invited Karl Benz, another motorcar manufacturer, to develop a bespoke aero-engine, whilst in the meantime the Oberursel Company from Frankfurt-am-Main was copying the French *Gnôme.* By the summer of 1912, according to further information gained by the British, the evidence of Germany's response to the challenge of potential air supremacy was already evident. Delegates from the British Technical sub-committee of the Committee of Imperial Defence had seen this for themselves when they visited five aeroplane factories in Germany – Rumpler, Etrich, Albatros, Harland, and Fokker.[22] Germany had the private industrial capability to build fit-for-purpose warplanes. From 1912 onwards General von Moltke, despite that initial push-back from the War Ministry, provided the heavyweight commitment to purchase them and incorporate them into the order of battle. He wrote on 3 December 1912 that:

> The annual reports of the Inspector-General of Foot Artillery (III.62375/12 of 8/11/1912) and the Inspector of Field Artillery (I.3740/12, Secret, of

[18]Ibid.
[19]Simon. J. House, *Lost Opportunity: the Battle of the Ardennes, 22 August 1914* (Solihull: Helion & Company, 2017), p. 203.
[20]Morrow, *The Great War in the Air,* pp. 19-20.
[21]Ibid., p. 15.
[22]Raleigh, *The War in the Air, Volume I,* p. 180.

> 26/10/1912), which I have now received, both show plainly that officers controlling artillery fire will be very materially assisted by spotting and observation from aircraft.[23]

Von Moltke's commitment was crucial. He called for an air force of at least 324 planes, writing that 'I therefore adhere to my former standpoint, that my programme must be carried into effect by 1 April 1914. Please see that this is done.'[24] With such high-level backing, it is no surprise that the German government's expenditure on aviation increased exponentially with the Armament Bills of 1912 and 1913, and the German aviation industry's production capacity with it. From a slow beginning, by the end of 1913 the German Army had procured 628 aeroplanes (of all types including trainers), at precisely the time that, as we shall see below, French aircraft procurement went into the doldrums.[25]

Records show that by 1912, albeit two years behind the French, German aeroplanes were being used to scout for ground troops in manoeuvres. In Germany, most of the really effective training came from day-to-day corps manoeuvres rather than the grand spectacle of the *Kaisermanöver*, to which the world was invited to observe. Each corps had its own large exercise ground, so there were probably many exercises involving aeroplanes, although few records survived the British bombing of the archives in Potsdam in 1945. One surviving record is of the August 1912 reconnaissance exercises between XIII Corps and XVIII Corps. The exercise involved reconnaissance cavalry advancing into contact, with a number of aeroplanes in support. The umpire's conclusion was that 'the fliers did not prove themselves; the Blue side did not put in an appearance and the Red side had eight defective motors before they even got near the enemy'.[26] However as we shall see, two year's practice later, in August 1914, it was a different story.

We have seen, above, how crucial was the support of von Moltke in obtaining funding and aeroplanes for the army up to this point. Arguably, equally important was his role in bringing military aviation into the fold of the army's scheme of 'inspectorates', setting up a new Aviation Inspectorate within General von Hoeppner's Inspectorate of Military Communications.[27] It is noteworthy that von Moltke saw aerial reconnaissance as the province of 'military communications' rather than (as the French) an ownership contest between engineering and artillery.

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[23]General Ludendorff, *The General Staff and its Problems, Vol. I, translated by F. A. Holt* (London: Hutchinson, 1920), p. 47.
[24]Ibid., p. 43.
[25]M. Cooper, *The Birth of Independent Air Power* (London: Allen & Unwin, 1986), p. 9.
[26]Bundesarchiv/Militärarchiv (BA/MA), Freiburg-im-Breslau, PH 6 I/200.
[27]House, *Lost Opportunity,* pp. 202-205.

Furthermore von Moltke's decision was immediately implemented, not fought over by bureaucrats. The clarity and leadership given from the top of the German army gave direction and impetus to the last-minute development of military aviation doctrine: dirigibles would be used for strategic reconnaissance, and would be held at OHL (Supreme Command) level; heavier-than-air machines would fill in at the operational and battlefield tactical level. The purchase of 'stolid, slow, stable airplanes' was preferred.[28] The bulk of the available aeroplanes would be allocated at army corps level - one *Staffel* of six planes per regular army corps - for tactical reconnaissance and for observation and spotting for heavy artillery. The impetus did not let up on the eve of war. Records show that from 17 to 25 May 1914 competitions were held to determine the relative merits of the latest LDV biplane compared to the A.E.G, Albatros and Aviatik models.[29] Furthermore it is clear that by the spring of 1914 the German War Ministry had bought into the long-term future of heavier-than-air fighting machines. 'By early 1914 the army was reckoning on the eight German aircraft manufacturers producing 100 planes a month on a regular basis', with an order for the mass-production of Benz aero-engines to power them.[30] Thanks to the sustained effort and steady expansion throughout 1912 to 1914, the German air force was in a good position when it went to war.

Following von Moltke's intervention in German military aviation policy in 1911-1912, the race for competitive advantage intensified, but with the French having a clear two-year lead. However a downside to General Roques' bureaucratic victory over Colonel Estienne had already appeared in French policy: he who owned the technological development determined the role that aircraft would play in war. The artillery wanted a practical short-range, stable observation platform, whereas the engineers were interested in building aircraft that would fly faster, higher and further than ever before. In a clear demonstration of their understanding of the key issue at stake, senior staff officers at the War Ministry at first (in 1910–11) had tried to resolve the internal dispute by allowing Estienne's artillery air arm at Vincennes, with its five aircraft, to keep ownership of short-range spotter planes, whilst Roques' Engineering Aviation Inspectorate would take ownership of long-range reconnaissance craft.[31] But Roques objected to this compromise. There was a bureaucratic tussle, at the end of which Roques won complete ownership of military aviation. Predictably one of his first decisions as Inspector of Military Aviation was to announce a 300km speed trial to determine France's best three-seat long-range

[28]Morrow, *The Great War in the Air,* p. 19.
[29]Raleigh, *The War in the Air, Volume I,* p. 275.
[30]Morrow, *The Great War in the Air,* p. 14.
[31]Ibid., pp. 13-14.

reconnaissance machine.[32] Focus turned away from tactical artillery spotting to strategic reconnaissance. The internal dispute, however, rumbled on.

In the short term, all seemed well. Aeroplanes played a prominent part in every French annual autumn manoeuvre: in 1911 '(t)he fall [autumn] manoeuvers [sic] demonstrated that airplanes could locate an enemy's exact position at 60 kilometers and that two-seaters were superior to single-seat for reconnaissance; they also suggested the need for squadrons organized by type' – which facilitated repair and maintenance – 'which were introduced in 1912'.[33] Organising aircraft into squadrons suggests that the French air force was close to achieving critical mass; and the fact that the army ordered 208 planes in 1910–11 (157 of which had been delivered before the end of 1911) supports this hypothesis.[34] There were of course technological problems in the early days, chiefly mechanical failures, such that Foch allegedly remarked in 1913 that 'airplanes are interesting toys, but of no military value', a remark which (if true) undoubtedly came back to haunt him. But the fledgling air force persevered. In 1913, during the Languedoc manoeuvres, General Pau (Blue Army) used his planes to great effect, spotting for his artillery as well as reporting on General Chomer's Red Army movements.[35]

Unfortunately for the prospects of the French air force in the event of an early war, the bureaucratic in-fighting between the artillery and engineers broke out again in April 1912 when General Roques moved on to take up a field command in charge of 7 Infantry Division. An artillery officer, General Bernard, was given command of the Military Aviation Inspectorate after another lengthy political battle. Bernard immediately attempted to return to a policy of using aircraft primarily for artillery spotting instead of long-range reconnaissance missions, insisting – on Colonel Estienne's advice – on the production of armoured planes capable of withstanding rifle and machine-gun fire from the ground. However, existing aero-engines were not at that time powerful enough to bear the extra weight, and while that problem was being solved, production of existing types of aeroplane slowed markedly.[36] Furthermore the development of a coherent doctrine was equally bedevilled by argument. It was unfortunate that the French air force attempted to execute this change of policy direction on the eve of war, and managed to descend into bureaucratic chaos instead of concentrating on producing a fit-for-purpose doctrine,

[32]Ibid., p. 15.
[33]Ibid., p. 15.
[34]Ibid., p. 16.
[35]H. C. Johnson, *Breakthrough: Tactics, Technology and the Search for Victory on the Western Front in World War I* (Novato, Ca: Presidio, 1994), p. 18.
[36]Morrow, *The Great War in the Air,* pp. 30-33.

organization and training programme. In short, the French air force had by early 1914 lost its initial advantage, and went to war in a state of disarray.

Application in War, August 1914

In August 1914, France mobilised 138 aircraft and Germany 220.[37] These figures demonstrate how effectively Germany had caught up and indeed outstripped France in aircraft production and military procurement. The disparity in numbers also influenced the deployment and organization of aerial assets in the field. The French, with twenty-three *escadrilles* (of six planes each) but twenty-two army corps and a penchant for centralized control, opted to place a number of *escadrilles* at the disposal of each army commander. General Joffre's choice of allocation seems to have been influenced by circumstance. Fourth Army in the centre opposite the densely wooded Ardennes, for example, was allocated two *escadrilles* of six planes each, whilst Second Army in the more open terrain of Lorraine had five. There seems to have been no formal instructions issued as to their use, no systems, no processes; the senior air officer of each army air detachment was simply attached to the staff at army headquarters and left to his or his chief's own devices. The German High Command, with thirty-three squadrons (*Feldflieger-Abteilungen*) of six planes each (plus spares) at its disposal, had allocated one to each of its army corps and three to the cavalry, leaving just one squadron for each of the eight army commanders and none at OHL level, where the Zeppelins were held for strategic reconnaissance.[38] That meant that the bulk of the available planes were used for tactical reconnaissance and artillery spotting at corps and divisional level – exactly as General von Moltke had envisaged and specified from the outset.

Close study of the early Battles of the Frontiers between 7 and 23 August 1914 shows that the German generals arguably made better initial use of their aviation resources.[39] German flyers embedded in each army corps performed valuable close-range spotting and observation work that influenced battlefield decisions. An early example took place on 14 August when a German plane overflew the French 4th Dragoon Brigade (General d'Urbal) near Florenville. It seemed to the French that it was signalling to ground troops by firing shots; but it flew too low and was shot down by French riflemen, whereupon its two aviators were captured.[40] A second example took place on 18 August, when a German plane from XV Corps' squadron tracked the advance of the French VIII Corps into Upper Alsace until it was shot

[37]House, *Lost Opportunity,* p. 203.
[38]Cooper, *The Birth of Independent Air Power,* p. 9.
[39]House, *Lost Opportunity,* pp. 202-205.
[40]General V. d'Urbal, *Souvenirs et anecdotes de guerre, 1914–1916* (Paris: Berger-Levrault, 1939) pp. 3-26.

down.[41] Thirdly, the French VIII Corps commander, General Castelli, later wrote that on 20 August at 14.00 a German aeroplane flew over his headquarters and shortly afterwards heavy calibre shells 'came crashing down'.[42] These three examples indicate that the doctrine laid out by von Moltke before the war was in fact executed, and point towards a general ability of German air reconnaissance between 3 and 30 August 1914 to lend significant support to their troops on the ground.

On the French side, the best surviving primary source for army use of aviation assets in August 1914 is the autobiography of General (then Captain) Armengaud, who led one of Second Army's *escadrilles* and was army commander General de Castelnau's favourite flyer.[43] He and his men were attached to Second Army's general staff, and when not flying took part in the work of preparing and executing orders and instructions for the ground troops, like ordinary staff officers. He says that this close involvement with 'normal' staff work promoted better relations with the staff, which is probably true. But on the other hand, there would have been a distinct possibility, in times of urgency, pressure and stress, that the chief of staff might co-opt the officer-observers into use in the Operations Bureau, to the detriment of their primary reconnaissance role. General Castelnau was according to his biographer 'one who understood the use of aeroplanes', unlike General Foch's chief of staff, Colonel Duchêne, who reputedly told Captain Armengaud: 'I find your reports ridiculous – *je me moque de vos renseignements*'.[44] But even such an advocate and keen user of aeroplanes as Castelnau seems to have struggled to find the right formula for battlefield use. He wrote that 'the new air arm was an unknown, without written doctrine on its characteristics, use or type of work – it was known vaguely that it was to be used for scouting'.[45] Despite his complaint about the lack of an air doctrine, Castelnau used his planes to good effect in the operational role: on 25 August, as he finalized his plans for his counterattack on the German VI Army advancing into the 'Charmes Gap' south of Nancy: he waited until his airmen had confirmed the continued march south of his enemy before confirming his orders for the attack.[46] Other French army commanders also used their aeroplanes on a regular and frequent basis, if with less success and yet always in an operational role; that is to say for medium- to long-range flights intended to cover the area one or two days' march ahead of the army. General de Langle de Cary (Fourth Army) put the lack of

[41]Captain E. Dupuy, *La Guerre dans les Vosges: 41e division d'infanterie, 1 août 1914– 16 juin 1916* (Paris: Payot, 1936). p. 22.
[42]General de Castelli, *Cinq journées au 8e corps* (Paris: Berger-Levrault, 1930). p. 22.
[43]General Armengaud, *Renseignement aérien* (Paris: Librairie Aéronautique, 1931).
[44]General Yves Gras, *Castelnau: ou l'art de cammander, 1851–1944* (Paris: Editions Denoël, 1990), Chapter VIII, pp. 147-74.
[45]Ibid., p. 156.
[46]Ibid., p. 162.

success of his twelve airmen squarely on the difficult terrain of the Ardennes: 'Our troops were to find themselves in wooded areas clashing with unforeseen defenses which our cavalry and our occasional aeroplane had been unable to discover.'[47] The use of the phrase 'our occasional aeroplane' by the man who directly commanded those aeroplanes plainly denotes a lack of ownership and of understanding, and is symptomatic of the key difference between French and German performance. To be fair to the French, it appears that even in the first weeks of the war, German ground troops showed themselves to be adept at concealing themselves in towns, villages and forests as soon as an aircraft was spotted on the horizon. So, between 16 and 21 August, the flyers attached to General Ruffey's Third Army failed to locate and report the divisions of the German Fifth Army that were but a day's march in front of them, reporting instead that the terrain was absolutely empty of enemy forces. The classic example is that contained in the French HQ's evening Intelligence bulletin on 20 August, which reported that aerial reconnaissance had reported no movement around Longwy, when in fact two German corps were conducting short marches through the area and a brigade detachment under General Kaempffer was preparing to lay siege to the fortress.[48] On 22 August, 3e Colonial Infantry Division clashed with a German division in the Forest of Rossignol, unaware of the enemy's approach: 'Neither our rather rare aerial reconnaissances nor the divisions of cavalry had succeeded in piercing the veil – the woods kept their secret'.[49] The general failure of French air reconnaissance between 3 and 30 August 1914 was a significant contributory factor in the defeats suffered by their troops on the ground.

The difference in performance – that is to say the application of doctrine and use of technology – between the French and German air forces in the first battles of the war is well exemplified in the Battle of the Ardennes on 22 August 1914. In this battle, French General de Langle de Cary had been ordered to march his Fourth Army due north through the inhospitable forests and hills of the Ardennes in order to seek out, discover, engage and destroy the German forces (described by French Intelligence as the 'Northern Group') beyond the northern forest edge. The German 'Northern Group' consisted in fact of four armies, three of which were engaged in the implementation of the so-called Schlieffen Plan, crossing the river Meuse in order to march through Belgium, around the French left flank, in a great encircling move. The fourth army in that Northern Group - in fact the German Fourth Army under

[47]General de Langle de Cary, *Souvenirs de commandement 1914–16* (Paris: Payot,1935), p. 13.

[48]*Ministère de la guerre/État-major de l'armée/Service historique: Les Armées françaises dans la grande guerre* (AFGG) Volume 1, Annex 581: *Bulletin de renseignements du 20 août, 18 heures*; and House, *Lost Opportunity*, pp. 39-40 & p. 64.

[49]General Puypéroux, *La 3me division coloniale dans la grande guerre* (Paris: L. Fournier, 1919).

General Duke Albrecht von Württemberg - had been given the task of remaining on the right bank of the river Meuse and defending the flank of the main German advance. Hence the clash of the French and German Fourth armies was more or less inevitable, given the converging direction of their marches. Furthermore, given the closing distance between the two sides – starting over 35 miles apart – and the paucity of accurate, up-to-date intelligence about each other's dispositions, aerial reconnaissance was likely to be a decisive factor.

De Langle's advance began early in the morning of 22 August 1914. The whole of the Ardennes was covered by a thick fog; there had been rain the day before and as the sun rose, river valley mist reduced even ground visibility to a matter of yards/metres. There was no possibility of flying – by either side – until the fog cleared, which it did from about 09.00 onwards. De Langle had been given two *escadrilles* of six aeroplanes each, for a total of twelve, Duke Albrecht had four *Staffeln*, also of six aeroplanes each, under his overall command. De Langle kept all his twelve aircraft under his direct control, whereas Duke Albrecht retained merely six, with the other three squadrons (18 aircraft) reporting directly to the commanders of his three regular (*aktiv*) army corps. As we shall see, the different dispositions made a major contribution to the way that aerial reconnaissance affected the battle.

Let us take the German side first. The official history records that the Fourth Army staff's six aeroplanes took off at 09.00 as soon as the fog started lifting. Within three hours, at about noon, Duke Albrecht had received the reports from these first flights, despite being away from his headquarters visiting the front. His aircraft had, crucially, spotted the advancing French columns on his right flank that had penetrated deep into the Ardennes and threatened to outflank him.[50] Thanks to the prompt, accurate reports from the aerial observers, Duke Albrecht was able to issue orders to his corps commanders to nullify the French threat.

On the French side, there is in the archive just a single aerial reconnaissance report for the Fourth Army dated 22 August, of a flight that took off at about 16.30; it is worth quoting in full:

> At 17.25 heavy fighting was observed on an irregular front oriented generally from south-east to north-west in the region of Framont/Maissin.[51] There was an artillery group concentrated south of the woods to the south of Paliseul

[50]House, *Lost Opportunity,* p. 51.

[51]These villages were on the extreme left wing of the French Fourth Army's deployment and the extreme right of the German Fourth Army; in other words the vital area from which a French attempt at envelopment might have developed, if so ordered by de Langle.

> railway station, which seemed to me to belong to our cavalry division. The villages of Ochamps, Glaireuse, Anloy were occupied. The triangle Bouillon, Tellin, Pendrôme, Gédinne did not appear to be occupied, the roads being deserted; but from 1,400 metres altitude the cloud cover and mist made observation difficult.[52] The above is however my impression. 6h.30 [18.30] return to Stenay.[53]

This record is remarkable on many counts. It is, given the tenor of the Official History regarding de Langle's lamentable lack of knowledge of what was going on, and in the absence of any other reports in the archive, likely to have been the only French Fourth Army reconnaissance flight that day. The official narrative states that de Langle was 'singularly uninformed' and that until 16.45 he was still under the impression that his left wing was progressing well when in fact one of his army corps was on the point of its retreat turning into a rout.[54] And that sole aerial report was received too late in the day to have been of any use to de Langle in directing his battle. Furthermore the French pilot flew high and over long distances, suggesting an operational or even strategic reconnaissance, rather than risking low-level flight to gain more precise information of a tactical nature. It also confirms a more general point that German troops were already adept at concealing themselves from observation of high-flying French aeroplanes by abandoning roads and waiting in woods, villages and other cover until the aeroplane had flown on: there was at least a brigade of German troops (more than 3,000 men) in the 'unoccupied triangle' over which lieutenant Gouin flew.[55] The poor quality of command and control over French military aviation, and of the pilots' and observers' performance during the first month of the war is clear and evidenced; and it compares badly with that on the German side.

When one looks at the tactical application of aerial observation during the battle of the Ardennes, the comparison worsens. Given the glowing reports in 1911 of French proficiency in ground-to-air co-operation during exercises at the Camp at Châlons, the deterioration is hard to understand or explain unless one looks to a systematic failure by the French high command to properly prepare for war. De Langle did not devolve control of any of his six aircraft to any of his five army corps commanders,

[52]These villages were behind the German Fourth Army's right flank; in other words the area into which a French enveloping move would have marched, if so ordered by de Langle.

[53]AFGG I/1, Annex 867: 'Aviateur lieutenant Gouin à Monsieur le général commandant l'armée; le 22 août 1914'.

[54]House, *Lost Opportunity*, pp. 53, 59, 125.

[55]H. Kaiser, *Deitsche und Französische Artillerie in der Schlacht bei Bertrix* (Hanau: Weisenhaus-Buchdruckerie, 1937), p. 33.

nor did he choose, it seems, to use any aircraft in the tactical role; and this despite the paucity of accurate intelligence flowing into his headquarters. Duke Albrecht, on the other hand, started with an organisation in which a *Staffel* of six aircraft was permanently under the command of his three regular corps commanders. Each corps commander directed his own aircraft, with significant results.

During the combat at Bertrix, a French divisional general failed to locate a strong enemy column advancing into his open flank; consequently the whole of his artillery was wiped out and his infantry decimated. A simple low-level flight by one of de Langle's aircraft might have avoided that catastrophe. His opponent, a German divisional general supported by his corps commander, had at his disposal a single reconnaissance aircraft that, having located the French column, tracked it and reported on its progress. So reliant on this form of reconnaissance was the German general that in his subsequent report he bemoaned the shooting down of his aerial scout, blaming the loss upon his subsequent surprise at the eventual time and place of the contact/engagement.[56]

The staff of a German army corps (and this is a general point) seem to have been in the habit of using makeshift landing strips in fields as close as possible to – sometimes alongside – the corps headquarters, marking the strip with ribbons of white cloth.[57] The French army (and incidentally the British) utilised army aerodromes, sometimes many kilometres away from the headquarters that they served, thus introducing an unnecessary element of delay (and several unnecessary layers of bureaucratic management) into the process of delivering aerial intelligence to the unit commander.

