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Experimental Units: The Historical Record

Williamson Murray

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INSTITUTE FOR DEFENSE ANALYSES

Theodore S. Gold – Joint Advanced Warfighting Program

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Experimentation has played a major role in the transformation of military forces throughout history. The process of experimentation with new military capabilities and force structures is not just a matter for simulations in laboratories or for the writings of theorists. Its success often depends on the establishment of experimental units that can test emerging theoretical and technological capabilities to the fullest. Moreover, it is not just a matter of peacetime innovation. The historical record indicates that experimental units in wartime can be equally important in developing new possibilities and potential.

In this paper, historian Williamson Murray examines a number of case studies from the first half of the twentieth century. These range from the use by the Germans of experimental Stormtroop units to develop concepts of fire and maneuver to the different paths pursued by the Germans and the British in developing the tank during the period from 1920 through 1930. He concludes with an examination of the creation of experimental carrier units by the US Navy in the interwar period (1919–1939). In all of this rich historical experience there is much we can learn.

In other IDA papers, Dr. Murray and his co-authors have also drawn from history to help illuminate transformation challenges we face today:

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War and Urban Terrain in the Twenty-First Century

Thinking About Innovation

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FY2000 End of Year Report: Volumes I, II, and III, Theodore S. Gold et al., IDA Paper P-3571, November 2000.

Preface

This paper was prepared under the task order Joint Advanced Warfighting Program (JAWP). The initial suggestion for this topic came from Dr. Andrew Marshall, Office of Net Assessment. It addresses the task order objective of generating advanced joint operational concepts and joint experimentation to assist the Department of Defense in transforming U.S. military capabilities.

The JAWP was established at the Institute for Defense Analyses (IDA) by the Office of the Secretary of Defense and the Joint Staff to serve as a catalyst for stimulating innovation and breakthrough change. The JAWP is composed of military personnel on joint assignments from each Service and civilian analysts from IDA. The JAWP is located principally in Alexandria, Virginia, and includes an office in Norfolk, Virginia, that facilitates coordination with the United States Joint Forces Command.

This paper does not necessarily reflect the views of IDA or the sponsors of the JAWP. Our intent is to stimulate ideas, discussion, and, ultimately, the discovery and innovation that must fuel successful transformation.

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Executive Summary

Introduction

In the past *Experimental units* have played a major role in extending combat capabilities and developing new concepts and doctrine for military organizations confronting seemingly insoluble challenges. Consequently, experimental units have become an essential part of the processes of successful and often revolutionary transformation and innovation.

This paper focuses on experimental units in the first half of the twentieth century: the experimental units of the First World War (German Stormtroopers and the British tank corps) and the experimental units in the interwar years (the German panzer force, the British Experimental Tank Force, and the US Navy's carrier experiments). All faced the same types of problems, and any success in the field was based, in part, on their leaders' ability to challenge the traditions and culture of their services.

Experimental Units in World War I (1914–1918)

The German Army's Stormtroop Experiment. The Germans created feedback loops to build an accurate picture of the battlefield, and used this to empower experimental units whose culture, tactical concept, and doctrine, and even weaponry were quite different than the regular line infantry units.

In 1916, the new Quartermaster General of the German Army, General Erich Ludendorff, initiated a wide-ranging re-assessment of German doctrine and battlefield concepts in reaction to the overwhelming materiel superiority of the British Army in the battle of the Somme. As a result, a substantial

portion of German defenders were moved towards the rear and out of the range of enemy artillery which had emerged in 1916 as the war's great killer. To hold defensive positions, the Germans now relied on a thin screen of machine gunners, a number of fortified positions with interlocking fields of fire, and counterattacks launched from positions out of the range of enemy artillery. The key component in the new German scheme of defensive warfare would be the counterattack.

Leading the counterattack were Stormtroopers, a recent innovation that emerged from the raiding units organized originally to handle the exigencies of trench warfare. The Stormtroopers were equipped with new and more effective weapons, but more importantly their training, doctrine, and leadership differed substantially from regular line infantry units. The Stormtroop units brought new concepts of combined-arms fire and maneuver to a battlefield once characterized by tactical futility. In addition, they eventually served as instructors to the regular infantry formations with which they served.

The British Army's Experimental Tank Corps. The British creation of a tank force was the other interesting employment of experimental units during World War I. The tank did not exist as a weapon or even as a concept—at least in the minds of military men—before the outbreak of World War I. The first tanks were developed by desperate innovation in the United Kingdom.

Among the difficulties the British confronted was the reality that no organization existed either to employ or to maintain such vehicles. Tactical conceptions did not yet exist for their employment in combat, nor did the means exist for these new weapons to cooperate with the infantry, much less the artillery.