Following the Battle of the Marne, the battles of the Frontiers came to an end, and so too the war of movement. From 15 September onwards, with each side seeking an open flank around which to manoeuvre, the fighting extended steadily northwards until the front reached the sea. By Christmas 1914 an almost continuous line of trenches stretched from the Channel to the Swiss border. The days of marching and manoeuvre were gone, and with it the earliest role of long-range observation planes and dirigibles. From then on, the generals required intelligence about what was going on – in detail – in the static trenches, in the gun lines behind them, and on the roads and railheads that supplied the front line. With static targets and trench lines lacking depth (at least in 1915), the job of the observation plane got both easier and more difficult. It was easier to locate your target, but it was impossible to hide (except in cloud), with many aircraft concentrating into narrow and predictable spaces; and counter-measures were not long in coming.

[56]Kaiser, *Deitsche und Französische Artillerie,* p. 33.
[57]BA/MA, PH6-I series.

In the very early days, man's natural aggression had led some observers to carry pistols and rifles and exchange pot-shots with enemy reconnaissance craft. The first French air-to-air victory came on 5 October 1914 when Corporal Louis Quénault, an observer in a *Voisin III* flown by Sergeant Joseph Franz, shot down a German *Aviatik*. The *Voisin III* was a pusher biplane, and Quénault used a Hotchkiss machine gun mounted in the observer's position in the front.[58] These early aerial combats were spontaneous, originating from individual soldier-airmen according to their inclination. However it was not long before an organized and systematic approach to hunting down the enemy was developed. Indeed the innovative technological groundwork for 'hunters' or 'fighters' as they became known had been laid before the war. The first 'pursuit' squadrons were formed over the winter of 1914–15, and in the spring of 1915 the organised hunting of enemy observation planes began in earnest.

To progress beyond the use of revolvers, rifles and light-machine guns required further innovation. It was generally decided that the best type of 'pursuit' plane was the smaller, faster, more manoeuvrable single-seaters, with the pilot simply pointing the plane's nose at the enemy. However the only way that a heavier weapon like the Maxim, Hotchkiss or Vickers gun could be carried on a 1914–15 type plane was on the fuselage, and that meant either placing the engine at the back (known as a 'pusher' type) or firing through the propeller. Reference has been made to August Euler's patent in 1910 for a synchronized machine gun. Another such was Franz Schneider, a Swiss engineer who worked first for the French *Nieuport* company and then for Germany's *LVG*. He first patented his synchronization device on 15 July 1913, and full details were published in the aviation periodical *Flugsport* in September 1914.[59] However the German War Ministry ignored the idea until forced to take action. It took one final maverick innovation to catalyse the warring powers into taking the final step towards the formalization of aerial combat. On 1 April 1915, French fighter pilot Roland Garros shot down an observation plane by firing a machine gun through his propeller – without interrupter gear. He used steel wedges on the back of the wooden blades to deflect those bullets that would otherwise have shattered them. He successfully shot down two more German observation planes over the next few days before crash-landing on 18 April behind German lines. It was only then that Anthony Fokker was commissioned to develop the synchronization device to a point where a Maxim machine gun could be mounted on a Fokker *Eindekker*, firing safely and effectively through the propeller. Soon the 'Fokker Scourge' of 1915 had begun; the Germans shot dozens of British and French

[58]Murphy, *Military Aircraft, Origins to 1918*, p. 53.
[59]G. van Wyngarden, *Early German Aces of World War I* (Oxford: Osprey Publishing, 2006).

observation planes out of the sky, denying the Allies vital reconnaissance intelligence. The concept of air superiority over the battlefield was born, and with it the invention of aerial combat.

From Balletics to Ballistics: French Artillery, 1897–1916

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ABSTRACT
The fighting on the Western Front during the First World War was characterized by the mass use of artillery and, thanks to scholarship from recent decades, is now understood as a crucible for learning and innovation. This article follows the trajectory of French artillery capabilities, mental and mechanical, from the late 19th century through to 1916.

Introduction

The First World War, fundamentally, was an artillery war. Central to every tactical question was the use of artillery: that of the attacker and the defender. The reason for this is largely technological. With the development of accurate, quick-firing artillery field armies would possess an unprecedented level of firepower. The 1890s introduced an era in which massed infantry charges could be largely turned back by artillery alone. These modern field guns could, if they chose, engage their targets from four to six kilometres away, thus freeing them from the constraints of their counterparts in the 1860s and 1870s, whose shorter ranges exposed them to deadly small-arms fire.

Against this new killing power there was little that infantry could do; little, that is, except dig. Trenches have always provided soldiers with protection from firepower. The same basic principles which Vauban had perfected in the 17th Century remained of vital importance well into the 20th. That the war on the Western Front was essentially a siege operation of unprecedented complexity and duration was not lost on the leadership of the French army. Joseph Joffre, commander-in-chief of the French army from 1911 to 1916, frequently made statements such as, '[this war] is a

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siege; thus, long and difficult'.[1] Such comparisons were not the sole purview of officers in GQG (*Grand quartier général*). General Cugnac, who commanded 18e DI (*Division d'Infanterie*) in 1915 stated that, 'The old principle of our fathers remains true – you cannot attack a wall without having destroyed the bastions' flanking positions, without demolishing the ramparts.'[2]

The trenches and other field fortifications which stretched from the English Channel to the border of Switzerland from 1914–1918 were dug not only to protect the infantry from the awesome effects of modern firepower, but also in response to a force–space ratio which did not permit large-scale flanking manoeuvres. Any attack would have to be launched head on. This unprecedented defensive network posed a serious problem to any would-be attacker: how could a force successfully quit its protective trenches, cross open land, and then capture enemy trenches without suffering undue or, in any case, unsustainable losses. This problem was the central focus of military thought on the Western Front, and still generates a large part of the sustained interest in the First World War, scholarly and otherwise.[3] Here, the parallels to old fashioned siege warfare begin to lose their relevance. The Central Powers were never going to be starved into submission without suffering serious military defeats, in the way a besieged town might. Likewise, the defensive structures built up and down the Western Front were easily and quickly replaceable. In a traditional siege one must only break the enemy defences once. On the Western Front the defences might be broken only to have the enemy retreat a few miles and

[1]Service historique de la défense (SHD), 16N1905; *« C'est une opération de siège, donc longue et difficile ».*

[2]SHD, 22N573; *« Résumé de l'attaque du 11 Mai sur la côte 140 »*, 1 June 1915*; « Le vieux principe de nos pères reste vrai – on ne peut pas attaquer une courtine avant d'avoir détruit les organes de flanquement des bastions, avant d'avoir démo[u]lé les caponières ».*

[3]The number of works that focus on the problems posed by trench warfare are legion and beyond a proper recounting here. Especially important for the thought leading up to this article were Michel Goya, *La Chair et l'acier : L'Armée française et l'invention de la guerre moderne (1914–1918)* (Paris: Tallandier, 2004); William Philpott, *Bloody Victory: The Sacrifice on the Somme and the Making of the Twentieth Century* (London: Little, Brown, 2009); Gary Sheffield, *Forgotten Victory, The First World War: Myths and Realities* (Chatham: Review, 2001); Paddy Griffith, *Battle Tactics on the Western Front: The British Army's Art of Attack, 1914–1918* (London: Yale University Press, 1994); Robin Prior & Trevor Wilson, *Command on the Western Front: the Military Career of Sir Henry Rawlinson 1914–18* (Oxford: Basil Blackwell, 1992); Gary Sheffield & Dan Todman, *Command and Control on the Western Front : The British Army's Experience 1914–1918* (Staplehurst: Spellmount, 2004) and more recently Aimée Fox, *Learning to Fight: Military Innovation and Change in the British Army, 1914–1918* (Cambridge: Cambridge University Press, 2018).

throw up a new, and perhaps even stronger, defensive position. In short, the problem was enduring.

Leaving aside important political considerations like clearing the Germans out of occupied France and Belgium, the Allies were only ever going to win by attacking the increasingly strong German defences. Such attacks would be costly, and required overwhelming firepower to ensure success. Artillery was the only weapon which could destroy or neutralise enemy trench-works and allow infantry to cross the killing zone and close with the enemy. This article will examine how French theory and practice concerning the employment of artillery changed as a result of the challenges posed by the Western Front. From the pre-war training of the French army, to the early battles of manoeuvre, through to the development of the trench network this article will map the evolution in French thought and practice in order to demonstrate not only that great strides and innovations were made in the First World War, but that they were made with startling speed. This speed is not only impressive in and of itself (having not yet been fully recognized by historians); it begs a reconsideration of the developmental trajectory of armies on the Western Front.[4] Given the life or death pressures of war it should not be surprising that armies innovated rapidly to try to save lives and secure victory. What is amazing is how far they progressed from pre-war thinking and practice.

Artillery from 1878–1914

The vast majority of the guns that were available to France in 1914 were produced in the 1870s and 1880s. These guns, the de Bange series, accounted for two-thirds of the French arsenal (8,150 out of a total 12,214), yet only 120 of them were attached to active field units in August 1914 (a little more than one-third of the 308 heavy guns and mortars with which the French army marched to war).[5] They were, in many ways, guns of a different era. Designed and crafted in the years after (and largely in response to) the French humiliation in the Franco-Prussian War, the de

[4]Older works, including Bruce Gudmundsson, *Stormtroop Tactics: Innovation in the German Army, 1914–1918* (Westport, Connecticut: Praeger, 1989) and Douglas Porch, *The March to the Marne: the French Army 1871–1914* (Cambridge: Cambridge University Press, 1981) have successfully cemented the idea of the French army as a bumbling organization, in contrast to the supposedly more dynamic German army. More recent works, especially Goya's monograph and PhD thesis, challenge these assumptions. Unfortunately, Anglophone scholarship has been slow to take up Francophone research into their historiography.

[5]Robert Doughty, *Pyrrhic Victory: French Strategy and Operations in the Great War* (Cambridge, Mass.: Belknap Press of Harvard University Press, 2005), p. 29; Émile Gascouin, *Evolution de l'artillerie pendant la guerre* (Paris: Imprimerie Nationale, 1920), p. 29 & Goya, *La Chair et l'acier*, pp. 148-150, 162.

Bange guns provided the range and power that French artillery had previously lacked. What the de Bange guns could not boast, however, was rapidity of fire. While the guns were 'virtually brand new' in 1914 (having never seen action), they were designed in a time before the invention of hydraulic recoil, which meant that the guns would have to be re-positioned and re-aimed after every shot.[6] This being the case, they were only capable of three shots a minute under the best circumstances. In the field, one shot a minute was the norm. Compared to the 10 to 15 shots a minute which more modern guns were capable of, the French reliance on the de Bange guns put them at a serious disadvantage. The French have been frequently slighted for having overly long artillery preparations in the First World War.[7] It is worth remembering that these preparations were not long by choice, but by necessity. It took a certain amount of tonnage to destroy or neutralize enemy trenches. With guns that could only reasonably fire one round a minute the French had no choice but to let the guns take as long as needed if they wanted to have any reasonable chance of success. Barbed wire was never caught off-guard by a surprise attack.

Recognising the inefficiency of the de Bange guns for modern warfare, the French army did attempt to retrofit many of the guns to make them more serviceable for operations on the Western Front. The de Bange 120L (long barrel), the most common de Bange heavy gun available, was the first in the French army to be coupled with motorised tractors, which greatly increased the guns' mobility (although there seemed to never have been a large number of these tractor-pulled 120Ls).[8] Likewise, plans were considered for retro-fitting 120Ls with the *affût Mourcet*, a crude recoil system, which would have increased their rate of fire. Ultimately, production of the *affût Mourcet* was not pursued; the French decided that the *affût Mourcet* would have been a waste in light of the 220 modern 105Ls that had been ordered soon after the outbreak of war in 1914.[9] Unfortunately, it would take some time for these new guns to be produced and reach the front lines (the order only being completed in 1916), which left the French with little option but to continue to slog on with its slow-cadence fire. This problem was exacerbated when the order of modern, quick-firing 105Ls was reduced from 220 to a mere 36 after the decision was made to rely on modifying existing French 75s to allow them to play roles normally reserved for heavy guns.

[6]Gascouin, *L'Évolution de l'artillerie pendant la guerre*, p. 28; *« presque à l'état de neuf ».*
[7]Goya, *La Chair et l'acier*, p. 155 ; Barthélemy Edmond Palat, *La Grande guerre sur le front occidental,* (Paris: Chapelot, 1927), p. 237.
[8]Gascouin, *L'Évolution de l'artillerie pendant la guerre*, p. 33.
[9]Goya, *La Chair et l'acier*, p. 161.

While the French were trailing the Germans in terms of heavy artillery production, they led the world in field artillery. The vaunted French 75mm field gun had reigned supreme since its debut in 1897. The first gun to be fitted with a hydraulic recoil system, the French 75 was the world's first modern artillery piece. Despite its early development, it remained a superior weapon, being markedly more effective than its German 77mm counterpart, which had been designed after the unveiling of the 75.[10] Even before war-time modifications the 75 boasted a longer range than the 77 (by 1,000m). It was also quicker-firing, and more accurate. It would remain an important part of the French war machine throughout the conflict, taking on roles as diverse as counter-battery fire, wire-cutting, and the delivery of poison gas.

Several attempts were made to enhance the accuracy and flexibility of the 75 in the years just before the outbreak of war. Most were attempts to get the 75 to fire a more arced shot, thus helping to overcome the shortage of high-arc heavy artillery that the French army suffered from (a shortfall made all the more evident by very public German advances in heavy artillery from 1905 onwards). The *plaquette Malandrin* was one potential solution. It was, in essence, a set of wooden fins which attached to a 75mm shell, causing it to fall sharply as it lost momentum.[11] The *plaquette* saw limited use in the early years of the war, although assessing how often it was used and how effective it was is profoundly difficult. The only definite use of the *plaquette* known to the author was by the 34^{e} DI in the build up to its attack on the village of Chantecler in June, 1915.[12] Chantecler was elevated above the French position, rendering terrestrial observation all but impossible. Aerial reconnaissance could not discern damage done by *plaquette*-equipped 75mm shells from other damage done in the division's preparatory bombardment (nor were they likely to have even tried). The 75's limited payload and relative inefficacy against established trench-works obscures any inquiry into the practicality of the *plaquette*. If the 75 was not strong enough to tackle the defences around Chantecler it is irrelevant whether or not the sharp drop-off provided by the *plaquette* actually occurred. In the end, the verdict on the usefulness of the *plaquette* is probably best answered by its rarity in the source material.

Very similar was the *cartouche réduit* (the 'reduced cartridge'). The reduced cartridge manipulated the charge of each round in such a way as to cause the shell to fall abruptly, thus allowing the 75 to effect 'plunging' fire. This, however, came at a cost: the range of the 75mm was reduced from 6,500m to 2,000 to 4,000m.[13] As with the *plaquette*, evidence of use of the reduced cartridge is slim. Ultimately, neither could

[10]Ibid., p. 154.
[11]Doughty, *Pyrrhic Victory*, p. 31.
[12]SHD, 24N741; *« Compte-rendu au sujet de la mission de l'A.D. 34 »*, 24 May 1915
[13]Gascouin, *L'Évolution de l'artillerie pendant la guerre*, p. 123.

hope to fill the role of heavy artillery, owing to the deficient range and striking power of the 75. A lack of modern heavy artillery (of which the French had only 104 pieces extant on the outbreak of war) was to be a major preoccupation of all armies on the Western Front (even the German) and was the primary driver which gave the early trench battles their shape and scope.

If France was innovative in its field artillery design it was purely reactive in its approach to heavy artillery.[14] Germany led the way with heavy-gun production, and unveiled Europe's first modern heavy artillery batteries to be organically attached to infantry formations. This forced the French military into an uncomfortable situation. Doctrinally the French did not see the need for heavy artillery batteries to be attached to infantry. Heavy artillery was reserved for sieges, a type of operation completely outside of the French emphasis on speed and mobility on the battlefield.[15] Heavy artillery was worse than existing field guns at hitting exposed infantry, it was argued, which would make them an actual hindrance, not just an unnecessary expenditure.[16] Supporting the bureaucratic inertia which hindered the French procurement of modern heavy artillery was a range of very valid questions. Would the heavy guns slow down the rapidly moving infantry and field guns? Would they ever be able to deploy in time to take part in the great battles of manoeuvre that were expected? How could the logistics network supply heavy guns with enough ammunition with the armies constantly on the move? How were artillery crews supposed to use guns whose range could be up to 10km when artillery crews could only observe fire up to 4km in the best of circumstances?

By contrast, the strategic position of Germany made the adoption of heavy artillery batteries an absolute necessity. All along Germany's western border were great forts (Liège, Namur, Verdun, Belfort) that Germany would have to assault eventually. The need to assault these forts, and to take them quickly, was reinforced by Alfred von Schlieffen's estimation that France would need to be crushed in a few short weeks if Germany was to avoid fighting a two-front war with France and Russia. Germany's early adoption of heavy artillery was not a result of great tactical foresight, but a response to clear and unavoidable strategic realities. France, on the other hand, did not expect to assault any major forts (aside, perhaps, from Metz), and expected to fight the next war in open terrain. Its doctrine and equipment reflected this. Bureaucratic inertia and budgetary insufficiencies kept the French from adopting

[14]David Stevenson, *Armaments and the Coming of War: Europe, 1904–1914* (Clarendon Press: Oxford, 1996), p. 57.
[15]Robert M. Ripperger, 'The Development of French Artillery for the Offensive, 1894–1914', *The Journal of Military History*,
59/4 (1995), p. 616.
[16]Ibid., p. 607.

modern heavy artillery until 1910; an act pursued more because the Germans had heavy guns than because the French had in mind a specific role for them.[17] It was then that the French first began to procure modern Rimailho 155CTRs (*court tir rapide*) and 105Ls. This program was expanded under Joffre from 1911, although it was not without incident; bureaucratic infighting would stunt or reduce many procurement efforts.[18] As a result, the French army would have only 140 modern heavy guns in August 1914: 104 155CTRs and 36 105Ls.[19]

Pre-War Artillery Doctrine

Discussing French doctrine before the Great War is not as straightforward as discussing hardware and procurement. This is largely because the French did not have a clear doctrine in the early 1900s. Douglas Porch claims that the French army of the early 1900s was simply incapable of producing or applying any set doctrine: a result of bureaucratic wrangling and even unprofessionalism.[20] Porch attacks the French high command for trying to substitute metaphysical concepts like *élan vitale* (the idea that, by their very 'Frenchness', French soldiers could overcome modern firepower) in place of a modern, scientific doctrine. More accurate is Michel Goya's assessment, which acknowledges the French army's large body of doctrinal and theoretical writings on war, but still asserts that this disparate collection of works did not represent a true 'doctrine' in any meaningful sense of the word.[21] Joffre himself admitted that the French had no real doctrine, at least up until 1911. In his memoirs he wrote that his primary goal upon becoming *Chef d'état-major général* was the creation of 'a firm doctrine for war, known by all and unanimously accepted'.[22] If Goya is correct it is nevertheless still useful to examine some of the pre-war writings on artillery to get a sense of how influential members of the French military establishment were thinking.

Hippolyte Langlois was one of the most important French military thinkers in the late 19th and early 20th centuries. Commissioned into the artillery in 1858 he went on to serve in the Army of Metz during the Franco-Prussian War. By the late 1880s he had become Colonel Langlois and was appointed professor of artillery at the *École de*

[17]Goya, *La Chair et l'acier*, p. 160.
[18]Doughty, *Pyrrhic Victory*, p. 31.
[19]Doughty, *Pyrrhic Victory*, p. 29; Gascouin, *L'Évolution de l'artillerie pendant la guerre,* p. 29 & Goya, *La Chair et l'acier*, pp. 148-50, 162.
[20]Douglas Porch, *The March to the Marne: The French Army 1874–1914* (Cambridge: Cambridge University Press, 1981), pp. 214-6.
[21]Goya, *La Chair et l'acier*, pp. 110-2.
[22]Joseph Joffre, *Mémoires du Maréchal Joffre (1914–1917)* (Paris: Librarie Plon, 1932), p. 29; *« Avant tout, il fallait doter notre armée d'une doctrine de guerre ferme, connue de tous, et unanimement acceptée ».*

guerre. Langlois would go on to be a *Général de division* (a two-star general). He served on the *Conseil supérieure de guerre*, and would be ultimately be elected into the *Académie française*. After joining the *École de guerre* Langlois embarked on an influential publishing career. In 1892 he produced *L'Artillerie de campagne en liaison avec les autres armes* ('Field artillery in liaison with other arms'). In this treatise Langlois stressed the importance of mobility and 'dash' in the artillery, which he considered to be uniquely French strengths, harking back to Napoleon.[23]

Langlois was a firm proponent of the centrality of artillery to modern warfare. Artillery, he claimed, allowed the attacker to amass a local firepower advantage, and thus overwhelm the enemy at a chosen point. The idea of focusing on the decisive point (or *schwerpunkt*) was an idea rooted firmly in the campaigns and battles of Napoleon (one potential criticism of Langlois's 1892 book is that certain passages are strongly Napoleonic with the infantry marching in column, trailed by a grand artillery train, etc.).[24] It was a concept made all the more relevant, many felt, by the vast expansion of Continental armies. As one could now attack the enemy at virtually any point along a line extending hundreds of miles the choice of location for any attack was paramount. The process of concentrating force for a local attack without overly-weakening other sectors inspired much debate. Foch's chapter *L'Économie des forces* in *Principes de la guerre* bears testament to this (and even opens with a quote from *l'Empereur* himself).[25] That many batteries of artillery could be secretly concentrated at the decisive point, could fire simultaneously, and all on the same area, made artillery the principal and most powerful arm on the modern battlefield according to Langlois. Once engaged, the artillery should concentrate its bombardment, and blanket the enemy with shell-fire to catch hidden artillery emplacements and induce shock.[26] Above all, this was to be done quickly: Langlois saw speed/tempo as the most important attribute for an attacker. Nevertheless, he did allow for changing circumstances in the field and held that, above all else 'the position of the artillery ought to respond to the tactical goal'.[27]

The foundation for the doctrine, however loosely defined, that informed the employment of French artillery in 1914 was laid in 1903. That year the French army produced the *Règlement provisoire de manouvre de l'artillerie de campagne* (Provisional

[23]Hippolyte Langlois, *L'Artillerie de campagne en liaison avec les autres armes* (Paris: Librairie Militaire R. Chapelot, 1908), p. 247.
[24]Ibid., pp. 278-84.
[25]Ferdinand Foch, *Œuvres complètes, Tome I: Les Principes de la guerre,* (Paris: Economica, 2008), p. 168.
[26]Ripperger, 'Development of French Artillery', p. 601.
[27]Langois, *L'Artillerie de campagne*, p. 255; *« la position de l'artillerie doit répondre au but tactique ».*

regulations for the manoeuvre of field artillery). The *Règlement* was a manual intended to cover the majority of aspects related to service in the artillery. As such, the first third of the *Règlement* deals entirely with training, gymnastics, and the proper forms of march and dress becoming of an artilleryman. The sheer amount of gymnastics in the *Règlement* is staggering, but we have to place it in the context of late 19th century France. In the years immediately after the humiliating defeat of 1870–1 gymnastics were seen as offering France a way to better prepare its young men for a military life.[28] Just as flying clubs proliferated in post-Versailles Germany, gymnasiums offered a pseudo-military outlet for French people (especially young men). This practice bled into military practice, and edged out some of the more practical and scientific aspects of artillery training. Ballistics and the higher art of artillery service, for example, are only belatedly covered.

The *Règlement* broadly agrees with Langlois' 1892 work, stating that 'speed of fire is the essential property for field artillery'.[29] Being written after the introduction of the French 75 it is not surprising that rapidity of fire was held to be of great importance. This emphasis on high-speed artillery fire (aimed over open sights) blanketing enemy positions with shrapnel was supported by Ferdinand Foch in his influential *Principes de la guerre* (also published in 1903): 'A quarter of an hour's quick fire by mass artillery on a clearly determined objective will generally suffice to break its resistance, or at any rate make it uninhabitable, and therefore uninhabited'.[30]

The *Règlement* anticipated the use of artillery at short to medium range (typically between 1,000 and 3,000 metres with 4,000 being the longest range discussed).[31] This was largely done to accommodate the observation of artillery fire, which the *Règlement* stated was to be done from within the immediate vicinity of the gun (in theory to allow for the gunfire to be quickly adjusted, ensuring accuracy). The *Règlement* does provide some equations for ascertaining the difference in altitude between the battery and its target, but failed to prepare artillerymen for firing from defilade or calculating wind resistance, the effects of barrel wear or other practical issues that a gun crew would have to consider in the field.[32] One area in which the *Règlement* is reasonably advanced was in its discussion of *tir progressif*, in which an

[28]Eugen Weber, 'Gymnastics and Sports in Fin-de-Siècle France: Opium of the Classes?', *The American Historical Review*, 76/1 (1971), p. 73. Weber's article remains the classic work on the subject.

[29]*Règlement provisoire de manouvre de l'artillerie de campagne*, (Paris: 1902), p. 66; *« La rapidité du tir…est la propriété essentielle du canon de campagne ».*

[30]Joseph C. Arnold, 'French Tactical Doctrine 1874–1914', *Military Affairs*, 42/2, (1978), p. 64.

[31] *Règlement provisoire*, pp. 92 & 130-143.

[32]Ibid., p. 109.

artillery battery would fire two rounds per gun before increasing their range by 100m and firing a further two rounds.[33] This was repeated four times for a total of eight rounds fired in quick succession to create a sweeping effect of shell bursts over a designated area. This practice would not only become the standard procedure for anti-aircraft fire but would also be the rough model for what would become the 'rolling barrage'.[34]

Contemporary wars naturally had an impact on how the French army thought about the use of artillery. The Russo-Japanese War (1904–5), for example, was held up as evidence to support the idea that guns were best employed atop hillocks, firing over open sights. This conclusion was based on the poor performance of the Russian artillery when it attempted to fire from defilade.[35] The Russo-Japanese War was also used to support the French doctrine of blanketing enemy areas with shell fire; the argument was that the vast tonnages of munitions expended were proof that weight of metal was the most important factor in deciding victory. Interest in contemporary conflicts was pervasive. Just four years before his death Langlois published *Lessons from Two Recent Wars*, an analysis of the Russo-Turkish War (1877–8) and the South African War (1899–1902). In this volume Langlois discussed artillery in terms that were very firmly in line with wider French doctrinal thinking. The passive defence (an unacceptable option for the post-1871 French army) was derided as surrendering the initiative, and thus placing one's troops at the mercy of enemy artillery, which would retain freedom of action and concentration. Langlois stated clearly that frontal attacks were inherently difficult and would likely be very costly (a long-standing concept in the French army, not a last-minute thought in 1913 as some have argued), but that technological developments still advantaged the attack over the defence.[36] Langlois presciently discussed the value of 'field fortifications' (trenches), stating that:

> If…we were to construct numerous trenches forming a strong firing line, were to securely protect their flanks and support them in the rear by other trenches, one behind another, we should arrive at a position which would be invulnerable against artillery. This invulnerability would depend not so much on the strength of any one or of the component parts, but on their number and their extension.[37]

[33]Ibid., p. 93.
[34]Pierre Joseph Louis Alfred Dubois, *L'Artillerie de campagne dans la guerre actuelle 75 & 90* (Paris: L. Fournier, 1916), pp. 163-165.
[35]Ripperger, 'Development of French artillery', p. 604.
[36]Paul Strong & Sanders Marble, *Artillery in the Great War* (Barnsley: Pen and Sword, 2011).
[37]Hippolyte Langlois, *Lessons from Two Recent Wars [The Russo-Turkish War and South African Wars]* (London: Mackie and Co, 1909), p. 138.

While Langlois is deserving of some praise for conceptualizing a grand network of field fortifications he failed to propose any methodology for dealing with them. In his book he did not discuss how such a defensive network could be attacked, nor did he suggest that such defences were invulnerable to artillery simply because French artillery was not heavy or powerful enough to attack them (a politically difficult thing to say, as the 75 was still embraced as the centrepiece of the French armoury).

This unwillingness to stretch the analysis that final step to considering a solution for a very real problem (trench-digging had become a major component of field battles the world over in the early 1900s) persisted through to the outbreak of the Great War. The last major French work of doctrine to appear before the war was 1913's *Décret du 28 octobre 1913 portant règlement sur la conduite des grandes unités (service des armées en campagne)*: [Decree of 28 October 1913, Regulations for the Direction of Larger Units (the service of armies in the field)]. The Decree relegated artillery to a greatly reduced role on the battlefield (far from its position as queen of the battlefield, conferred intellectually by Langlois, Foch, and others) stating that 'the artillery has as its essential mission to support the forward movement of the infantry'.[38] Artillery would help infantry get across the killing ground, but would do little else; it certainly would not be the principal arm on the battlefield. The regulations went even further to state that artillery's role on the battlefield would be principally morale-centred (a boost for friendly troops, and a demoralizer for the enemy). Such an understanding of the utility of artillery on contemporary battlefields would be sorely tested in the Great War.

La Guerre de Manœuvre

1914 would prove to be a trying year for the French army. In its five months of war 1914 would claim enough French casualties (301,000 dead, many more missing or wounded) to be the second-bloodiest year of the war for the French.[39] To a large extent this was owing to the fact that the entire French army was engaged in regular battle. Poor French performance in battle, however, did not help. The artillery was frequently left behind by the infantry who would impetuously advance into battle without waiting for artillery support. When artillery was brought to bear it was done on an entirely *ad hoc* basis, without liaison between batteries or a co-ordination of efforts across most formations.[40] Despite this chaos there were instances in which

[38]*Décret du 28 octobre 1913 portant règlement sur le conduite des grandes unités (service des armées en campagne)* (Paris: 1913), p. 39; *« l'artillerie a pour mission essentielle d'appuyer le mouvement en avant de l'infanterie ».*

[39]Lieutenant-colonel De Chasteigner, '1915 : Le Martyre de l'infanterie. Un exemple: Les Éparges', *Revue historique des armées,* 21/ 2 (1965), p. 8.

[40] Gascouin, *L'Évolution de l'artillerie pendant la guerre*, pp. 74-76.

French artillery was able to successfully intervene in a battle and influence the outcome of events. At times the artillery filled the role designated to it in pre-war doctrine firing over open sights upon massed German infantry.[41]

These instances, combined with the celebrated performance of the 75 at the 1914 Battle of the Marne, would cement in the minds of many the enduring centrality of field artillery, to the detriment of heavier guns.[42] As the trenches were dug in late 1914, however, the 75 began to show some of its inadequacies. Despite the fact that guns were firing at relatively short ranges artillery still had difficulties providing close infantry support. This was one of the major challenges for the French army from 1915, and a range of solutions were proposed. Flares were probably the best and quickest option available. French flares came in three colours (green, red, and white), but were hindered by the fact that the white flare was practically invisible in daylight.[43] As flares were not always abundant the use of flags and other visual symbols (including hand and arm signals) were encouraged, especially in communicating over relatively short ranges.[44] Telephones were the clearest means of communication, but were subject to lines being cut by enemy fire, and also to accidental damage done by French infantry moving through the trenches. During the Second Battle of Champagne (September 1915) French formations tried to deal with the problem of close fire support by sewing white squares on the backs of advancing French infantrymen.[45] The white squares would signal to the artillery where the front line was, allowing them to engage in close support with less fear of inflicting friendly fire casualties. This proved less than effective.

Far more pressing than the difficulties regarding close fire support was the task of maintaining an adequate number of guns and shells in the field. French artillerymen were, on the whole, not taking very good care of their guns at a time when their guns were being asked to fire previously unthinkable quantities of munitions. Intense firing programs, such as those on which every attack relied, would cause many guns to fatally malfunction (typically, more guns were lost this way than were lost to enemy action).[46] From February 16–22 Fourth Army lost 10% of its field guns (86 of

[41]Ibid., pp. 87-88.
[42]Émile Rimailho, *Artillerie de campagne* (Paris : Gauthier-Villars, 1924), p. 109.
[43]SHD, 19N1686; *« Note au sujet de l'emploi de fusées signaux comme liaison entre l'Infanterie et l'Artillerie ». 3e Bureau, X Army*, 26 April1915.
[44]SHD, 24N741; *« Note pour les C.A. », 10e Armée*, 2 May 1915.
[45]SHD, 19N735.
[46]Rémy Porte, *La Mobilisation industrielle, « premier front » de la grande guerre?* (Cahors: 14–18 Éditions, 2005), p. 69.

860) due to excessive barrel-wear and subsequent malfunction.[47] 34e DI, which had been a part of Fourth Army at the time, would again find itself suffering from gun shortages four months later. In its preparation for an attack on the village of Chantecler the division had only 20 fully-operational guns (six were firing at reduced capacity: four could only fire shrapnel shells for fear of causing a barrel rupture, and two were firing erratically); the division had effectively lost over one-third of its full paper complement to malfunction.[48]

While the number of guns lost to malfunction (including barrel rupture) were greatly reduced as the war continued (a result of meticulous barrel oiling and the increased use of replaceable barrels) it posed a serious industrial problem to the French war machine.[49] The loss of France's industrial north-east in the initial German advance of 1914 put incredible strain on France's ability to keep its armies supplied with the ever-increasing materiel needed to conduct modern war.[50] The loss was especially trying as France did not simply need to replace spent munitions and lost weapons, but needed to create an entirely new armoury of heavy artillery, which was sorely lacking. This lack of modern weaponry made itself sorely felt in the initial trench battles.

La Guerre de Tranchée

In December 1914 the French army launched its first, concerted trench offensive. This effort, the First Battle of Artois, was launched by Tenth Army, under the command of General Louis de Maud'huy. Initially, Tenth Army's three corps were to make a simultaneous assault aimed at capturing Notre Dame de Lorette, a dominating piece of high ground just over a kilometre north-west of Vimy Ridge. It was always going to be a difficult operation, but the lack of artillery exacerbated the situation. When it became clear that there was not enough heavy artillery to support the action the attacks were staggered to allow the artillery to concentrate on each sector in turn. Thus, the entirety of Tenth Army's heavy artillery would support the actions of XXI CA on 16 December, X CA on the 17th, and then XXXIII CA on 18

[47]État-major de l'armée, , *Les Armées françaises dans la grande guerre* (AFGG) (Paris: Imprimerie Nationale, 1923), *Tome II, Annexe 288.*

[48]SHD, 24N741; *« Le Général de Lobit comt la 34 DI à M. le Général cdt la 17e CA »*, 12 June 1915.

[49]J Campana, *Les Progrès de l'artillerie: l'artillerie française pendant la guerre 1914–1918* (Paris: Imprimerie la Renaissance, 1923), p. 43.

[50]Porte, *La Mobilisation industrielle*, p. 63.

December.[51] Despite this measure (which was not at all out of line with pre-war theories of concentration) the artillery preparation was still woefully inadequate.[52]

The French simply did not have enough guns or shells to yet launch a successful attack against a well-defended trench network. As a stop-gap, increasing numbers of older guns (primarily de Bange) were being pressed into service, including the 58mm cannon, which would be one of the principal wire-cutting tools of the French in the early trench battles. These weapons, however, were not built for modern war, and had serious problems beyond their slow rate of fire. The 58mm was a notoriously inaccurate weapon; if it was not for its ability to fire 50kg shells in a high arc at close range (mortar-fashion) it would likely not have been put into field service. Firing in a controlled test environment 58mm crews were unable to put more than one in five shells within five metres of the intended target.[53] The inaccuracy of the 58mm cannon was exacerbated by a quirk in the manufacturing of 58mm shells whereby some shells had their fins welded on and others were bolted on. Shells with wings bolted on tended to lose those wings mid-flight, resulting in the shell landing on its side or rear and then failing to detonate.[54] Fully 25% of shells with bolted-on fins failed to detonate for this reason. This put strain on logistical networks to provide more shells to make up for the 'duds', and also made essential preparatory tasks, like wire-cutting, all the more difficult.

Despite the many technical and logistical difficulties with which the French contended in 1915, the year was full of important innovations. The truly complex nature of the problem facing any attacker in the war was understood by tactical commanders very quickly. Most celebrated among the 'early adopters' of artillery-centred warfare is Andre Laffargue. A young officer who had served in the Artois region, Laffargue wrote a widely-distributed pamphlet entitled *Étude sur l'attaque dans le période actuelle de la guerre: impressions et réflexions d'un commandant de compagnie* (called 'The Attack in Trench Warfare' in its English translation) in response to what he felt were the 'flagrant tactical failures' of the French army up to that point.[55] Read in all the major armies on the Western Front (copies were captured and translated by the Germans) the pamphlet set out a firepower-intensive vision of how offensive trench battles should be conducted, while also stressing caution to avoid

[51] AFGG, *Tome II*, p. 177-8.
[52]Marie-Émile Fayolle, *Cahiers secrets de la grande guerre* (Paris: Librairie Plon, 1964), p. 63.
[53]SHD, 22N163.
[54]SHD, 22N163.
[55]André Laffargue, *Étude sur l'attaque dans la période actuelle de la guerre: impressions et réflexions d'un commandant de compagnie* (Paris: Plon-Nourrit et Cie, 1916) [Note: I reference the 1916 edition here].

unnecessary infantry casualties. Laffargue gave artillery five key roles, most of which have to do with the destruction of enemy defences (he assigns separate roles for the destruction of barbed wire, trenches, and machine guns); the other two roles were counter-battery fire and the firing of a barrage to keep enemy reserves from joining the fight.[56] Laffargue argued persuasively that the French army needed more mortars, as they were the best weapons available for wire-cutting according to Laffargue, and also advocated better reconnaissance and maps.[57]

Despite Laffargue's reputation in the historiography, it would be best to consider his work for its implication (that the French army was becoming more tactically refined) rather than its impact. Pamphlets read are not pamphlets followed, and there is a dearth of evidence to support there being any actual effect of Laffargue's writing.[58] Furthermore, the ideas in Laffargue's pamphlet were not particularly new when he published them in Autumn 1915. His emphasis on the importance of mapping and reconnaissance had already been laboured by Philippe Pétain (who had also served in Artois).[59] Far worse, many of Laffargue's firepower-intensive recommendations were already official doctrine by Spring 1915; thus raising the possibility that Laffargue's pamphlet attacking French methodology was in fact inspired by existing French doctrine and methodology. What the historiography has seen up to now as a forward-looking cry in the wilderness by a desperate and intelligent young officer may well have been a simple act of plagiarism.

In April 1915 the French army produced its first broad doctrine on trench warfare. The doctrine places artillery in a privileged position, as Laffargue would go on to do, and insisted that artillery prepare attacks methodically.[60] The new doctrine assigned the artillery four roles (destruction of enemy defences, counter-battery fire, direct support of infantry attacks, and the bombardment of enemy soldiers), all of which broadly agree with the five roles that Laffargue would later propose. The importance of aerial reconnaissance was heavily stressed, as was adequate observation, reconnaissance, and mapping.[61] Infantry–artillery liaison, especially via telephone, is held up as essential for the effective employment of artillery. This is in stark contrast to the pre-war army which assigned only 500m of telephone wire to each battery (additional supplies were hurriedly purchased in Paris and Switzerland in the early

[56]Ibid., p. 8.
[57]Ibid., p. 47.
[58]Goya, *La Chair et l'acier*, p. 206; Griffith, *Battle Tactics on the Western Front*, p. 56 & Gudmundsson, *Stormtroop Tactics*, p. 173.
[59]SHD, 24N1991; *« Le Général Pétain, Commandant le 33e C.A. à Monsieur le Général Commandant la 10e Armée »*, 27 May 1915.
[60]SHD, 19N735; *« But et conditions d'une action offensive d'ensemble »*, 16 April 1915.
[61]SHD, 19N735; *« But et conditions d'une action offensive d'ensemble »*, 16 April 1915.

months of the war).[62] Heavy artillery and mortars are highlighted as the most important weapons for the destruction of enemy defences (especially barbed wire), while the 75 is given the bulk of the responsibility for engaging enemy infantry (through shrapnel barrages) and for counter-battery fire. In short, the French had managed to develop a fairly accurate understanding of the necessities of trench warfare within a few months of the solidification of the trench network along the Western Front.

In this new model for trench warfare the famed French 75 saw a reduction in its role on the battlefield. Partially this was due to unchangeable facts of the 75mm design: it would forever be too light, and fire shells at too flat a trajectory, to have a serious destructive impact against field fortifications. As such, the single most common French artillery piece could only be used in certain roles, such as the firing of barrages to hinder enemy movements or efforts at improving their trench network.[63] The importance of the 75 would arguably continue to diminish as the war progressed, making way for the dominance of heavy artillery and mortars in the larger, later battles of the war. Even traditional field-artillery roles, such as direct-fire support, were being eroded by light mortars (like the British Stokes mortar) and other trench guns, especially the 37mm.[64] Nevertheless, the 75 did have serious contributions to make in the two most transformative artillery developments in 1915: the rolling barrage and the delivery of asphyxiating gas shells.

The rolling barrage was one of the most important artillery procedures in the First World War. In effect, a rolling barrage was an artillery barrage (a wall of fire and steel created by shrapnel or high-explosive shells) which would advance at a set pace in order to provide a protective curtain for advancing infantry. Its use was a crucial means of suppressing enemy infantry, allowing advancing troops to cross the killing zone with minimal small-arms interference. In theory, advancing troops would be able to reach an enemy trench before its would-be defenders had time to emerge from their deep dugouts. The close-range fighting that would ensue would strongly favour the attackers, especially if they were armed with sufficient grenades for engaging enemy troops still emerging from underground shelters.

Historians cannot, and probably never will, agree on when the very first rolling barrage was fired; most, however, agree that it was used within the first year of

[62]Goya, *Le Processus d'évolution tactique*, p. 232.
[63]SHD, 16N2095; *« Recherche de la permanence de réglages de l'artillerie »*, 14 July 1916.
[64]Ibid., *« Le Canon de 75 est par excellence le canon d'accompagnement de l'infanterie ».*

trench warfare on the Western Front.[65] Its first inclusion in a grand work of French doctrine is easier (and potentially more important) to pinpoint. In the new trench warfare doctrine issued in April 1915 the rolling barrage is very clearly established as the standard procedure for any serious infantry attack: 'at the hour fixed for the infantry attack the artillery will increase its range *progressively* to make, in front and on the flanks of the attack, a longitudinal and transversal barrage to shelter the infantry so they can advance'.[66] That this fundamental trench tactic, which is frequently cited as first appearing in Autumn 1915, was elucidated as a key and basic aspect of French doctrine after a mere five months of trench warfare warrants a rethinking of the timeline along which Allied innovation and adaptation in the trenches took place.

To illustrate the level of refinement achieved in rolling barrages in 1915 let us consider one early example. On 9 May 1915, 77e *Division d'Infanterie* (DI), part of Philippe Pétain's XXXIII *Corps d'armée* (CA), fired one of the more successful barrages of the year. Starting at H-hour (10.00) the barrage rolled forward for ten minutes before resting at *ouvrage 123* (a trench-work noted on divisional maps).[67] Here the barrage waited for a sign from the infantry to show that they too had reached *ouvrage 123*, and were ready to continue their attack. In doing so, it prevented the barrage from advancing too far beyond the advancing infantry, and also gave the artillery a chance to roll back the barrage to support the infantry if the attack stalled. The infantry, thanks to a detailed artillery preparation and well-paced rolling barrage, reached *ouvrage 123* without meeting much organized resistance, and signalled their readiness to continue. As the barrage moved on from *ouvrage 123* it fanned out towards the division's different objectives. Arguably it did so too slowly (the division suffered vicious enemy flanking fire while advancing over open country behind the barrage). Nevertheless, it was a crucial aspect of the division's attack which won some four kilometres of ground, 600 prisoners, and a handful of German machine guns and heavy artillery.[68]

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[65]Doughty, *Pyrrhic* Victory, p. 194; Goya, *La Chair et l'acier*, p. 190; Strong & Marble, *Artillery in the Great War*, p. 70.

[66]SHD, 19N735 *« But et conditions d'une action offensive d'ensemble »*, 16 April 1915*; « À l'heure fixée pour l'attaque de l'infanterie, l'artillerie allonge progressivement son tir, pour faire, en avant et sur les flancs de l'attaque, un barrage longitudinal et transversal à l'abri duquel l'infanterie peut progresser ».*

[67]SHD, 25N172; *« Emploi et rôle de l'artillerie dans la zone de la DIVISION »*, 5 May 1915.

[68]SHD, 22N1832; *« Compte-rendu sommaire des opérations de la 77e division pendant les journées des 9, 10, & 11 Mai ».*

Equally important to the development of the rolling barrage was the development of artillery-delivered poison gas. After the Germans made the first successful asphyxiating gas attack on 22 April 1915 the Allies were anxious to retaliate. The British would pin their hopes on an emulative gas attack (utilising a cloud of chlorine gas) during the battle of Loos on 25 September. The French asphyxiating gas programme, which had existed since January 1915, took a different path.[69] The French examined the utility of chlorine clouds after Second Ypres, even to the point of making an organisation and doctrine for so-called 'Z companies' to deploy the gas, but were unable to source enough chlorine to actually launch such an attack.[70] Even if enough chlorine had been on hand the French had a severe shortage of gas masks, which precluded infantry from advancing into the gassed area. As an alternative, the French began to experiment with delivering gas via artillery from May 1915.

The delivery system which first found its way into use was a 75mm shell filled with a mixture of carbon disulphide (CS2) and phosphorus.[71] This shell was not only asphyxiating but also incendiary (courtesy of the phosphorus), and produced prodigious quantities of smoke; attributes that combined to make it a potentially very effective counter-battery weapon. 10,000 CS2/P shells were produced in quick order (with a further 40,000 being ordered on 31 May), and on 10 June were being rushed to the front to be tested against the enemy. There would be no time for training artillery crews in the proper use of these new shells as the French were at that time in the final stages of preparing a renewed general offensive in the Artois region. Instead, instructions were simply sent forward with them detailing their proposed use. The instructions from GQG were that the shells were best used against fixed and flammable defences in the German rear areas. One Thousand shells would need to be delivered quickly in order to inundate one hectare of terrain with enough gas to have an effect.[72] This necessitated spreading the shells out amongst 75mm batteries to keep any one battery from having too great a load; the shells were highly unstable and GQG wanted to minimize the risk of gas being unleashed on friendly troops as a result of an untimely barrel rupture.

The shells were first used on 16 June by IX, XX, and XXXIII CAs serving under Tenth Army, part of the *Groupe provisoire du nord* commanded by Foch. While the incendiary effects were far weaker than had been hoped (fires had been set in

[69]SHD, 16N826; *« Rapport sur l'organisation du service du matériel chimique de guerre, présenté par M. D'Aubigny, Depute »*, 25 August 1915.
[70]SHD, 16N826; *« NOTICE sue la procède d'émission de gaz asphyxiant au moyen des appareils système Z 2 et sur l'organisation es compagnies des sapeurs chargés de la mise en œuvre de ces appareils »*, *Ministère de la Guerre.*
[71]SHD, 16N707; *« Compte-rendu du 14 Mai 1915 »*, *GQG.*
[72]SHD, 16N707; *« Note pour la D.A. »*, 9 June 1915.

Angres, but apparently nowhere else), the overall effect of the shells had exceeded expectations.[73] Fired primarily against known concentrations of enemy batteries, the launch of gas shells silenced German artillery for an hour-and-a-half across the front of XX CA, and seriously weakened the German artillery activity before IX CA.[74] Used again on 17 June, the gas shells produced much the same effect, a silencing of the targeted batteries. Within a week-and-a-half reports of these astounding results had reached the War Ministry where they were well received. Plans were immediately put into effect to vastly expand the use of poison gas shells by the French army, especially for the counter-battery role in which they had proven so effective. By the end of 1916, 25% of all French shells produced would be for the delivery of poison gas; these shells formed a cornerstone of French artillery fire for the rest of the war.

French artillery also improved its defensive policies.[75] Joffre's 1914 decree that artillery do more to hide its presence from German aircraft was expanded upon, and local corps and divisional commanders worked hard to ensure that their troops did not reveal too much to the Germans.[76] Batteries were encouraged to move frequently between various pre-prepared emplacements, thus making them harder to detect and engage by the Germans.[77] This suggestion was made along with the idea that batteries needed to keep better records on their target registration so that batteries could inherit an emplacement and not have to begin their registration from scratch as they would have pre-existing data to rely on. After the French successes with poison gas as a counter-battery weapon GQG recognized the importance of supplying French *artilleurs* with protection from gas to keep French batteries operational during battle.[78] French artillery also worked to improve its defensive fire plans, emulating the Germans' use of pre-sited artillery barrages to disrupt German attacks.[79] Despite these and other French artillery refinements there were still certain problems which proved very difficult to solve.

Enduring Challenges

While the advances made in the early stages of the war were impressive, they still required extensive refining before they became the war-winning methodologies of

[73]SHD, 16N707; *« Compte-rendu au sujet des obus spéciaux de 75 »*, 23 June 1915.
[74]SHD, 22N573; *« Compte-rendu de la Journée du 16 », 17e DI.*
[75]Dubois, *L'Artillerie de campagne dans la guerre actuelle,* p. 132.
[76]SHD, 22N1472; *« Le Général Maistre commandant le 21e corps d'armée à M. toutes les autorités »*, 30 May 1915.
[77]SHD, 16N2095; *« Note aux Ccommandants de groupe d' armées sur l'utilisation de l'artillerie », GQG, 3e Bureau*, 30 July 1915.
[78]Ibid.
[79]Dubois, *L'Artillerie de campagne dans la guerre actuelle,* p. 215.

1918. Technical problems posed by obsolescent weapons could never be overcome; the French would have to wait for the production of modern, quick-firing heavy artillery like the Rimailho 155mm *court tir rapide*. Not until such weapons were in abundance could the French consider reducing their extended artillery preparations (sometimes lasting a week or more) before every attack.[80] Likewise the problems posed by German counter-barrages, which were instrumental in halting French attacks in 1915, could not be easily solved, even with an extensive use of gas shells. As the Germans could fire pre-sited barrages against advancing French infantry their guns were able to remain silent (and therefore hidden) right up to the moment of attack. Pétain's suggestion at the time was to use aerial assets to methodically map and observe German rear areas, and for counter-battery fire to be a better managed *longue durée* operation.[81] While counter-battery was already a routine activity, Pétain felt that too much was left to inaccurate reactionary barrages fired on the day of an attack when hidden German batteries suddenly began pouring fire into advancing *poilus*. As time progressed the French would get better at counter-battery fire, both in the long and short term. By 1917 then commander-in-chief Robert Nivelle would write that aircraft were essential for effective counter-battery fire in real time with one aircraft flying for two hours being able to facilitate the neutralisation of up to four enemy batteries.[82] Such a feat was simply impossible in the early trench battles.

Aerial reconnaissance and observation was a crucial component of Allied efforts. It was only from the sky that secondary German trench systems (frequently sited on reverse slopes, which made them incredibly difficult to hit) could usually be observed. General Marie=Émile Fayolle wrote in his diary 'as for taking many successive lines, those which we cannot see will be intact'; successful attacks relied on the accurate bombardment of these secondary German positions.[83] Using aircraft to direct artillery fire, however, was very difficult. Aircraft could not do this if there was a great deal of artillery action on both sides: the job became too dangerous and observation too difficult. Aircraft could be fitted with wireless (*télégraphie sans fil*, or TSF), but did not have enough power to house transmission and reception units: planes could only send information.[84] The ground-based receivers were unwieldy and were best kept in one place, meaning that they could only service batteries cited

[80]Palat, *La Grande guerre sur le front occidental*, p. 237.
[81]SHD, 24N1991; *« Le Général Pétain, commandant le 33e C.A. à monsieur le général commandant la 10e armée »*, 27 May 1915.
[82]SHD, 16N2095; *« Note sur l'emploi de l'aviation en liaison avec le A.L.A. pendant les dernières opérations sur le front de V armée »*, 5 May 1917*; no. 2.*
[83]Fayolle, *Cahiers secrets de la grande guerre*, p. 98; *« Quant à emporter les lignes successives, dont plusieurs, celles qu'on ne voit pas, seront intactes ».*
[84]SHD, 19N1686; *« Instruction sur l'emploi des avions munis de TSF dans la situation actuelle »*, *X Armée*, 30 April 1915.

closely together. Signalling, therefore, was largely visual, which meant that it easily suffered from misinterpretation, if the signals were seen at all.

Photography proved to be one of the best means by which aircraft could assist in tracking the development (or destruction) of enemy positions.[85] While aerial photography became a cornerstone of the wider Allied artillery efforts, it remained open to misinterpretation. Pilots might have vastly differing opinions on the state of German trenches, creating an air of uncertainty about artillery preparations.[86] Balloons offered certain advantages to fixed-wing aircraft, not the least of them being speed and clarity of communication. Balloons, however, were highly vulnerable, and could not easily observe secondary German trench networks. There was no perfect answer to the Allies' general lack of good terrestrial observation; on the western front battlefields from 1915 to 1917, the First World War was a war fought for observation posts (ridges) as much as anything.

Of course the German defensive network was not static; it was ever evolving and improving to counter Allied improvements in offensive methodology. The Germans, like the French, started off with a largely improvised trench network in late 1914. Many parts of the front were poorly organised, as lines were dug based on the random chance of battle, rather than a rational assessment of the needs of the German army.[87] This quickly changed. By mid-1915 the Germans began to take their trench defences much more seriously.[88] Secondary positions were dug, and made as strong as their forward positions, to ensure that the Allies would not be able to 'breakthrough' the German trench line out into the open. The German trench systems were progressively moulded to lie on reverse slopes and to lure Allied attackers into pre-determined fields of fire.[89] German artillery made extensive efforts to assist in breaking up the coherence of any attack with pre-planned counter-barrages. Small Allied improvements in methodology were quickly met with German counter-measures. After the French proved the value of advancing above trenches

[85]SHD, 19N1686; *« Note résultat de l'étude des photographie prises en avion », 58th DI, 21e CA, X Armée*, 1 May 1915.
[86]SHD, 24N741; *« Compte-rendu, observateur aux tranchées = Dubois (3e Groupe, 23e artillerie) »,* 1 June 1915.
[87]Robert T Foley, *German Strategy and the Path to Verdun: Erich Von Falkenhayn and the Development of Attrition, 1874–1916* (Cambridge: CUP, 2005) p. 163.
[88]Jean-Claude Laparra, *La Machine à aaincre, de l'espoir à la désillusion: Histoire de l'armée allemande, 1914–1918* (Mercuès: Imprimerie France Quercy, 2006), p. 121; Jack Sheldon, *The German Army on the Somme 1914–1916* (Barnsley: Pen & Sword Books Limited, 2005), p. 66.
[89]Pascal Marie Henri Lucas, *L'Evolution des idées tactiques en France et en Allemagne pendant la guerre de 1914–1918* (Paris: Berger-Levrault, third edition, 1925), p. 76.

rather than through them (to avoid slowing the impetus of the attack by forcing infantry through narrow German communication trenches) the Germans began to line even their communication trenches with barbed wire to make it difficult for French infantry advancing over the top to return to the trench network.[90] It was this war of constant innovation between the Allies and the Germans that produced the stalemate on the Western Front, not a lack of imagination.

The lessons and procedures learned in the early months of trench warfare continued to be refined as the war progressed. Artillery bombardments became increasingly scientific, and came to rely on sophisticated mathematics as indirect fire became commonplace (whether the target was behind a reverse slope, the battery was in defilade, or both).[91] Of course, the mathematical skills of French artillerymen varied. Nevertheless they were expected from 1916 to be able to calculate the effects of atmospheric conditions on artillery fire, among other common range and accuracy modifiers.[92] By 1916 French officers began to write about a more precise employment of artillery, rather than hoping for an increased mass of munitions. While in command of Sixth Army during the Battle of the Somme Fayolle implored his artillery to prioritise accuracy (saying that 1,000 shells will have no effect if not fired on a clear target), and also encouraged his artillery to aim for the neutralization of enemy trenches, rather than their outright destruction.[93] This shift from destruction to neutralisation was a necessity. The French could never produce enough shells to absolutely flatten the entire German front. What shells the French had, needed to be applied carefully and precisely in order to maximise the return on each shell fired. To facilitate this, observation moved from the vicinity of the battery to forward posts which increased infantry morale and yielded better results.

Artillery doctrine also continued to be refined. In April 1916, in anticipation of the coming Somme offensive, Foch produced a substantial work of doctrine for his *Groupe d'armées du nord* called *La bataille offensive* ('Offensive Battle'). In this work Foch claimed to be 'adapting' various GQG instructions to better fit 'current circumstances'.[94] *La Bataille offensive* elucidates the situation facing the Allies: a lengthy war which must be fought methodically if it is to be won. The nature of this war meant making 'larger and larger demands on our artillery, which alone is capable

[90]Barthélemy Edmond Palat, *Les Grandes batailles de la guerre : Les Batailles d'Artois et de Champagne, 1915* (Paris : Chapelot, 1927), p. 127.
[91]Dubois, *L'Artillerie de campagne dans la guerre actuelle*, p. 17.
[92]SHD, 16N2095; *« Recherche de la permanence de réglages de l'artillerie »*, 14 July 1916.
[93]SHD, 16N2095; *« Note sur le préparation par l'artillerie »*, 28 September 1916; no. 18
[94]SHD, 18N148; *« La Bataille offensive », Groupe d'armées du nord*, 20 April 1916.

of destroying enemy defences'.[95] Infantry were reduced to a secondary role; to be used only in limited numbers in order to avoid heavy casualties. Foch wrote that 'the artillery preparation is the definitive measure of infantry possibilities'; these possibilities were limited to advances of two to four kilometres in a single bound, according to Foch.[96] This being the case, battles needed to be thought of as 'operations' (although that word is not used). Thus, a series of small, artillery-dominated battles would be fought in succession to achieve a strategic aim. Ideas dating back to the writing of Langlois are brought up to explain the primacy of artillery on the battlefields of the ongoing war, including its ability to concentrate overwhelming fire. Furthermore, artillery could be used much more regularly and for a longer period of time before wearing out; infantry seemed to rapidly melt away once exposed to the war machine of earth, steel, and high explosives.[97]

This is an articulation of the artillery war that would survive through to 1918. While improvements would still be made on the tactical and technical sides of artillery (the 1917 doctrine *Instruction sur le tir d'artillerie* was comprehensive regarding trench warfare; it was less effective for the war of movement in 1918), a clear conceptualisation of how artillery was going to be used in the First World War had emerged by early 1916.[98] This was a great feat of adaptation and innovation. The French army in 1914 had found itself in a war it was not truly prepared to fight, with weapons largely ill-suited to the task. This state of unpreparedness and unfamiliarity was turned around far more quickly than anyone might have expected. While the French would struggle in many of their operations in 1915, they ultimately mastered the complexities of industrial warfare from 1916 onwards. New technology, from poison gas to aeroplanes, were mastered and integrated into the French tactical–operational system. New procedures like the rolling barrage were quickly hit upon and formed a cornerstone of all offensive manoeuvres from early 1915 onwards. An understanding of this rapid and astonishing transformation is central to any understanding of the great dynamism which thrived on the Western Front.

[95]Ibid.; *« Ceci implique un appel de plus en plus grand à notre artillerie, qui est seule capable de la destruction des organisations ennemies ».*
[96]Ibid.; *« La préparation par l'artillerie est en définitive la mesure des possibilités de l'infanterie. ».*
[97]Ibid.
[98]SHD, 16N2095; *« Observations sur diverses instructions du G.Q.G. »*, 29 June 1918.

The Introduction of New German Defensive Tactics in 1916–1917

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ABSTRACT
Responding to the crisis posed by the battle of the Somme, in late 1916 the German army introduced new defensive tactics. It has been suggested that formal, top-down doctrine was a less important driver of this change than the bottom-up system of after-action reports, and that once initial resistance was overcome the new tactics were successfully adopted throughout the army. This article draws on little-studied archival material to reveal how doctrine evolved by stages in a complex combination of action, after-action reports, personalities and the high command's desire to impose greater top-down control. Throughout this period, doctrine remained key to tactical change, but its implementation was patchier than the German army's reputation suggests.

Introduction

The crisis of the battle of the Somme forced the German army to introduce new tactics.[1] By the start of the battle, German defensive methods had moved away from the pre-war system of establishing and holding one strong line. Doctrine issued in October 1915 called for the construction of at least two positions, far enough apart to force the enemy to mount a separate operation to attack each.[2] Experience at Verdun had indicated that manning the front thinly reduced casualties. However,

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[1]This section draws heavily on Robert T. Foley, 'Learning War's Lessons: The German Army and the Battle of the Somme 1916', *Journal of Military History*, 75/2 (2011), pp. 471-504. For a recent account of German tactical development, see Anthony Cowan, 'Genius for War? German Operational Command on the Western Front in Early 1917', Ph.D. thesis (King's College London, 2016), Chap. 7.
[2]Bundesarchiv-Militärarchiv (BA/MA), PHD7/1, OHL circular, '*Gesichtspunkte für den Stellungskrieg*', Nr. 7563 r., October 1915, pp. 2-3.

General Fritz von Below, commanding the main Army fighting the battle of the Somme, insisted on defending the front line to the death if need be, and on counterattacking to regain any ground lost.[3] With these tactics the Germans indeed prevented an Entente breakthrough, but at great cost. Some senior officers complained that the casualties incurred were out of all proportion to the successful defence or recapture of the ground concerned.[4] The German army was able partially to reverse the initial Entente superiority in the artillery–infantry–aviation combined-arms battle, but problems remained.

The stress of the battle led to changes at the operational (as we would now call it) and tactical levels. On average, infantry divisions had to be relieved after two weeks of fighting. In late August a self-standing Army Group Rupprecht was established, mainly to handle the flow of reserves needed for these reliefs. The constant movement of divisions also led to changes in the control of the battle. The German army had gone to war with the corps, a formation of two divisions, as its main battle unit. The frequent divisional reliefs made this system unworkable, and the fixed link between corps and divisions was broken. Corps headquarters increasingly became static controllers of *Gruppen* [Groups] through which divisions rotated. Divisions became responsible for the close and short-term battle. But they could not handle the deep battle, or the long-term co-ordination of the defensive structure needed for their sectors. *Gruppen* provided continuity in space and time by running the local framework of fixed defences, supporting arms – especially extra artillery and aviation forces – and supply networks into which the divisions fitted.

Tactical changes included the gradual shift from prepared defences, which were too easily located and destroyed, to improvised shell-hole positions. Most units welcomed this change as restoring their initiative and saving casualties. Others disliked it because it complicated artillery support, co-ordination with neighbouring units and control. As the battle continued, increased emphasis was placed on thinning the front-line garrison, defence in depth and retaining sufficient strength for counterattacks. An immediate counterattack [*Gegenstoß*] was to be made by any troops available before the enemy had consolidated after their initial assault. If this failed, a prepared counterattack [*Gegenangriff*] should be made. It proved necessary to reissue 1915 guidance that a *Gegenangriff* should only be undertaken if the ground lost was tactically important; and that enough time must be allocated for proper preparation.

[3]Hauptstaatsarchiv Stuttgart (HSAS), M660/038 Bü 16, Second Army order, Ia Nr. 575 geh., 3 July 1916 and First Army order, Ia Nr. 1438 geh., 22 October 1916.
[4]Jakob Jung, *Max von Gallwitz (1854–1937): General und Politiker* (Osnabrück: Biblio Verlag, 1995), pp. 74-5, quoting senior Bavarian officers.

Operational and tactical adaptation enabled the German army to survive the Entente offensive on the Somme, but by the end of 1916 it was in a bad way. It had suffered some 1.2 million casualties during the year and a total of nearly four million since the beginning of the war. Following a number of failures by divisions, OHL [*Oberste Heeresleitung*, Supreme Army Command] became concerned about the army's declining quality: in November it called for regular assessments of the battle-worthiness of every division.[5]

Developing and Implementing New Doctrine

Robert T. Foley has suggested that circulation of unit after-action reports [*Erfahrungsberichte*] was the main driver of tactical change at this period.[6] The German army had originally developed this system in peacetime to draw lessons from manoeuvres.[7] Given the advantages of speed and immediacy, the system developed extensively, and during the battle of the Somme it was indeed the main means of making relevant experience broadly available. There was, however, an obvious drawback. As we saw, divisions might have different views on an issue. Circulating these views made a wide range of experience available, but also risked sowing confusion and complicating co-ordination of the battle. The declining level of expertise in divisional staffs aggravated this problem.

One partial solution was mediation of such differences by the various levels of command above the division. Although no longer responsible for direct control of the battle, *Gruppe* commanders did oversee training of divisions in their areas. First Army, handling the most active part of the Somme front, issued incoming divisions with folders containing standing orders on tactics and administration; each order had a reference number and could easily be replaced by an updated version. The Army commander or chief of staff supplemented these orders with oral briefing on arrival.[8] General Max von Gallwitz, an army group commander on the Somme in July and August, passed on the experience he had just gained from several months at Verdun.[9]

[5]Cowan, 'Genius for War?', pp. 44-46.
[6]Foley, 'Learning War's Lessons', p. 504.
[7]Christian Stachelbeck, '"Lessons learned" in WWI: The German Army, Vimy Ridge and the Elastic Defence in Depth in 1917', *Journal of Military and Strategic Studies*, 18/2 (2017), p. 127.
[8]Generallandesarchiv Karlsruhe (GLAK), 456 F1/525, First Army report, '*Erfahrungen der 1. Armee in der Sommeschlacht 1916. I: Taktischer Teil*', 10 (hereafter '*Erfahrungen der 1. Armee*'). HSAS, M660/038 Bü 16 has examples of the Army's orders.
[9]Foley, 'Learning War's Lessons', p. 481, n. 32.

But despite such efforts disagreements on tactics continued. Some of them, especially on a less rigid form of defence, emerged at an important conference of senior staff officers held by Hindenburg and Ludendorff in early September, shortly after they took command at OHL. Later in the month, OHL issued interim instructions as a temporary measure to bridge the differences of opinion. These stressed holding the front thinly and defending it by counterattack and defence in depth. They also emphasised the need for counter-battery work, while avoiding the linked but thorny question of control of heavy artillery. Army Group Rupprecht reported in late September that First and Second Armies had different approaches to this, the former centralising heavy artillery control on *Gruppen*, the latter devolving it to divisions. Views differed too on how to handle defence in depth and the two forms of counterattack.[10]

In order to eliminate the damaging friction caused by these continuing disagreements and to ensure uniform training of commanders and units, OHL pushed forward a large-scale revision of defensive doctrine. This did not emerge from a vacuum. Even before Hindenburg and Ludendorff arrived, OHL had begun to supplement and update the doctrine issued in October 1915 with a new series of manuals entitled 'Regulations for trench warfare for all arms' [*Vorschriften für den Stellungskrieg für alle Waffen*]. Under Hindenburg and Ludendorff, OHL expanded the series. It was intended to contain all the information needed to understand the different arms of service and all-arms co-operation. By the start of the spring battles in April 1917, manuals had been published or updated covering command in trench warfare, construction of field defences, infantry and artillery co-operation with aircraft, communications, trench mortars and close combat weapons.[11]

The most important of these manuals were Part 8 in the series, 'Principles for the conduct of the defensive battle in trench warfare' [*Grundsätze für die Führung in der Abwehrschlacht im Stellungskrieg*, hereafter 'Defensive battle'], issued on 1 December 1916; and to a lesser extent Part 1a, 'General principles of field fortifications' [*Allgemeines über Stellungsbau*] of 13 November, a revision of an earlier manual. Three further editions of 'Defensive battle' were issued, in March and September 1917 and again in September 1918, as well as a 'Special manual' [*Sonderheft*] in June 1917 and numerous other amendments. 'Field fortifications' was updated in August 1917 and August 1918.

[10]Reichsarchiv, *Der Weltkrieg 1914 bis 1918: Die militärischen Operationen zu Lande*, Vol. XII: *Die Kriegführung im Frühjahr 1917* (Berlin: E.S. Mittler, 1939), pp. 29 and 32-37.

[11]*Weltkrieg*, XII, pp. 38-39; BA/MA, PH3/28, folio [f.] 22, OHL to Third Army, II Nr. 38642 op., 3 November 1916 and Bauer to Army Group Crown Prince, 13 November 1916.

The issuing of successive editions of 'Defensive battle' is important, because scholars have not always sufficiently recognised the major differences between them. This has tended to give the impression of tactical development which after initial resistance was smoother and more uniformly accepted in the army than was actually the case. It also blurs the gap between doctrine and what happened in reality. For instance, G. C. Wynne cited many specialised defensive terms in the opening discussion of the new tactics in his influential *If Germany Attacks*, but very few appear in the first or second edition of 'Defensive battle'.[12]

Tactical experts and historians regard 'Defensive battle' as a turning point, so it is odd that none have worked on the actual first edition of December 1916. The officer who produced a research paper comparing different editions of 'Defensive battle' for the central German military history organisation, the *Reichsarchiv*, was unable to find a copy of the first edition. He relied instead on a draft written by General Maximilian Ritter von Höhn, one of the officers involved in drawing up the new doctrine. The German official history '*Weltkrieg*' based its description of 'Defensive battle' on the second edition of March 1917.[13] Anglophone scholars have relied on this edition too as it was the first to be captured and translated by the British.[14]

At least one copy of the first edition does in fact exist.[15] By comparing this with the *Reichsarchiv* research paper and the second edition, we can examine the evolution of doctrine in some detail. Work on the first edition began in September 1916 under the direction of *Oberstleutnant* [Lieutenant-Colonel] Max Bauer of OHL. '*Weltkrieg*' gives most of the credit for producing the final draft to his subordinate *Hauptmann* [Captain] Hermann Geyer, adding that Höhn had played a temporary role as a consultant. Bauer himself accorded Höhn a larger role since he had written the text which provided the basis for the final document.[16]

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[12]G. C. Wynne, *If Germany Attacks: the Battle in Depth in the West* (Brighton: Tom Donovan, 2008; first edition London: Faber, 1940), pp. 102-109.

[13]BA/MA, RH61/291, Oberstleutnant Engelmann unpublished research paper, '*Grundsätze für die Führung in der Abwehrschlacht im Stellungskriege*', n.d., p. 1 (hereafter 'Engelmann paper'); *Weltkrieg*, XII, p. 38.

[14]General Staff (Intelligence), *SS. 561: The Principles of Command in the Defensive Battle in Position Warfare* (Army Printing and Stationery Service, 1917).

[15]HSAS, M660/037 Bü 44, Chef des Generalstabes des Feldheeres, *Vorschriften für den Stellungskrieg für alle Waffen. Teil 8: Grundsätze für die Führung in der Abwehrschlacht im Stellungskriege. Vom 1. Dezember 1916*, (hereafter '*Abwehrschlacht*', December 1916).

[16]*Weltkrieg*, XII, p. 32 fn. 2; Oberst Bauer, *Der große Krieg in Feld und Heimat*, 3rd edition, (Tübingen: Osiander'sche Buchhandlung, 1922), pp. 118-119.

Höhn's involvement is important in understanding the dynamics of the drafting process. He was a field artillery officer in the Bavarian army, with experience of commanding heavy artillery. Having trained as a general staff officer, he was posted twice to the Great General Staff in Berlin. He commanded 6th Bavarian Infantry Division from 1913 to early 1915 and then became Third Army Chief of Staff. He was well thought of, and had an ability to process and apply lessons learned. He was removed from his Third Army post in September 1915 after recommending withdrawal in the initial stages of the French offensive. The Army commander thought he had been scapegoated.[17] Höhn's next appointment, as commander of 2nd Guard Infantry Division, bears this out: for a Bavarian to command a Prussian Guard division was a unique distinction.[18] In summer 1916 he took command of 6th Bavarian Infantry Division again and led it through both Verdun and the Somme. The division was heavily engaged when on 25 September Höhn was urgently summoned to OHL, initially simply to discuss artillery–air force co-operation.[19]

Höhn's secondment to OHL at this critical moment is one sign of the importance attached to drafting the new manual. His experience and strengths clearly qualified him for this work. OHL presumably hoped he would lend credibility to the process. Bauer and Geyer had little combat experience, and there was a danger that the manual would be seen as mere theory; there would shortly be mutterings about the young theoreticians around Ludendorff and the excessive paperwork they caused.[20] The German army prided itself on its practical approach to problem-solving: 'Situations which arise in war are so varied and change so quickly that it is impossible to lay down binding rules… Formulas fail'.[21] OHL may well have seen Höhn's up-to-date experience commanding a division as a way of selling the new doctrine to other senior officers.

Although we do not have a copy of Höhn's draft, we can deduce its overall thrust from the *Reichsarchiv* study. The draft contained all the basics of what we now know variously as mobile defence, elastic defence or defence in depth (though these terms

[17]Generaloberst von Einem, *Erinnerungen eines Soldaten 1854–1933* (Leipzig: K.F. Koehler, 1933), pp. 182 and 185.
[18]Fritz von Loßberg, *Meine Tätigkeit im Weltkriege 1914–1918* (Berlin: E.S. Mittler, 1939), p. 167.
[19]Bayerische Hauptstaatsarchiv Abteilung IV: Kriegsarchiv, München (KAM), HGr. Rupprecht neue Nr. 31, OHL to Army Group Rupprecht, 2 No. 35708 op., 25 September 1917.
[20]Max von Gallwitz, *Erleben im Westen, 1914–1918* (Berlin: E.S. Mittler, 1932), p. 158.
[21]Kriegsministerium, *D.V.E. Nr. 53. Grundzüge der höheren Truppenführung vom 1. Januar 1910* (Berlin: Reichsdruckerei, 1913), p. 9.

do not occur in the first two editions of 'Defensive battle'). The main points were that the division assumed tactical control of the all-arms battle, which was to be fought around rather than in the front line. The forward lines were to be thinly manned, and defence was to be in depth. Temporary withdrawal from the forward lines was permissible provided that by the end of the battle the original positions had been recaptured. If positions had been lost, commanders should consider whether recapturing them was worth the cost in men and matériel. The divisional artillery commander assumed control of all artillery allocated to the division.

The finalised first edition of 'Defensive battle' included all these points but added further explanation. It also gave more explicit instructions on conducting the infantry battle and on artillery fire. Importantly, unlike Höhn's draft it described in detail the role and operations of the air force; it added new sections on training, railways and roads; and it gave a fuller description of logistics. Two significant points emerge from this analysis. First, whereas Höhn's draft was in effect a traditional operational manual, the finalised edition was an instruction on how to conduct modern defensive battle. Second, although commentators at the time and present-day writers describe the resulting tactics as new, both Höhn's draft and 'Defensive battle' show much continuity with what had gone before. The October 1915 instructions had begun the stress on deployment in depth.[22] Above all, ideas on mobile battle and artillery organisation had evolved steadily during the Somme. 'Defensive battle' was new doctrine in the sense that there had been no agreed principles on how to conduct such a battle. We should therefore see it as codification of existing practice rather than a radically new departure. It was also new in that its focus was on the all-arms battle at divisional level. The pre-war army was well aware of the principle of all-arms battle, but no specific regulations on it had been issued nor had it been adequately instilled by training.[23]

Units were soon referring to 'Defensive battle' to explain, simplify and supplement their orders.[24] However there was also resistance to the new tactics. Hindenburg later explained the risk in making tactical changes during war. There was the usual problem of overcoming conservatism and misunderstanding which made even peacetime changes problematic; in addition the more flexible tactics placed heavier demands on the courage and skill of the troops, at a time when the quality of the

[22]BA/MA, PHD7/1, OHL circular, '*Erfahrungen aus den letzten Kämpfen*', Nr. 17411 Op., [n.d.], p. 26.
[23]Hew Strachan, *The First World War*, Vol. I: *To Arms* (Oxford: Oxford University Press, 2003), pp. 238-239.
[24]GLAK, 456 F1/374, Seventh Army to its Gruppen, '*Vorbereitungen für die Abwehrschlacht*', Ia Nr. 155/Dez. 16, 28 December 1916.

army had declined.[25] Ludendorff described a furious controversy in OHL over precisely this point. When he visited Western Front headquarters in mid-January 1917, he found that in general 'Defensive battle' was warmly welcomed but that the section on withdrawal was disputed. Resistance by senior officers to the more mobile infantry defence was significant enough to be mentioned in '*Weltkrieg*'.[26]

Two of the main resisters were Fritz von Below and *Oberst* [Colonel] Fritz von Loßberg. As commander and chief of staff of First Army, which had been in the most active area of the Somme battle, they had the latest army-level experience of defensive battle. Their views could therefore not be ignored, and OHL circulated their after-action report in January 1917. Much of it agreed with 'Defensive battle'. But in the important area of temporary withdrawal from the front line, the two documents directly contradicted each other, with First Army repeating its Somme order that defenders must resist to the death if need be.[27] Furthermore, the new regulations on infantry training issued in February 1917 also insisted that infantry squads were to hold out to the last man.[28]

So a major report and a new piece of doctrine both contradicted an important part of 'Defensive battle'. This contradiction has been seen as deliberate testing of 'Defensive battle' at Ludendorff's request, and a sign of the intellectual flexibility of the German army.[29] Just possibly it reflects the different levels of the two doctrinal manuals – 'Defensive battle' was for all-arms commanders at divisional level, the infantry regulations for that arm alone up to regimental level. By the end of the year, OHL was instructing that giving up ground where necessary was a concept for commanders only; troops should simply be told to prepare to hold it.[30] But in wartime circumstances when simplification of methods was a priority, the differences between 'Defensive battle', First Army's report and the infantry regulations were a

[25] Marshal von Hindenburg, *Out of my Life* (trans. F. A. Holt) (London: Cassell, 1920), pp. 262-263.
[26]General Erich Ludendorff, *My War Memories 1914–1918* (London: Hutchinson, 1919), p. 387; BA/MA, Geyer papers, RH61/924, f. 32, OHL memorandum, '*Gesamteindrücke der Westreise*', 21 January 1917; *Weltkrieg*, XII, p. 32.
[27]'*Erfahrungen der 1. Armee*', p. 63.
[28]Kriegsministerium, *Ausbildungsvorschrift für die Fußtruppen im Kriege (A.V.F.)* (Berlin: Reichsdruckerei, 1917), pp. 178 and 226.
[29]Foley, 'Learning War's Lessons', p. 503; Wynne, *If Germany Attacks*, p. 111.
[30]Jonathan Boff, *Winning and Losing on the Western Front: The British Third Army and the Defeat of Germany in 1918* (Cambridge: Cambridge University Press, 2012), p. 167.

potential source of doubt and confusion. Geyer later wrote that First Army's line on rigid defence had seriously impeded the German conduct of war.[31]

The other significant area of dispute was the devolution of control of the battle from corps to divisions, including the main responsibility for artillery. We know that among the resisters on artillery devolution were *Major* Georg Wetzell, head of OHL's operations section, and the commanders of Seventh Army and XIV Corps.[32] We do not know which other corps commanders resisted this devolution, but we can see striking personnel changes at this period. When Hindenburg and Ludendorff took over OHL in August 1916, 18 of the 40 corps commanders in place at the outbreak of war still held their original jobs. Between then and the opening of the Entente spring offensive in April 1917, 13 of them – one-third of the corps commanders on the Western Front – moved to other jobs or were sacked. We cannot tell if this was a deliberate clear-out, but the removal of so many of the original corps commanders was certainly convenient in terms of breaking any resistance to the new tactics.[33]

OHL knew that to make the new doctrine reality, it needed to be inculcated by training. Shortly after 'Defensive battle' was issued, OHL ordered the establishment of courses to test the tactics and to train the division-level officers who would implement them.[34] The first course was piloted by Army Group Rupprecht in February 1917. Soon after, a similar course was introduced in Army Group Crown Prince. Courses lasted for a week and consisted of classroom explanation with practical demonstrations on an exercise ground. 60–100 officers attended each course. They were mainly divisional and brigade-level commanders and staff officers from Western Front units; but officers from the Eastern Front, OHL, Ministry of War, the Navy and allied armies also attended.[35] The courses acted as a link between current practice and doctrine. Students were expressly encouraged to discuss their experiences and make proposals about the new tactics. Courses were adapted as experience accumulated. In particular, at about the time they started, the Germans captured a French order explaining the tactics of the forthcoming offensive. Teaching

[31]Matthias Strohn, *The German Army and the Defence of the Reich: Military Doctrine and the Conduct of the Defensive Battle, 1914–1939* (Cambridge: Cambridge University Press, 2011), p. 55.

[32]Bauer, *Der große Krieg*, p. 119; GLAK, 456 F1/374, Seventh Army to OHL, Ia Nr. 61, 10 December 1916; Gallwitz, *Erleben im Westen*, p. 152.

[33]Figures calculated from author's database.

[34]Otto von Moser, *Feldzugsaufzeichnungen 1914–1918 als Brigade-, Divisionskommandeur und als kommandierender General*, 3rd edition, (Stuttgart: Belser, 1928), p. 266.

[35]*Weltkrieg*, XII, p. 59; Moser, *Feldzugsaufzeichnungen*, pp. 271-276.

students how to defeat these then became the main subject on the course. OHL students, including Geyer, could keep up to date with best practice as they were developing doctrine.[36]

It is clear that these courses were important to OHL. In Army Group Rupprecht, a reinforced infantry division demonstrated the tactics. The choice of the first course leader, General Otto von Moser, was also significant. From his pre-war and wartime career, he had experience in explaining theory, commanding troops of different qualities in different situations and winning a recent defensive action on the Somme. Like Höhn he added credibility to the new doctrine and was soon given a corps command, a sign of high-level approval of his work.

Four courses had been held in the Army Group Rupprecht school by the opening of the Battle of Arras, and three in Army Group Crown Prince by the start of the Nivelle Offensive. 500–600 officers may have been trained by mid-April 1917. This output was impressive, but two questions arise about the practical effect of these courses by the time the Entente offensive began. First, the subject matter was complex and the courses short. Moser commented that the new defensive tactics placed much higher demands on divisional commanders, because they now carried the main responsibility for the battle. Many of them had only recently assumed command. They had previously led single-arm brigades, which tended to instil a certain narrowness of vision. Moser stressed during the courses that divisional commanders must constantly concern themselves with all-arms co-operation and training.[37] They were aided by their general staff officers, but there were concerns as to their lack of experience too.[38]

This leads to the second question: even assuming the students absorbed the course content, to what extent were they able to make use of their new knowledge in the short time before the Entente offensive began? The first course ended on 16

[36]HSAS, GU117 Bü 362, General Karl Ritter von Wenninger, '*Französisches Durchbruchs-Verfahren*', lecture to the fourth divisional command course in Valenciennes, 28 March–3 April 1917, p. 7, and '*Einleitender Vortrag des Kursleiters*', lecture to the fifth divisional command course in Valenciennes, 14–16 April 1917 (hereafter '*Einleitender Vortrag*'), pp. 2-4.

[37]Moser, *Feldzugsaufzeichnungen*, pp. 270-271. Christian Stachelbeck, *Militärische Effektivität im Ersten Weltkrieg: Die 11. Bayerische Infanteriedivision 1915 bis 1918* (Paderborn: Schöningh, 2010), p. 182 quotes a divisional commander and his general staff officer commenting that the material on the Army Group Crown Prince course was actually rather simple.

[38]Hermann von Kuhl, *Der deutsche Generalstab in Vorbereitung und Durchführung des Weltkrieges*, 2nd edition (Berlin: E.S. Mittler, 1920), p. 187.

February, and the bombardment for the battle of Arras began on 4 April, only seven weeks later. Subsequent courses had even less time before battle. Nor were they taking place in a vacuum. Fighting continued on the Somme in February. Even more important, preparation for and implementation of the withdrawal to the Hindenburg Line took up a great deal of mental energy and time until it was successfully completed on 18 March. Evidence from later in 1917 suggests that months after the courses began the new tactics were still not being completely implemented.

It was clear that the army would require considerable training if it was to adopt the new tactics successfully. OHL and army groups attempted to ensure that divisions got at least three weeks' training time.[39] But the same events which took up the attention of commanders as well as assignments to labour on defences and the severity of the winter all disrupted the programme. 50th Reserve Division reported that its training for the new tactics had been undesirably limited. 17th Reserve Division was still issuing orders based on the old tactics as late as 28 March, just two weeks before it faced the British attack at Arras.[40] At the other end of the scale, 3rd Bavarian Infantry Division had been practising automatic counterattacks for months. Three divisions had acted as demonstration units for the command courses, and a fourth had just started.[41] These stints were generally short but at least gave the divisions a practical understanding of the new tactics which they would shortly employ in battle. The official verdict was that a considerable number of divisions on the Western Front and a few of those arriving from the east did receive a block of three weeks for rest and training.[42] But there were clearly substantial differences between divisions.

On 1 March 1917, OHL issued an updated version of 'Defensive battle'. Its title called it a reprint of the December edition. But it included important changes and considerable extra detail, and was therefore actually a second edition. Input for its drafting came from teams of experienced officers and from Moser's command course. Moser's point about the inexperience of many divisional staffs in all-arms warfare may explain the extra length of the new edition. Much of this comprised added clarification of the principles involved. The edition included more guidance on how artillery and infantry should conduct the defence, with greater emphasis on immediate counterattacks. It was couched more in the form of orders than the

[39] *Weltkrieg*, XII, p. 55.
[40] KAM, AOK 6 Bd. 419, 50th Reserve Division, I Nr. 1764/17, 8 June 1917; BA/MA, PH10-II/97, 76th Reserve Infantry Regiment order, I/1444, 10 March 1917 and 17th Reserve Division, Abt. I Nr. 815 geh. and 816 geheim, 28 March 1917.
[41] '*Einleitender Vortrag*', p. 2.
[42] *Weltkrieg*, XII, pp. 55-56.

recommendations in Höhn's original draft – possibly reflecting greater confidence that the principles it was expounding were correct.[43]

Given the resistance to the new tactics, the most important changes in content related to control of artillery and withdrawal. The second edition confirmed the subordination of most artillery to divisions by further restricting corps control and the role of senior corps artillery officers. On withdrawal, both first and second editions authorised moving to the side, rear or forwards to escape enemy fire or attack, provided the original position was subsequently reoccupied. The second edition expressed a strong preference for moving forward, with detailed reasons, and stressed that higher-level commanders were not to hold ground rigidly. On deciding whether to evacuate a position permanently, the first edition had placed the responsibility on division, or in urgent cases brigade or regiment commanders. The second edition moved the responsibility upwards, to army or corps; and divisions could decide only in the most urgent cases. This shift illustrates trench warfare's erosion of the traditional mission command, in which commanders explained their intention and allocated missions but left subordinates free to decide how to execute the mission. And we should probably see changes to both forms of withdrawal as a means of placating resistance to the new tactics.[44]

The Test of Battle and Further Development of Doctrine

The Anglo-French Entente spring offensive of 1917 began with a serious German defeat at Arras, but that was its high point. Subsequent British and French tactical gains and captures of men and matériel bore no relationship to the plans for a breakthrough, the hopes of the soldiers or the casualties suffered. The German high command was naturally delighted by this success. Seventh Army, facing the French assault, wrote that 'Defensive battle' had made an outstanding contribution to victory. In particular, it had guaranteed a uniform approach before and during the battle, without restricting commanders' freedom of action. 50th Infantry Division, which had made an only partly successful counterattack on 16 April, commented

[43]Stachelbeck, *Militärische Effektivität*, p. 164 fn. 564; Moser, *Feldzugsaufzeichnungen*, pp. 271-272; Engelmann paper, pp. 1-2.

[44]'*Abwehrschlacht*', December 1916, 15; Chef des Generalstabes des Feldheeres, *Vorschriften für den Stellungskrieg für alle Waffen. Teil 8: Grundsätze für die Führung in der Abwehrschlacht im Stellungskriege. Vom 1. Dezember 1916. Neudruck vom 1. März 1917* (Berlin: Reichsdruckerei, 1916), 6b, 15 and 24; '*Einleitender Vortrag*', pp. 20-21. Definition of mission command from Colonel Balck, *Tactics*, 2 vols (trans. Walter Krueger) (Fort Leavenworth, Kansas: U.S. Cavalry Association, 1915), I, *Introduction and Formal Tactics of Infantry*, p. 41. Modern British doctrine defines mission command as 'centralised intent and decentralised execution': Ministry of Defence, *Army Doctrine Publication: Operations* (London: Ministry of Defence, 2010), para 0621.

that commanders and men felt themselves absolutely the superior of the enemy, even if the objectives had not been completely reached; the feeling of having a certain freedom of movement in tactical procedures also cheered everyone up. Many other units were equally positive.[45]

It is worth looking in more detail at one action during the Entente spring offensive, by 3rd Bavarian Infantry Division, since Army Group Rupprecht and OHL viewed it as a model application of the new tactics. The division was deployed for 15 days at Arras. Its commander, General Karl Ritter von Wenninger, had replaced Moser as head of Army Group Rupprecht's divisional command course. He therefore had at least a theoretical understanding of the new tactics when his own division went into action on 11 April in the chaotic circumstances, including lack of fixed defences, caused by the British success when the battle started.[46]

Wenninger initially ordered the construction of a traditional continuous front-line trench, backed by machine-gun nests with all-round barbed wire protection. His subordinates protested that this would be too visible from the air and could be easily destroyed. Wenninger let himself be persuaded to fight instead using the shell-hole positions created by the bombardment, and he later conceded that his subordinates had been right. He commented that the division in effect fought a defensive battle in the open field and on the basis of the new doctrine. A key element of the defence was the deep zone [*Tiefenzone*] between the thinly held front line and the second or main combat line [*Hauptkampflinie*] some 500–1000 metres behind it. In this zone were concealed the immediate supports and reserves as well as most of the machine guns and trench mortars. The zone was backed by a third line two kilometres to the rear, the whole forming the 'first position' [*I. Stellung*]. The *Wotan-Stellung* (called the Drocourt–Quéant Switch by the British), still under construction, would form a second position three to four kilometres further back.

As the British artillery could not easily identify the important points of resistance, it was forced to divide its fire and it could often not directly support its infantry. The immediate counterattacks which 3rd Bavarian Infantry Division had practised were extremely effective against the British infantry, which often surrendered freely. The

[45]GLAK, 456 F1/523, Army Group Crown Prince to OHL, '*Zusammenstellung einiger Lehren aus der Doppelschlacht Aisne-Champagne*', Ic Nr. 2880, 8 June 1917; 50th Infantry Division report, '*Erfahrungen der 50. Inf. Div. aus dem Angriff der Franzosen am 16. April 17*', [no reference or date]. GLAK, 456 F1/523 is the main collection of Seventh Army after-action reports on the Nivelle Offensive. KAM, AOK 6 Bd. 419 has the Sixth Army reports on Arras.

[46]This account is from 3rd Bavarian Infantry Division's after-action report, KAM, AOK 6 Bd. 419, '*Erfahrungen aus den Kaempfen bei Arras*', 6 May 1917.

defence was aided by the British infantry's lack of skill, and by the rigid nature of British artillery fire which could usually be avoided. Despite the huge volume of British shelling, the division's casualties were little more than a third of what it had suffered on the Somme. Summing up, Wenninger believed that the new tactics saved lives and raised morale.

Of course not everything had gone as well as this. The disaster on the first day of the Battle of Arras had sparked near panic in the German command followed by a search for the alleged culprits and, more productively, for lessons learned.[47] OHL deduced and promulgated the initial lessons from Arras by 12 April. There were three: divisions whose combat capability had already suffered had not been replaced in time; the artillery had not been active enough during the British bombardment; and in particular reserves had been kept too far behind the front. Army Group Crown Prince, about to face the French assault, began to apply these lessons immediately.[48]

Circulation of lessons learned continued during the offensive. 3rd Bavarian Infantry Division's action was used as an example of best practice. On Army Group Rupprecht's orders, in early May Wenninger gave a talk on 'mobile offensive defence' followed by a demonstration on the ground. About 1500 officers attended, including both army and most corps and divisional commanders from Second and Sixth Armies.[49] The talk aroused wider interest, and the printed version was requested by, among others, Fritz von Below, still commanding First Army and now facing the French on the Aisne.[50] In his talk, Wenninger stressed that he was describing the experiences of only one division in one set of circumstances; this could not be generalised to cover all situations. However, Army Group Rupprecht had the bit between its teeth. It submitted a report describing the division's experiences in detail and recommending further development of tactics. Even the 'Defensive battle' principle of conducting the fight around rather than in the front line did not go far enough given the new power of the enemy artillery. The battle should be fought in a

[47]Jonathan Boff, *Haig's Enemy: Crown Prince Rupprecht and Germany's War on the Western Front* (Oxford: Oxford University Press, 2018), pp. 159-161 argues that the lessons-learned process after the initial defeat at Arras lacked objectivity and sought to throw blame on individuals rather than the new defensive tactics. See also Jack Sheldon, *The German Army on Vimy Ridge, 1914–1917* (Barnsley: Pen & Sword Military, 2008), Chap. 8.

[48]*Weltkrieg*, XII, p. 291.

[49]BA/MA, Otto von Below papers, N87/61, Otto von Below unpublished manuscript, '*Lebenserinnerungen. V: Frankreich*', 7 May 1917.

[50]KAM, AOK 6 Bd. 419, Sixth Army to Wenninger, Ia Nr. 32877, 9 July 1917.

still more mobile fashion, over a greater depth; more use should be made of shell-hole positions and less of properly constructed defences.[51]

This is a clear example of the bottom-up influence of experience on doctrine: 3rd Bavarian Infantry Division's regiments had persuaded it to change its procedures, and the resulting success persuaded the army group too. However, what happened next shows the limitations of this process. Asked for its views on Army Group Rupprecht's proposals, Army Group Crown Prince commented maliciously that the initial defeat at Arras had forced the defenders back into open and unfortified terrain. The more mobile method of fighting then adopted made sense in those circumstances but should not be seen as generally valid. If Army Group Crown Prince had used the same method, it would have had to abandon the two crucial positions in its area. The defensive battle must be for possession of the forward position, not least because units must know what ground they were to hold.[52]

Despite the efficiency with which lessons were deduced from the initial defeat at Arras and then applied, there were concerns about the after-action reporting system and throughout 1917 steps were taken to tighten it up. On 25 April, Army Group Rupprecht complained that some reporting on the initial defeat at Arras had still not arrived. By then the second phase of the battle had taken place, and the army group ordered that once relieved divisions were to report quickly and concisely on points which it specified in detail.[53] Later in the month, OHL commented that units were protesting about being swamped with material. After-action reports should only be directly circulated if necessitated by urgent or local circumstances. OHL would summarise and issue reports worth broad circulation. This would also avoid units having to adapt to new tactical orders, some contradicting regulations, each time they changed sector.[54]

Over the summer, OHL moved to synthesise lessons learned from the spring offensive, issuing four doctrinal documents of ascending weight. It began with short instructions in early May while the battle was still in progress, followed a month later by a substantial 'Special manual'. This departed from the traditional German approach to doctrine, which was understood as less rigid and more open to the

[51]GLAK, 456 F1/523, OHL to Western Front army groups and armies, I. Nr. 54446 geh. op., 6 May 1917.
[52]GLAK, 456 F1/523, Army Group Crown Prince to OHL, Ia/Ib Nr. 2605, 8 May 1917.
[53]KAM, AOK 6 Bd. 419, Army Group Rupprecht to its armies, Ic No. 2881 geh., 25 April 1917.
[54]HSAS, M660/038 Bü 17, f. 45, OHL circular, II Nr. 57804 op., 16 June 1917.

exercise of judgement than in the British army.[55] OHL now insisted that to ensure uniformity the manual was to be regarded as binding. Together, these two documents stated that the defeat of the spring offensive had proved the principles in 'Defensive battle' and 'Field fortifications'; however, the principles had not yet become second nature to the army and various points needed improving.

OHL adopted a middle position between the two army groups' views on how to develop tactics. The defence should generally be mobile and aggressive. Only in very rare cases did the front line have to be held under all circumstances. Thin manning of the front and deployment in depth were correct but must be backed by reserves and, when needed, counterattack divisions [*Eingreifdivisionen* – the first use of this term in official doctrine]. These divisions must be close enough to intervene quickly but not so close that they became fought out from excessive casualties. Forward lines should usually be treated as advanced positions [*Vorstellungen*]. But it was impossible to renounce all defensive construction and fight a purely fluid battle. Fixed defences, especially to the rear, were important for economising on manpower in ordinary trench warfare and were crucial to proper command and supply arrangements in major battle; also, they forced the enemy to make time-consuming preparations to deal with them.[56]

The final step in updating doctrine was the publication of new editions of 'Field fortifications' in August and 'Defensive battle' in September. The latter was a major re-write, half as long again as its March predecessor. The section on artillery still occupied about a third of the total. The biggest changes related to the infantry and air force. The infantry section included important new instructions on the establishment of a lightly-held forward zone [*Vorfeldzone*], and in particular the difficult question of how toughly it was to be defended. More stress was laid on the need to fight a mobile battle in the whole depth of the defensive position. Other new content covered counterattack divisions, the increasing role of communications and the light-machine gun, introduced much more widely in the army since the spring battles. The section on the air force more than doubled in length and now included instructions on gaining air superiority. Finally, greater emphasis was put on training as the cornerstone of a unit's quality.[57]

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[55]Strohn, *Defence of the Reich,* p. 14.

[56]HSAS, M660/038 Bü 17, f. 38, OHL circular, II Nr. 54472 op. , 5 May 1917; Chef des Generalstabes des Feldheeres, *Sonderheft zum Sammelheft der Vorschriften für den Stellungskrieg. Vom 10. Juni 1917* (GHQ: Druckerei des Chefs des Generalstabes des Feldheeres, 1917).

[57]Chef des Generalstabes des Feldheeres, *Vorschriften für den Stellungskrieg für alle Waffen. Teil 8: Grundsätze für die Führung der Abwehrschlacht im Stellungskriege. Vom 1. September 1917* (Berlin: Reichsdruckerei, 1917) (hereafter '*Abwehrschlacht*',

The Germans won another important defensive victory at Third Ypres in autumn 1917. The new tactics have been viewed, especially in the older historiography, as a prime reason for German defensive successes in 1917. There seems little doubt that despite some continuing dissent (see below), they were broadly welcomed as helping to reduce casualties and raise morale. The Entente were impressed too: the British official history commented favourably on the German army's management of battle, especially the constant flow of reserves, and skilfully conducted counterattacks.[58]

There are two objections to this view of the new tactics as the decisive factor in these German successes. First, they were only part of the story. Western Front battles were complex, operational-level actions and many factors explain their outcomes, including effective logistics and intelligence. Equally significant was enemy performance: French and British operational and tactical abilities were clearly not adequate to achieve a breakthrough.[59] Second, the new tactics were no panacea, and there was almost no way of preventing the success of properly conducted Entente 'bite and hold' attacks with limited objectives. This was not a new problem, but it became increasingly difficult as the Entente adapted to German tactics in the continuous Western Front process of introducing or reacting to tactical and technical innovation.

Between June and November the Germans suffered six heavy local defeats.[60] At each of these battles there were problems relating to some of the core elements of mobile defence, especially withdrawal and counterattacks. The obvious remedy to Entente tactics was to withdraw before the assault. The withdrawal to the Hindenburg Line was a successful example at the strategic level which pre-empted part of the Entente spring offensive. 'Defensive battle' allowed for withdrawal rather than attempting to retain unfavourable positions, and indeed Sixth Army evacuated the untenable Lens salient in June.[61] But withdrawal had been considered and ruled out before three of the six defeats mentioned, Messines, Verdun and Malmaison. One common factor was mission command: the two army groups concerned had

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September 1917). Engelmann compares the March and September editions of 'Defensive battle' in detail.

[58]Captain Cyril Falls, *Military Operations: France and Belgium, 1917*, Vol. I: *The German Retreat to the Hindenburg Line and the Battles of Arras* (London: Macmillan, 1940), pp. 553-5.

[59]Cowan, 'Genius for War?', pp. 259-61.

[60]Messines (June), Verdun (August), Menin Road (September), Polygon Wood (September), Broodseinde (October) and Malmaison (October). Cambrai (November) is excluded as a special case.

[61]'*Abwehrschlacht*', March 1917, 6b; Below, '*Lebenserinnerungen*', 19 and 21 June 1917.

advocated pre-emptive withdrawal but let themselves be convinced by local objections based on a variety of practical and emotional reasons.[62] The two army groups' failure simply to issue orders for withdrawal shows how mission command could become weakness of command.

A linked problem was the question whether to hold or abandon the Forward Zone. The September edition of 'Defensive battle' stated clearly that temporary evacuation of positions was allowed, as long as they were completely recaptured by the end of the battle. However, it also stated, rather less clearly, that local commanders had to decide in every case how toughly to defend the Forward Zone; this was recognised to be a particularly difficult decision.[63] Some senior officers continued to oppose the whole idea of flexible defence. General Gerhard Tappen, a divisional commander at Third Ypres, commented that the new tactics caused what he bitterly called the 'victorious retreats' of 1917–1918. They showed the troops that enemy fire could be escaped by withdrawal. Also, if the Forward Zone was given up it either had to be recaptured, often with heavy casualties, or established further back to regain the defensive depth lost by the withdrawal.[64]

An integral part of mobile defence was counterattack to recapture ground temporarily lost or given up. In the spring fighting, automatic counterattacks from the rear had often worked, and throughout 1917 local efforts could be very successful. But as Entente barrages became thicker and longer, large-scale counterattacks from the rear became increasingly difficult to mount: this was a concern to Army Group Crown Prince as early as 24 April.[65] At Verdun in August and at Third Ypres in the autumn, counterattacks from the rear arrived late and suffered heavy casualties. The alternatives were to avoid the enemy barrage by moving the counterattack units forward before it started, or by reverting to the older tactic of holding the front line more thickly. But both these methods led to the premature exhaustion of the counterattack troops as well as heavy casualties; and the front positions were overrun anyway.[66]

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[62]Hermann von Kuhl, *Der Weltkrieg 1914–1918*, 2 vols (Berlin: Wilhelm Kolk, 1929), II, pp. 113-114; BA/MA, N58/1, Graf Friedrich von der Schulenburg-Tressow unpublished manuscript, '*Erlebnisse*', p. 160.

[63]'*Abwehrschlacht*', September 1917, 6c and 39.

[64]BA/MA, RH 61/986, Gerhard Tappen unpublished manuscript, '*Meine Kriegserinnerungen*', p. 62. See also Stachelbeck, 'Lessons learned', pp. 134–135.

[65]GLAK, 456 F1/249, Army Group Crown Prince to Seventh Army, Ia 2431, 24 April 1917.

[66]Nick Lloyd, *Passchendaele: A New History* (London: Viking, 2017), Chaps. 10-12.

Conclusion

Although contemporaries referred to the 'new' German tactics of 1916–1917, most of the constituent parts had evolved gradually from the beginning of trench warfare and especially during the battle of the Somme.[67] The tactics were new in the sense that there was a new codification of existing best practice into doctrine, rather than the introduction of something radically different from what had gone before. The doctrine was promulgated by the publication of manuals such as 'Defensive battle' which explained to the army what actually constituted best practice. After-action reports, though important, were no substitute. Wenninger was not alone in commenting that his division's action represented one experience in one particular situation. Standardisation of procedures throughout the army was crucial to all-arms co-operation, and this could only be achieved by doctrine. Doctrine was anyway ultimately based on experience, including after-action reports. It was not necessarily particularly behind events, as manuals could quickly be supplemented by interim amendments and special instructions which were then incorporated into subsequent editions.

Doctrine was therefore more than a static paper exercise. There was a continuous cycle of action, after-action reports, discussion, synthesis into and promulgation of doctrine, followed by training at different levels and then the beginning of the next cycle.[68] Throughout 1917 OHL increasingly took control of this process, by ending broad circulation of after-action reports and by insisting on the binding nature of doctrine. This contributed to limitations on mission command, which were partly a consequence of trench warfare and partly the result of increasing micro-management by Ludendorff at OHL. Nevertheless, there was still plenty of scope for human factors to play a role. Officers such as Höhn and Moser who drafted doctrine and led training on it were carefully selected to lend credibility to the process. However, as a fallible human organisation, the German army's record in implementing doctrine was patchy. Enemy adaptation was one reason for this, but another was forgetting lessons already learned: indeed, some tactical mistakes which the army had cured in 1917 recurred during the final campaign of the war in 1918.[69] So doctrine was key to German performance but could never be perfect or perfectly implemented.

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[67]Ralf Raths, *Vom Massensturm zur Stoßtrupptaktik. Die deutsche Landkriegtaktik im Spiegel von Dienstvorschriften und Publizistik 1906 bis 1918* (Freiburg: Rombach, 2009), pp. 203-18 suggests that many of the changes stemmed from pre-war thinking.

[68]For parallels and differences with the British army's learning processes, see Aimée Fox, *Learning to Fight: Military Innovation and Change in the British Army, 1914–1918* (Cambridge: Cambridge University Press, 2018).

[69]Boff, *Winning and Losing*, Chaps. 6 and 8 and pp. 246-7.

'Everything in war is very simple...' The Great War French tank regulations and their implementation

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ABSTRACT
This article examines how the French army developed its tank doctrine during the Great War. How that doctrine came to be formulated and how it worked in practice will be discussed, as will the obstacles to devising such doctrine in the context of continuous and large-scale operations on the Western Front from 1916 to the end of the war. The three French tank designs, the Schneider, the St Chamond (both medium tanks) and the Renault light tank had to be tested and developed in the field, as was the doctrine used to employ them. As will be shown, despite developing sound tank doctrine on a tactical and operational level reasonably quickly, the French army would then discover that good doctrine was only part of the equation leading to military effectiveness, illustrating Clausewitz's dictum that 'everything in war is very simple, but the simplest thing is difficult'.[1]

Such was the scale of the French tanks' failure in their first engagement during the Nivelle Offensive in April 1917 that the *Artillerie Spéciale* (Special Artillery – *AS*, the code name for the French tank force) was in danger of being disbanded.[2] However, two subsequent and successful operations at Laffaux and Malmaison confirmed the tanks' utility to the French Army and enabled it to develop an effective tactical doctrine for the tanks, one that lasted for the most part unchanged for the rest of

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[1]Carl von Clausewitz, *On War,* Edited by Michael Howard & Peter Paret (Princeton: Princeton University Press, 1984), p. 119.

[2]Charles-Maurice Chenu, *Du Kepi rouge aux chars d'assaut* (Paris: Albin Michel, 1932), p. 248.

the war. This article will discuss that doctrine, how it came to be formulated and how it worked in practice. One major theme arises; the comparative ease with which the French army developed an effective doctrine for its tanks is in stark contrast to the difficulties of actually implementing this doctrine successfully on the Great War battlefield.

The French army developed sound offensive doctrine during the Great War at both the tactical and operational levels, but this was nearly always in advance of the technology or equipment immediately available. Thus implementing these sound tactical and operational ideas proved very problematic, illustrating Clausewitz's dictum that 'everything in war is very simple, but the simplest thing is difficult.'[3] This is particularly the case in relation to the French army's tank regulations, which encompassed what would be called doctrine today. By the beginning of 1918, the French army had a soundly thought-out doctrine for their tank units and the other arms they were supporting or being supported by. However, an examination of the development of the French tank regulations demonstrates that having sound ideas about tank tactics is only half of what is required for military effectiveness. The other half requires that these regulations be understood and then implemented. It was the latter provision that was to prove most difficult in the context of the Great War.

The original conception of the French tank force came from a senior artillery officer, Colonel (later General) Jean-Baptiste Estienne. He wrote to the French commander-in-chief, General Joseph Joffre several times during 1915 suggesting that an armoured vehicle on tracks should be developed. His initial letters disappeared into the bureaucracy of GQG (the French General Head Quarters) and he was forced to approach Joffre privately, which resulted in an immediate interview with one of Joffre's deputy chiefs of staff, General Maurice Janin.

Estienne's initial ideas on how to use the tanks centred on using them in a surprise attack across a wide front, without the usual accompanying artillery barrage. In the attack, the tanks would begin their advance before the infantry who would only join the tanks when the first trench line had been taken. The attack would continue with tanks advancing on the next trench line, with Estienne expecting that such swift movement would reach the German artillery-line within an hour.[4] After consideration by GQG, it was agreed that tank manufacture would begin. It is

[3]Clausewitz, *On War*, p. 119.

[4]GQG, *Emploi tactique des cuirassés terrestres*, 18 August 1916, Ministère de la Guerre*, Les Armées française dans la grande guerre,* Tome 4, Volume 2*,* annexes 3, number 2958. All further references to the French official history will be abbreviated as AFGG, followed by the tome and volume number. Thus this would be cited as AFGG 4/2, 3, 2958.

notable that it took less than two months, from the initial meeting of Estienne and Janin, for GQG to draw-up detailed tank specifications, accompanied by clear ideas about how they were to be used.

The French army had three tank-designs in service by the end of the war, the Schneider, the St. Chamond (both medium tanks coming into service in 1917) and the Renault light-tank (in service in 1918).[5] They all pushed contemporary automobile technology to the limits, a problem that was compounded by the lack of any experience with tracked vehicles within French industry. The initial two medium-tank designs were particularly troubled by manufacturing and design faults. The first of these to go into production in 1916 was the Schneider, essentially an armoured rectangular box on a US Holt-tractor chassis. It was armed with a short-barrelled 75mm howitzer, mounted on the right-side of the tank with a very limited arc of fire (20°), and a machine gun on each side. It weighed just over 13 tonnes, but the primitive engine struggled to move the tank at more than walking pace. Elements within the Ministry of Armaments independently commissioned another medium tank, the St Chamond. This was larger (23 tonnes) and was armed with a full-size 75mm field gun, with an even more limited arc of fire (5°) than the Schneider, and four machine guns. Its tracks were driven by two electric generators that were in turn powered by a petrol engine, an ambitious arrangement that French engineering was unable to make reliable until late in the war.

The Renault light-tank, introduced into service in 1918, was, by contrast, a very fine design, setting the template for nearly all tanks that followed it with its revolving turret, armed with a 37mm gun or a machine-gun. However, the good design was not able to overcome the technological constraints of the time. In particular, despite only having a crew of two and weighing significantly less than the Schneider, its engine was unable to move it faster than walking pace.

The first instructions on tank tactics came from GQG in August 1916 and were essentially just a refined version of Estienne's initial ideas.[6] The tanks were to enable an offensive to take possession of the battlefield over several hours, on a large front, all the way to the enemy's artillery batteries. This would be done in such a way as to make the following infantry attack a matter of occupying the taken positions, followed by the cavalry who would exploit this success. To maximise surprise and shock, the tanks were to advance simultaneously on their objectives, which ensured both a quick advance and conserved ammunition. The instructions were quite

[5]Not all the light tanks were manufactured in the Renault factory but the light tanks will all be referred to as Renaults here.

[6]AFGG 4/2, 3, 3002, GQG, *Emploi tactique des chars d'assaut*, 20 August 1916.

explicit in recognising that once the tanks had set off, it was going to be very difficult to issue new orders to them.

These ideas were made redundant when the British unveiled their tanks at the Somme in September 1916, which removed the element of surprise and demonstrated the limitations of the British tanks. During Estienne's trip to Lincoln in June 1916 to examine the British tank programme, he tried to persuade the British of the importance of delaying the initial use of tanks, until they could be used in large numbers and simultaneously by the allies.[7] The French asked E. S. Montague, the British Minister of Munitions, to stop the British tanks being used until the spring of 1917, when the French tanks would be ready for combat. Montague saw Haig in September 1916 to discuss the French proposal but the latter, although sympathetic, was not prepared to change his plans at such a late stage.[8] This was to have a serious effect on Anglo-French co-operation on tank warfare as the British unveiling of the tank instantly removed any question of using tanks in a surprise attack and the British had made official interaction more difficult by ignoring very serious French concerns.[9]

For the *AS*, the unveiling of the British tanks in 1916 was a significant setback, as one very effective but simple measure that the Germans took after the first British tank attack was to widen their trenches. There was no possibility of modifying the existing French tank designs to enable them to cross these wider trenches and making a way over these for the tanks required that they were closely supported by

[7]Service Historique de la Défense (SHD), 16N2121, Estienne, *Compte-rendu d'une mission en Angleterre les 25 et 26 Juin 1916*, 26 June 1916.

[8]See Tim Gale, *The French Army's Tank Force and Armoured Warfare in the Great War; the Artillerie Spéciale* (Farnham: Ashgate, 2013), pp. 34-35.

[9]Co-operation between the French and British tank services during the war is a complicated story and deserving of a study of its own. Informal liaison continued intermittently from 1916 to early 1918 but technical and tactical co-operation was inherently difficult because of the differences in the tank designs. Co-operation increased in 1918 as the general military situation changed but it was only with the formation of the Inter-Allied Tank Committee that the allies instituted formal co-operation and began to organise joint tank programmes. Its first meeting was held on 6 & 7 May, with representatives from France, the UK, Italy and the United States present. The discussion over these two days illustrates the rather different view on tank tactics that the British and French held, views that were not reconcilable within the remaining months of the war. For a further discussion on this issue, see; Elizabeth Greenhalgh, 'Technology Development in Coalition: The Case of the First World War Tank', *The International History Review*, 22/4, December 2000, pp. 806-1008.

accompanying infantry. Thus, a new tactical approach had to be developed and the tanks became close-artillery support for the infantry, with Estienne setting out the new parameters in October 1916. The role of the *AS* was to precede the infantry and be 'their guide and light.'[10] The tactical and administrative unit was established as the *groupe* (company), which consisted of four batteries (each with four tanks), the battery being the manoeuvre-unit. *Groupes* were to be organised into *groupements* (battalions).

Attacks were to be carefully planned using aerial photos, with the orders for each battery's attack made in detail. Tanks would move to their starting positions at night to avoid detection, possibly with artillery fire used to mask the tanks' motors. Although the tanks were armed with cannons and machine guns, their main strength was considered to be the ability to keep advancing under enemy fire. The cannon's primary role was to engage enemy machine guns; Schneiders were not expected to engage targets beyond 200 metres and the St Chamonds would not normally fire beyond 600 metres. Because the tanks were only to use their guns at short range, this was another reason to attack in fog or during the early morning. Estienne summed up the purpose of tank guns; 'only fire when you can't march.'[11]

A tank attack was to have three distinct phases. Initially the tanks would help the infantry take the successive trenches of the first enemy position, then move to attack the enemy artillery batteries, followed by an attack on the second enemy position. This process, theoretically, would be completed in less than three hours, with an advance of up to six kilometres. It is important to note that Estienne emphasised that the tanks should attack only when under the cover of fog or before daybreak. The British experience had also shown the necessity for close infantry and tank co-operation and an infantry company was therefore attached to each battery, primarily tasked with the removal of obstacles but also to assist in consolidating captured positions.[12]

The first French tank combat operation was undertaken within this methodological framework and was far from a success. Two *AS groupements* participated in V Army's attack at Juvincourt on 16 April 1917, a part of the Nivelle Offensive. Having been promised that the enemy artillery would be totally suppressed, the *groupements* made their approach march in broad daylight and in full view of the German artillery observers, who were on commanding heights above the battlefield. One *groupement* was shot to pieces by indirect German heavy-artillery fire without getting past the

[10], AFGG 5/1, 1, 49, Estienne, *Bases générales de l'organisation et de la tactique de l'artillerie d'assaut (A.S),* 9 October 1916.
[11]Ibid., This was a pre-war French infantry slogan.
[12]Ibid.

first German trenches. The other's commander was killed when his tank was hit by artillery before his units could deploy. His *groupement* carried on and some tanks penetrated more than three kilometres further into the German lines than could the French infantry. However, these modest successes had been bought at a considerable human and material cost; 76 tanks out of the 132 engaged that day were put out of action, with fifty-seven destroyed by German artillery.[13]

If all three of the available tank-*groupements* had been used on 16 April, then the subsequent story of the *AS* might have been very different. Fortunately, one *groupement* had not been used in April and was therefore available to be used in a later stage of the Nivelle Offensive. This second *AS* operation was executed very differently than the first, demonstrating a remarkable ability within the *AS* to learn from experience and rapidly introduce effective innovations.

Estienne and GQG took the opportunity to analyse the 16 April attacks in detail and to make sure that mistakes were not repeated.[14] The lengthy approach march on 16 April had been identified as a serious mistake; this time, three batteries of each *groupe* were placed close to the French front-lines before the operation, in order that they could advance at the same time as the infantry.[15] The tanks were more closely integrated with the infantry than on 16 April, primarily through placing the *groupes'* command posts with those of the infantry divisions. Each battery had specific tasks and objectives (unlike on 16 April where objectives had been given to the *groupes*), with one battery held in reserve, giving the *groupe* commanders some tactical flexibility. This thinking was also applied to the *groupements.* The in-line formation of the *groupements* on 16 April was agreed to be impossible to control. Accordingly the *groupements* were to be echeloned in depth, which gave the *groupement* commander the ability to reinforce success and concentrate effort, in addition to being easier to command.

Particular attention was paid to protecting the tanks from enemy artillery fire, as this had proved to be the tanks' greatest danger on 16 April.[16] A dedicated aircraft was provided to keep the commander informed of his tanks' movements and to signal artillery fire onto enemy anti-tank batteries.[17]

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[13]SHD, 6N2120, Estienne, *Rapport au sujet de la participation aux opérations de la V armée des groupements Bossut et Chaubès de l'artillerie d'assaut, 23 avril 1917*, *Tableau no. 2*.
[14]SHD, 16N2120, GAN, *Projet pour l'emploi tactique des chars d'assaut, 1 mai 1917*.
[15]SHD, 16N2120, *Emploi des tanks le 16 avril 1917*, undated, p. 3.
[16]Ibid,. pp. 4-5.
[17]SHD, 16N2120, Estienne, *Rapport au sujet de la participation du groupement Lefebvre et du 17e BCP aux opérations de la VIe armée, les 5 et 6 Mai 1917,* 18 May 1917.

The operation on 5–6 May was very successful, with few casualties and all objectives taken, and was only marred by mechanical difficulties. Nineteen Schneiders went into action, with only three breaking down, whereas the twelve St Chamonds had considerable difficulty on the terrain, with six breaking down, and one destroyed by German artillery.[18] Thus the results were better than those of 16 April, particularly as only one tank had been destroyed.

The large-scale disturbances in the French army after the Nivelle Offensive meant that only limited operations were undertaken during the remainder of 1917. Pétain, the new commander-in-chief, took the opportunity to launch a series of limited-objective offensives, in order to restore morale in the army and experiment with tactics. One such operation was made by French VI Army against the plateau containing the remains of the pre-war Malmaison fort. Capture of this plateau would give the French army an enfilading position over the Ailette River valley and allow flanking fire on the enemy positions on the eastern part of the Chemin des Dames and the Aisne valley.

In this operation, the *AS* units were engaged under a provisional framework prescribed by Pétain in a note to the armies on tank use, reflecting the lessons drawn from the battles in April and May.[19] In this note, Pétain emphasised the importance of close liaison between the tanks and the other arms, the infantry, artillery and aviation. As with all attacks, he said, success required the effective neutralisation of all the enemy artillery that could fire into the combat zone, which was not just the artillery itself but also its observation posts. All the German terrestrial observatories were to be blinded by smoke shells and the advance of the tanks was to be protected by specially designated aircraft. In the most favourable circumstances, fog or early morning mist would be used to mask the tanks' movement on the battlefield.

At the start of an operation, tank units would be attached to an infantry division. The divisional commander would develop his plan in conjunction with the tank commanders, who would then liaise with the relevant regimental commanders. During combat, the tank units' overall commander was to be stationed close to the divisional commander and the *groupe* commanders were to be with the infantry's regimental commanders. If the tanks were not attacking the first position, they were to remain in cover until signalled forward by the infantry, a tank liaison officer being attached to the infantry to ensure this was done correctly.[20]

[18]Ibid.
[19]AFGG 5/2, 2, 957, Pétain, *Note pour les groupes d'armées*, 22 August 1917.
[20]Ibid.

In line with the experience of 5 May, each tank *groupe* was to enter into action by successive echelons, with one or two batteries making the initial attack, while the other batteries remained in cover until their intervention was necessary. The advance of tanks was to be covered by a rolling barrage of smoke shells. Once the tanks had arrived on the enemy positions, they were to neutralise them and then signal the infantry to advance. Pétain drew attention to the grave danger of leaving stationary tanks on the battlefield and they were only to do this until the French infantry had occupied and organised the conquered area. The note emphasised that it was 'indispensable' for the most thorough training to be had by the infantry if they were to co-operate effectively with the tanks.[21] These thoroughly sensible recommendations about tank deployment were to be put to the test at Malmaison, where the theory was applied in less than ideal circumstances.

At Malmaison, French VI Army had 38 Schneider and 30 St Chamond tanks to support the three attacking infantry corps, as well as copious amounts of artillery. There was no attempt at surprise; over five days, French artillery fired just over 1.5 million shells at the German positions.[22] When the operation was over on 26 October, the French had advanced in some places nearly six kilometres and had captured over eleven thousand Germans and significant amounts of material. This had been achieved with casualties of fewer than twelve thousand men, comparing very favourably with the thirty thousand casualties in this area in April and May.[23]

From the point of view of the *AS*, the battle's most important result was that it had restored confidence in the tanks within the French Army. Not surprisingly, the view of the infantry commanders was determined by the effect of the tanks in their sector but there was only one wholly negative one.[24] Only two tanks were destroyed and there were eighty-two casualties, light compared with later engagements.[25] Thus Malmaison demonstrated that the tanks would suffer comparatively light casualties if the enemy artillery was efficiently suppressed, although an extensive artillery preparation would render the ground unusable to them.

The major lesson of Malmaison was that getting the tanks into action close enough to the enemy was going to be difficult whenever an extensive artillery preparation

[21]Ibid.
[22]F Pellegrin, *La Vie d'une armée pendant la grande guerre* (Paris, 1921), pp. 172-3.
[23]Robert Doughty, *Pyrrhic Victory: French Strategy and Operations in the Great War* (London; Harvard University Press, 2005), p. 389.
[24]SHD, 16N2162, VI Armée, *Rapport du Lieutenant-colonel De Bailleul 23 octobre 1917*.
[25]See Gale, *The French Army's Tank Force*, p. 102.

had taken place.[26] However, once the tanks were within close range, it was clear that the Germans had limited options to counter them; German prisoners expressed considerable dismay that their counter-tank preparations had been of no avail, stating that the tanks had caused 'disarray' in their ranks.[27] The tanks could thus be very valuable to their infantry, particularly in relation to keeping down casualties, an issue of pressing concern to Pétain and the French government.

The experience gained from 1917 was considered sufficient to enable provisional tank regulations to be issued; the *Instruction provisoire sur l'emploi des chars d'assaut*, in 29 December 1917.[28] The tank regulations contained two main elements; the regulations dictating the actions and preparation of the *AS* units themselves and the more general rules regulating how the tank units were used in conjunction with the rest of the army. It received only one set of major modifications, largely due to the introduction of the Renault light tanks and the changes to the organisation of the *AS* this necessitated, to become the *Instruction sur l'emploi des chars d'assaut* of 14 July 1918. This did not change the general methodology of tank-use and thus the *Instruction provisoire* of December 1917 remained the basis for tank tactics and operations throughout the rest of the war.

The *Instruction* starts by defining the aim of the *AS*; 'The *artillerie d'assaut* acts as *accompanying artillery* for the infantry, immediately acting to the demands and necessities of combat.'[29] Note the change here from the tanks original role as the infantry's 'guide and light'. The *Instruction* emphasised the mechanical limitations of the medium tanks, particularly in relation to crossing broken terrain and wide trenches.

In relation to the organisation of the *AS* units, this was in line with the experiences of 1917. The *groupe* commanders had great difficulty in keeping communication with, and had little control over their batteries and thus the *groupe* became three, rather than four, batteries.[30] A battery was assigned to an infantry battalion, the infantry commander taking command of it during combat. Three or four *groupes* constituted a *groupement*, along with a re-supply and maintenance unit, which gave the

[26]SHD, 16N2120, GAN, *Observations sur l'emploi des chars d'assaut le 23 Octobre*, Novembre 1917.
[27]Quoted in R Lafitte, *L'Artillerie d'assaut de 1916 à 1918* (Paris: Henri Charles-Lavauzelle, 1921), p. 38.
[28]SHD, 16N2142, GQG, *Instruction provisoire sur L'emploi des chars d'assaut*, 29 December 1917.
[29]*Instruction*, p. 1. My emphasis.
[30]Ibid,. p. 3.

groupement the ability to deploy and engage in an operation without the necessity of further support.[31]

In relation to the conditions needed for a successful tank attack, the *Instruction* is quite explicit. The best use of tanks was in an engagement where the artillery preparation 'is not complete.'[32] If the enemy positions were subject to a heavy artillery preparation, the infantry would be able to occupy these without tank support, rendering the use of tanks 'superfluous.' The *Instruction* pointed out that a tank would be quickly immobilised crossing badly overturned ground, with 'no profit to the infantry,' which was the main lesson from Malmaison.[33] There the artillery preparation had destroyed the German positions and the terrain as well, so even that though the tanks were moved through relatively undamaged areas of the battlefield, twenty-four out of the twenty-eight St Chamonds deployed had ditched or broken down before arriving in the combat zone.[34] This established that tank employment would require relatively undamaged ground, which in turn required a different approach to artillery preparation of the battle zone.

By contrast, if the preparation was either short or technical issues made it less effective; the use of tanks was both 'necessary' and the 'easiest' method of attacking with a reduced preparation.[35] Thus *coup de main* attacks against the first position were not ruled out, providing the ground was known to be suitable for tank movement. However, the deeper the objective, the better suited the operation was for tank combat, as the enemy artillery would be less effective.

As might be expected, close liaison with the infantry and the artillery was a 'necessity.'[36] The *AS* units were commanded in battle by the infantry commanders in order that they might react as quickly as possible to the needs of the infantry, particularly in relation to enemy machine guns. However, the regulations warned that the presence of the *AS* was not a reason to modify the general plan of engagement, which should be capable of fulfilment with or without the tanks. The *Instruction* stressed that it was vital that 'the infantry does not act as a spectator' to the tanks, this particular issue being a problem for the rest of the war.[37] By 1918, the French infantry and its commanders were understandably cautious in combat and *AS*

[31]Ibid,. pp. 3-4.
[32]*Instruction*, p. 4.
[33]Ibid.
[34]*Observations sur l'emploi des chars d'assaut,* p. 1.
[35]Ibid,. p. 5.
[36]Ibid.
[37]Ibid,. p. 8.

commanders continually complained about the failure of the infantry to follow the tanks forward.

The *Instruction* pointed out that modifications to the plan of engagement made necessary by the tanks (neutralising the enemy artillery) would also favour the other arms.[38] Despite the introduction of anti-tank rifles and mines by the Germans from mid-1918, artillery fire accounted for the majority of tank losses and remained the tanks' greatest danger. To protect the tanks, it was indispensable to have the following conditions; effective counter-battery fire in the preparation, arrangements for firing on enemy batteries that appeared during the battle, the blinding of enemy observatories, the extensive use of smoke shells in the rolling barrage and protection in the air against enemy aircraft.[39]

These provisions obviously required considerable forward planning if they were to be implemented effectively. In relation to infantry liaison, this could not 'develop in a fruitful way on the battlefield' but required prior preparation in exercises on the training grounds.[40] Three or four combined exercises were generally considered 'sufficient' to familiarise a battalion with tank combat and enable its infantry to assist and be assisted by the tanks. The importance of this training was such that instruction centres were formed at the Army Group *AS* bases, which any large unit stationed nearby was expected to use for infantry-tank training.[41] The tanks also needed their own close-support infantry but these required two or more weeks' training so they could not be taken from the divisions designated for the offensive.[42]

Reconnaissance was considered as of particular importance for a successful tank operation.[43] The *AS* officer attached to each army group was expected to maintain a constant reconnaissance of the armies' fronts and organise work on the ground to enable tanks to be quickly deployed. Once the decision to use tanks had been made, the *AS groupements* would then be attached to either specific corps or divisions and the *AS* officers would work with the staffs of these units to develop a plan. The infantry and *AS* commanders at every planning level were expected to work closely together on both the plan and the work required to enact it. At the higher levels of command, this involved establishing the de-training points for the tanks and the *AS* units' waiting and departure positions. At the lower levels, clearing the tanks' routes

[38]Ibid.
[39]*Instruction*, p. 8.
[40]Ibid,. p. 9.
[41]Ibid.
[42]Ibid,. pp. 9-10.
[43]Ibid.

through the front lines and finding camouflaged positions for the tanks were of primary importance.[44]

Once in combat, the tanks were to precede the first waves of attacking infantry, just behind the rolling barrage. They were to engage enemy resistance points as they appeared, although the infantry were expected to help identify these for the tanks, it being conceded that tank crews could not always do this for themselves due to the tanks' poor external visibility.[45] To ensure that liaison was as close as possible, the *AS* commander was to be stationed with the infantry commander during combat and batteries were expected to maintain constant contact with their commanders. Liaison with the infantry once in combat was to remain a problem as it was hazardous for both parties. On the battlefield, either the infantry had to approach the tanks, usually being subjected to heavy machine gun or artillery fire, or the tank commanders had to leave their tanks, with the dangers this presented. For example, in September 1918, one Renault battalion had fourteen men killed out of their tanks in combat, while liaising with the infantry.[46]

To account for the differences between the medium-tanks and the light ones, a provisional regulation for light tanks was issued in April 1918.[47] This is very similar to the *Instruction* of December 1917, with variations to take into account the differences in combat, organisation and maintenance between the Renaults and the medium tanks. In relation to tactics, the major difference was that the light tanks would be acting more closely with the infantry.

Mirroring the infantry that they were closely supporting, the light tanks were organised into companies, battalions and regiments. A company had three identical combat sections (with five tanks), a resupply and repair unit and a radio-tank. The light-tank battalion (bataillon des chars légers – BCL) would have three companies and three battalions would form a tank regiment, along with a varying number of medium-tank *groupements*.[48]

The light-tank regulations follow the general principles laid down in the *Instruction* of 27 December 1917; the Renaults would participate in offensive actions that were either 'regularly mounted' (i.e. with adequate planning and preparation) or in

[44]Ibid,. p. 13.
[45]Ibid,. p. 17.
[46]SHD, 16N2159, 21 CA AS, *Rapport sur les opérations de Champagne du 20 septembre au 3 octobre,* 26 October 1918.
[47]SHD, 16N2142, GQG, *Reglement provisoire de manœuvre des unités de chars légers*, 10 April 1918.
[48]Ibid., *Reglement provisoire*, p. 1.

operations that were rather more ad hoc, such as during the second phase of an offensive.[49] As per the *Instruction,* there was to be a detailed reconnaissance made by the *AS* officers at every level and an engagement plan developed with the infantry commanders. The army groups were instructed to rotate as many infantry units through their *AS* camps for training as possible but this was never easy, and infantry were considered sufficiently trained once they had two or three exercises with the tanks.

In relation to combat, the regulations described the section as the main tactical unit in combat, emphasising that it 'should never be divided.'[50] During combat, tank-sections were under the orders of the infantry battalions they were attached to and could be asked to fight with several successive waves of infantry. The section was never to 'cavalier seul' (go it alone, i.e. without infantry support) but was to remain in close contact with the infantry.[51] Thus the French army had a well-thought out methodology for the use of both medium and light tanks in offensive operations but this needed to be tested in combat, particularly in relation to the largely untried light tanks.

The first tank operations undertaken by the *AS* with the new regulations were the frantic defensive battles fought to stop the German spring offensives of 1918, including the introduction of the Renaults at the end of May. It had been intended that they would only be used *en masse* in a large-scale offensive, but necessity meant that their first engagement was in a small-scale counterattack against German Seventh Army, which was making alarming progress south-west of Soissons and thus in the general direction of Paris. GQG ordered that all available forces were to be thrown into the battle to stop the Germans entering the forest of Villers-Cotterets, 'whatever the cost.'[52] A local counterattack by one division was supported by elements from two light-tank companies. The tank attack was eventually beaten-off but the offensive capacity of two German divisions had been 'crippled,' the first appearance of the Renaults causing 'a real panic' in the German ranks.[53]

Although the regulations were now clear about tank employment, the immediate difficulty was ensuring that both the tank and infantry officers understood and were implementing them. Accordingly a number of different documents were issued,

[49]Ibid,. p. 21.
[50]Ibid,. p. 24.
[51]Ibid.
[52]Captains Delacommune & Cornic, 'Le Premier engagement des chars Renault en 1918', *La Revue d'infanterie,* August 1932, pp. 215-23, p. 223.
[53]SHD, 16N2150, GQG, *Historique des opérations des unités de chars légers du 501 RAS*, 30 June 1918, p. 2.

addressed to both sets of officers. For example, in June 1918, Pétain issued a note, specifically addressed to infantry officers, on the employment of light-tanks which summarised the relevant parts of the *Reglement*.[54] He emphasised the importance of the infantry supporting the tanks; the latter's 'actions are in vain if not supported properly by the infantry.'[55] There was an important prescription at the end of the note. It said that the light tanks were only to be used *en masse* (that is one battalion per infantry division) in properly organised offensives and that any derogation from this rule must be immediately reported to Pétain.[56]

The tank officers also needed reminding of the regulations. For example, a note was issued to the *AS* army group commanders in April 1918 pointing out that medium-tank units had been recently used 'in contradiction to' the regulations.[57] It was considered necessary to remind all the *AS* commanders that the 'normal employment' of the *AS* was in *groupes* and only 'very exceptionally by the battery.'[58] Attention was also drawn to the requirements for good planning and the difficulties of moving the tanks on rough terrain.[59] There was a culture within the *AS* of carefully analysing after-combat reports and these were expected to be accurate, regardless of whether this was embarrassing for other *AS* officers. For example, Estienne's second-in-command, General Monhoven, wrote a scathing report on an *AS* engagement south-east of Soissons in June.[60] Three light-tank companies were involved in a small-scale action to clear the Forêt de Retz, which while successful, had shown up numerous deficiencies in the leadership of the section-commanders. One section-commander lost sight of one of his half-sections (two tanks) and left his other tanks to go and find it. Unsurprisingly perhaps, he found the missing half-section but had lost contact with the other, compounding his poor performance by then firing dangerously close to some nearby French infantry, contrary to the regulations. Another section-commander lost his entire unit on the battlefield and meeting a small group of German prisoners, decided to escort them back to the rear, contributing nothing to the battle according to the report. Monhoven also severely criticised some section-commanders for failing to observe the strict maintenance schedules of their tanks (which were detailed in the tank regulations), resulting in two sections not getting into action due to losing the majority of their tanks to breakdowns. Monhoven instructed *AS* personnel to compile accurate after-

[54]SHD, 16N2142, Pétain, *Note sur l'emploi des chars légers*, 9 June 1918.
[55]Ibid.
[56]Ibid.
[57]SHD, 16N2150, GAN, *Note pour les commandants d'AS de GA*, 20 April 1918.
[58]Ibid. Underlined in the original.
[59]Ibid.
[60]SHD, 16N2159, Artillerie d'assaut, *Remarques relatives à l'engagement du 28 juin*, 19 July 1918.

action reports, which should not avoid, 'where truly merited,' criticism of *AS* officers and crews.[61]

The only large-scale use of the *AS* before July 1918 was the Battle of the Matz in June, when the French army was forced to undertake a desperate counterattack on the flank of German Eighteenth Army, which was threatening to open the road through Compiegne and then to Paris. Under the command of one of France's most competent generals, Charles Mangin, five infantry divisions and all the available tanks (144 medium tanks) in the area were launched at the exposed German flank. Mangin's immediate superior, General Émile Fayolle (commanding Reserve Army Group), thought the attack would take two or three days to organise but Mangin did it in one. As might be expected, the speed and urgency of the operation meant that many requirements of the tank regulations were broken. In particular, the detailed liaison in advance of combat between the infantry and *AS* officers that was so emphasised in the *Instruction* was simply not possible. Most of the *groupe* commanders only met their infantry equivalents several hours before the battle started and the infantry had no opportunity to undertake any training at all with the tanks. Indeed, many had never seen a tank before the day of the attack.[62] Fortunately, most of the *AS* officers had been stationed previously in the area and were thus familiar with the ground, which was just as well as there was no time for the regulation meticulous reconnaissance.[63]

It was intended that the tanks were to set off with the leading waves of infantry but delays on the approach march meant that only two *groupements* were able to do this. The initial attack was a great success, although the speed of the operation meant that it was unable to start in early morning, as per the tank-regulations. Fortunately, there was a persistent heavy mist that morning, which prevented the German artillery coming into action effectively until the afternoon. Across an eight-kilometre front, the French had pushed the Germans back three kilometres and it was clear that the German offensive could not continue. Seventy-three tanks were lost and there were 385 casualties, including 50 dead, out of the 2313 men who had gone into action. These casualties were not evenly distributed among the *AS* units, some *groupes* having lost 21% of their personnel and over 80% of their tanks.[64] Roughly

[61]Ibid.
[62]SHD, 16N2164. Groupement X, *Engagement du 11 juin dans la région Tricot-Courcelles.*
[63]SHD, 16N2163, Groupement III, *Rapport*, undated.
[64]SHD, 16N2120, GQG, *Tableau rectifie des pertes en chars et personnel par engagement au cours de la campagne.*

three-quarters of the tanks lost were hit by direct fire, usually from field guns, the others succumbing to indirect heavy artillery fire, usually after being immobilised.[65]

In June 1918, it was decided that the *Instruction Provisoire* was in need of revision because of the introduction into service of the light-tanks and the formation of tank-regiments.[66] Alterations ranged from changes of emphasis to more detailed instructions on practical matters such as the strategic movement of tanks. Most importantly, part of the resume was changed. From stating that 'the *AS* should only be used *en masse* and with a precise aim' it was changed to; 'the *AS* should only be used *en masse* in regularly mounted offensives.'[67]

The conduct of operations from April to June had often been in contradiction to the provisions of the tank regulations, due to necessity and the extemporised nature of the fighting. The first opportunity to test the regulations in a large-scale offensive came in July 1918 at Soissons, as the final part of the Second Battle of the Marne. General Estienne had been considering mounting a tank attack without a preliminary artillery preparation since he first visited GQG with his proposals for a tank force in 1915. This idea had met with considerable scepticism within the French army until the success of the British tank attack at Cambrai silenced most doubt.[68] Experiments with surprise tank attacks on a small scale were made during the first half of 1918 that gave confidence that a large-scale engagement with this methodology could be used successfully.[69]

At Soissons, French X Army had 55 Renaults and 171 medium-tanks available on 17 July 1918, although breakdowns prevented many coming into action the next day.[70] In line with the tank-regulations, the original intention had been for the Renaults to accompany each front-line division but there were simply too few available to do this and they became the army reserve. As there would be no artillery preparation, the tanks were ordered to advance ahead of the infantry, tasked, as per the regulations, with neutralising machine guns and any strong points not destroyed by artillery fire. The jump-off time (04.35) was also in line with the regulations, having been chosen so that the tanks could get into action in semi-darkness. In addition to the normal

[65]Ibid.
[66]SHD, 16N2142, GAN, *Note pour le général commandant l'artillerie d'assaut,* 20 June 1918.
[67]Ibid.
[68]SHD, 16N2142, GAN, *Renseignements complémentaires de détail au sujet de l'emploi des tanks à Cambrai*, 6 March 1918.
[69]See SHD, 16N2163, Groupement Chanoine, *Compte rendu de l'opération du 9 Juillet,* 11 July 1918.
[70]AFGG 7/1, p. 23.

counter-battery fire and neutralisation of known artillery observation posts, a large number of smoke shells were included in the barrage.[71] In each infantry division a *groupe* of field-guns was tasked with only undertaking counter-battery fire against anti-tank guns.[72] Thus the tanks were to be well-protected from enemy artillery, in line with the regulations.

On 18 July, the French medium tanks went forward with the first wave of infantry, just as the intensive artillery barrage was unleashed, catching the Germans entirely by surprise, in some areas the French advancing several kilometres in the first push. The initial tank attack was very successful but as the day progressed the tank attacks became less and less effective as the tanks were used in smaller and smaller numbers.

Despite its success, Soissons raised a number of issues connected with the tank-regulations, although these were more to do with their implementation than any problems in their prescriptions. To address these problems, an important *Note* was issued by Groupe d'armeés du nord (GAN), addressed to its infantry and artillery commanders down to the level of battalion and *groupe*.[73] It was in effect a précis of the *Instruction,* justified because many important prescriptions 'were often forgotten in the last battles and the failure to observe these gave poor results.'[74] In particular, Soissons had confirmed that operations with either weak infantry or tank units would be unlikely to be successful. The *Instruction* had advised that the *AS* 'is used-up quickly on the battlefield,' requiring a careful management of tank reserves by commanders.[75] This is clearly illustrated by the course of the Battle of Soissons; on 18 July 1918, X Army had 226 tanks engaged, the following day only 105 tanks went into action. By 20 July, X Army *AS* had only 32 tanks combat-ready, although, through great overnight efforts by the maintenance crews, 100 were available for combat the next day. The following morning, there were only three tanks fit for combat and the *AS* was retired from the battle into the army reserve that evening.

A key mistake at Soissons was that the tank units had often been used piecemeal, with weakened infantry units, in insufficiently planned attacks, after the initial morning assault in the morning of 18 July, quite contrary to the provisions of the tank regulations. The *Note* emphasised that nearly all coming operations would be in

[71]SHD, 16N2162, Groupement I, *Annexe au rapport sur les opérations du 18 au 23 Juillet 1918*, undated.
[72]Ibid.
[73]SHD, 16N2142, GAN, *Enseignements tirés des combats récents en ce qui concerne l'artillerie d'assaut*, 9 September 1918.
[74]Ibid.
[75]*Instruction*, p. 6.

depth and the *AS* units needed to be distributed accordingly. The continuity of *AS* action could only be assured by having tank reserves at army, divisional and regimental level, with potential employment plans for these being made in advance by commanders.

Although it must be conceded that it was tempting for infantry commanders to use every means at their disposal to increase their success, it was clearly erroneous to expect small-scale tank attacks, unsupported by artillery and with depleted and exhausted infantry, to be successful against enemy positions that had already resisted a full-scale tank attack. However, getting this message across to the infantry commanders, desperate to limit their units' casualties, was to remain a problem for the rest of the war. As for the *AS,* one senior officer wrote that it was simply a matter of honour for them to remain on the battlefield to support the infantry.[76]

It was now clear that tanks could be used as a substitute for artillery in semi-mobile warfare, but it remained to be seen if this approach could work in an attack on a strongly fortified position. The operations in Champagne (September-October 1918) provide an illustration of how the tank regulations were being implemented towards the end of the war. By this stage of the war, the medium tanks were very much on the wane and initially only eighteen Schneiders were available for this operation to support 138 Renaults. The strength of the German defences in Champagne was formidable; in the main combat zone, the Germans had two lines of double-trenches, the second of which was placed on the reverse-slope of a crest and was at the limit of the French field artillery's range.[77] All the German trenches were covered by an extensive network of barbed-wire, with deep shelters in the trenches and concrete shelters for the German machine guns and observation posts. The terrain was equally difficult, being covered in small woods, with successive undulations and crossed by the Somme-Py to Manre railway line.[78] Once past this area, the ground became very treacherous for the tanks; it was heavily wooded with a series of deep ravines, the two principal ridges being held in strength by the Germans. In addition, the Germans had brought numerous reinforcements into the area as well as additional equipment, including machine guns, mines, cannons and anti-tank rifles.[79]

Despite such unfavourable conditions, the Champagne operations were relatively successful, particularly considering that, unlike at Soissons, they had taken place against a well-entrenched enemy. The Germans had received ample warning of a possible tank-attack and had plenty of time to prepare for it but the tank casualties

[76]21 Corps AS, *Rapport*, p. 12.
[77]SHD, 26N459/2, *Opérations offensives (26 Septembre–8 Octobre)*.
[78]Ibid.
[79]Ibid.

were relatively light; only fifty-two Renaults and five medium-tanks were seriously damaged out of the six hundred and seventy two tanks eventually engaged in the operation.[80] Although the rapid advance of the French infantry prevented most of the isolated forward anti-tank guns from coming into action, German field guns, both batteries and single guns, remained the main danger to the tanks.

The operations in Champagne reinforced the *AS* officers' belief in the soundness of their regulations. When used according to the regulations, as on the first day of action in Champagne, the tanks could offer substantial assistance to the infantry, but this was diluted as operations became of a smaller scale and more extemporised. The Champagne operations' major lesson in relation to the *AS* was the same as that of Soissons; there was a need for the tank regulations to be understood and adhered to by the infantry commanders, rather than any revision required, and there were no further tank regulations issued during the war.[81]

The experience of the *AS* illustrates the difficulties encountered in bringing sound military ideas into practice; as Clausewitz says, '...in war it is difficult for normal efforts to achieve even moderate results.'[82] The battles of Soissons and Champagne both demonstrate that French infantry commanders, from divisional level downwards, frequently either misunderstood or decided to ignore the tank regulations, the latter being likely in the majority of cases. The French army and GQG cannot be accused of failing to promulgate information to the infantry and artillery commanders as numerous notes on tank use were sent out on a regular basis.

The issue of risk is the key to understanding French battle-planning in 1918. By this stage of the war, the mutinies of the previous year had made French commanders well aware of the fragile nature of their force and they were, not unnaturally, somewhat risk averse. A widely circulated GQG report on Malmaison had drawn attention to the lower percentage of overall casualties suffered there when compared with the battles on the Aisne in April and May 1917 and Verdun in August 1917; the losses at Malmaison being 8.45%, on the Aisne 17.7% and 18.4% at Verdun (the majority of these casualties being from the infantry).[83] In relation to keeping infantry losses down, the tanks had proved particularly useful in eliminating German machine-gun nests untouched by the artillery preparation, thereby considerably reducing the infantry's losses. This fitted in nicely with French military planning, which was oriented around avoiding or minimising risk, even if taking a risk might

[80]*Tableau rectifie des pertes.*
[81]SHD, 16N2150, Estienne to Pétain, 21 November 1918.
[82]Clausewitz, *On War*, p. 120.
[83]AFGG 6/1, 1, 187, GAN, *Note sur les attaques à objectif limité*, 15 December 1917.

produce better results. It was clear to GQG that infantry casualties would be high, regardless of success, and therefore it was of the highest priority to ensure the initial attack was successful. The tanks therefore offered infantry commanders, at all levels, an opportunity to minimise their casualties.

David Johnson has argued that the French Army after the Great War 'viewed technology from an evolutionary perspective supportive of its existing doctrine,' which is equally true of the army's attitude during the war.[84] This appears a rather conservative approach until one considers the level of technology available, which was far too primitive to allow anything other than an incremental approach to integrating it into the army. It was certainly not developed enough to justify a radical break with existing doctrine in an army that had become justifiably cautious.

The evidence is that the *AS* fought the war in as intelligent and sensible a manner as was possible, given the state of the technology available. It was the limitations of this technology that caused the most problems in *AS* operations, rather than any failure of preparation, planning or execution. Not only was tank technology dependent on the primitive automobile industry of the time, it had to be tested and developed in the field. No amount of sound tank doctrine could compensate for the fragility of the material, for the paucity of battlefield communication equipment and for the lack of tank-infantry training opportunities. This is an illustration of an important if little acknowledged aspect of the war. Contrary to the popular caricature of the Great War military, good ideas were often quickly adopted but they had to wait for adequate equipment to come into service before they could be implemented. There was no lack of intellectual understanding of the tactical war in French commanders by 1917, what was lacking was the equipment to put this understanding into practice. Only in 1918 was the French army equipped with enough aircraft, enough tanks and, most importantly, enough heavy-artillery to begin to exercise a mastery of the new form of combined-arms warfare that arose in the Great War.

[84]David E. Johnson, *Fast Tanks and Heavy Bombers: Innovation in the US Army 1914–1945* (Ithaca, NY: Cornell UP, 1998), p. 3.

SUBMISSION GUIDELINES (July 2019)

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Book Reviews

The BJMH seeks to publish concise, accessible and well-informed reviews of books relevant to the topics covered by the Journal. Reviews are published as a service to the readership of the BJMH and should be of use to a potential reader in deciding whether or not to buy or read that book. The range of books reviewed by the BJMH reflects the field of military history, taken in the widest sense. Books published by academic publishers, general commercial publishers, and specialist military history imprints may all be considered for review in the Journal.

Reviews of other types of publication such as web resources may also be commissioned.

The Journal's Editorial Team is responsible for commissioning book reviews and for approaching reviewers. From time to time a list of available books for review may be issued, together with an open call for potential reviewers to contact the Journal

Editors. The policy of the BJMH is for reviews always to be solicited by the editors rather than for book authors to propose reviewers themselves. In all cases, once a reviewer has been matched with a book, the Editorial Team will arrange for them to be sent a review copy.

Book reviews should generally be of about 700 words and must not exceed 1000 words in length.

A review should summarise the main aims and arguments of the work, should evaluate its contribution and value to military history as broadly defined, and should identify to which readership(s) the work is most likely to appeal. The Journal does not encourage personal comment or attacks in the reviews it publishes, and the Editorial Team reserves the right to ask reviewers for revisions to their reviews. The final decision whether or not to publish a review remains with the Editorial Team.

The Editorial Team may seek the views of an author of a book that has been reviewed in the Journal. Any comment from the author may be published.

All submitted reviews should begin with the bibliographic information of the work under review, including the author(s) or editor(s), the title, the place and year of publication, the publisher, the number of pages, the ISBN for the format of the work that has been reviewed, and the price for this format if available. Prices should be given in the original currency, but if the book has been published in several territories including the UK then the price in pounds sterling should be supplied. The number of illustrations and maps should also be noted if present. An example of the heading of a review is as follows:

James Gow, *The Serbian Project and its Adversaries: a Strategy of War Crimes*. London: Hurst, 2003. xii + 322 pp. 1 map. ISBN 978-1850654995 (Paperback). Price £17.50.

The reviewer's name, and an institutional affiliation if relevant, should be appended at the bottom of the review, name in Capitals and Institution in lower case with both to be right aligned.

Reviews of a single work should not contain any footnotes, but if the text refers to any other works then their author, title and year should be apparent in order for readers to be able to identify them. The Editorial Team and Editorial Board may on occasion seek to commission longer Review Articles of a group of works, and these may contain footnotes with the same formatting and standards used for articles in the Journal.

BJMH STYLE GUIDE (July 2019)

The BJMH Style Guide has been designed to encourage you to submit your work. It is based on the Chicago Manual of Style and more about this style can be found at:

http://www.chicagomanualofstyle.org/home.html

Specific Points to Note

Use Gill Sans MT 10 Point for all article and book review submissions, including footnotes.

Text should be justified.

Paragraphs do not require indenting.

Line spacing should be single and a single carriage return applied between paragraphs.

Spellings should be anglicised: i.e. –ise endings where appropriate, colour etc., 'got' not 'gotten'.

Verb past participles: -ed endings rather than –t endings are preferred for past participles of verbs i.e. learned, spoiled, burned. While is preferred to whilst.

Contractions should not be used i.e. 'did not' rather than 'didn't'.

Upon first reference the full name and title of an individual should be used as it was as the time of reference i.e. On 31 July 1917 Field Marshal Sir Douglas Haig, Commander-in-Chief of the British Expeditionary Force (BEF), launched the Third Battle of Ypres.

All acronyms should be spelled out in full upon first reference with the acronym in brackets, as shown in the example above.

Dates should be written in the form 20 June 2019.

When referring to an historical figure, e.g. King Charles, use that form, when referring to the king later on in the text, use king in lower case.

Foreign words or phrases such as *weltanschauung* or *levée en masse* should be italicised.

Footnoting:

- All references should be footnotes not endnotes.
- Footnote numeral should come at the end of the sentence and after the full stop.
- Multiple references in a single sentence or paragraph should be covered by a single footnote with the citations divided by semi-colons.

Quotations:

- Short (less than three lines of continuous quotation): placed in single quotation marks unless referring to direct speech and contained within that paragraph. Standard footnote at end of sentence.
- Long (more than three lines of continuous quotation): No quotation marks of any kind. One carriage space top and bottom, indented, no change in font size, standard footnote at end of passage.
- Punctuation leading into quotations is only necessary if the punctuation itself would have been required were the quotation not there. i.e. : ; and , should only be present if they were required to begin with.
- Full stops are acceptable inside or outside of quotation marks depending upon whether the quoted sentence ended in a full stop in the original work.

Citations:

- For books: Author, *Title in Italics*, (place of publication: publisher, year of publication), p. # or pp. #-#.
- For journals: Author, 'Title in quotation marks', *Journal Title in Italics*, Vol. #, Iss. # (or No.#), (Season/Month, Year) pp. #-# (p. #).
- For edited volumes: Chapter Author, 'Chapter title' in Volume Author/s (ed. or eds), *Volume title in italics*, (place of publication: publisher, year), p. # or pp. #-#.
- Primary sources: Archive name (Archive acronym), Catalogue number of equivalent, *'source name or description' in italics* if publicly published, p. #/date or equivalent. Subsequent references to the same archive do not require the Archive name.
- Internet sources: Author, 'title', URL (with date accessed) The time accessed may also be included, but is not generally required, but, if used, then usage must be consistent throughout
- *Op cit.* should be shunned in favour of shortened citations.
- Shortened citations should include Author surname, shortened title, p.# for books. As long as a similar practice is used for journals etc., and is done consistently, it will be acceptable.

- Ibid., with a full stop before the comma, should be used for consecutive citations.

Examples of Citations:

- Michael Howard, *War in European History* (Oxford: Oxford University Press, 2001), p. 21.
- Michael Collins, 'A fear of flying: diagnosing traumatic neurosis among British aviators of the Great War', *First World War Studies*, 6, 2 (2015), pp. 187-202 (p. 190).
- Michael Howard, 'Men against Fire: The Doctrine of the Offensive in 1914', in Peter Paret (ed.), *Makers of Modern Strategy*, (Oxford: Clarendon, 1994), pp. 510-526.
- The UK National Archives (TNA), CAB 19/33, Lieutenant-General Sir Henry Sclater, evidence to Dardanelles Commission, 1917.
- Shilpa Ganatra, 'How Derry Girls Became an Instant Sitcom Classic', *The Guardian*, 13 February 2018 https://www.theguardian.com/tv-and-radio/2018/feb/13/derry-girls-instant-sitcom-classic-schoolgirls-northern-ireland. Accessed 1 January 2019.

Note: Articles not using the citation style shown above will be returned to the author for correction prior to peer review.