Initial setbacks were not sufficient to end the British Expeditionary Force's support for continued development of the weapons system. The experimental Tank Corps attracted and then nurtured a number of imaginative and innovative advocates for the further development and employment of the tank. By November 1917, the crews of the Royal Tank Corps had learned how to work with the infantry and the artillery.

After much experimenting, the tank forces eventually played a major role in the Allied victory in the late summer and fall of 1918. In the long term, the experimental tank unit was responsible for creating an entirely new weapons system and opening up one of the avenues through which modern combined-arms mechanized warfare would emerge in the 1940s.

Experiment Units and the Interwar Years (1919–1939)

The years between 1919 and 1939 showed imaginative use of experimental units to expand and develop new concepts and technologies. Experimental units were essential to the development of mechanized combined-arms warfare, carrier warfare, airborne assault, amphibious warfare, and strategic bombing. Experimental units also proved to be crucial in translating concepts emerging from World War I into a form usable by the larger force structure. In the two cases recounted here, the development

of mechanized combined-arms warfare and the development of carrier warfare, the combat forces that evolved from the experimental units of World War I came to dominate the conduct of war by the armies and navies of World War II.

The Creation of the German Panzer Force and the Failure of the British Experimental Tank Force. The German Army took a number of important steps to improve its performance in the next conflict. It established experimental mechanized and motorized units to explore:

- ▶ *independent tank battalions*, largely aimed at supporting the infantry;
- ▶ *independent tank regiments*, with an emphasis on all-armed formations;
- ▶ *motorized infantry divisions*, to explore increasing the maneuverability of the infantry;
- ▶ *light divisions*, to explore the use of cavalry and armor working together as a reconnaissance force; and
- ▶ *armored divisions*.

All received provisional status within the framework of the regular army buildup, but clearly the intention was to discover, through experiments and exercises, what worked and what did not.

By the late 1930s, the work with the *Wehrmacht's* experimental units had begun to pay off, as the winners and losers became clear. The clearest winner was the panzer division, with three divisions established in 1935.

The British emerged from World War I with the most experienced armored force. But the drastic downsizing in the war's aftermath shrank the Tank Corps to a few insignificant

units. Despite considerable restraints, Lord Milne, the Chief of the Imperial General Staff, established an experimental armored force out of the hodgepodge of motorized and tank units for the 1927 maneuvers.

This experiment exposed some of the difficulties in waging operations with mobile forces. But at the same time, the light tank force executed a stunning twenty-five-mile march that entirely dislocated the opposing force and brought the maneuvers to a halt. Succeeding maneuvers with experimental forces over the course of the next two years, and then again in 1934, suggested the operational parameters within which mechanized warfare might operate. These British experiments were the most imaginative and innovative of the interwar period. *Unfortunately, it was the Germans who learned the most from these efforts.*

The US Navy's Carrier Experiment. The late entry of the United States into the First World War robbed its navy of opportunities to participate in significant naval action outside of anti-submarine warfare. Moreover, the Royal Navy, its only real rival in the 1920s, emerged from the war with the first flush deck carrier and considerable experience in launching aircraft off ships. Yet twenty years later, at the outbreak of the Second World War, the carriers of the US Navy would possess capabilities significantly superior to those of the Royal Navy.

Concluding Comments

Confronted with a dynamic environment involving technological and tactical change, military institutions have used experimental units not only to point the way to the future but as a means to further the doctrinal and conceptual possibilities. Among the implications for today:

- ▶ Radically new weapons systems demand the creation of experimental units.
- ▶ The military should address the past honestly and carefully, and not use lessons-learned analyses to justify current concepts and beliefs or to make their officers look good.
- ▶ Feedback loops should be used to empower and build on experimental units, and help build a more accurate picture of the battlefield.
- ▶ Experimental units should remain connected to an intelligent basic doctrine capable of expansion and flexibility.
- ▶ Concepts and tactical framework for the experimental forces should be tested to their limits. When the results show that the experimental units are not working out, they should be changed.
- ▶ To challenge the traditions and culture of a military service still requires the services of mavericks, usually seen as the outsiders.

Experimental Units: The Historical Record

Introduction

Military institutions invariably believe their organizational structures, doctrine, training, and tactics are second to none. Consequently, any significant change represents a threat to hard-earned truisms, beliefs, and capabilities. There is some basis to such attitudes. Radical change not only has the potential to bring about significant advances in military performance, it also has the potential to destroy significant military capabilities inherited from the past as well as military capabilities that rest on realistic appraisals of the harsh, fundamental nature of war. Understandably, there is a sense among some in the Services that the current structures of U.S. forces represent the final stage in the processes of military evolution stretching back four hundred years.

Unfortunately, the biological sciences suggest there is no such thing as *stasis* in living, dynamic organisms.¹ In a complex adaptive environment, organizations either adapt to changing circumstances or they die. Military institutions that have refused to adapt to new paradigms of war were inevitably those that lost wars and placed the survival of their nations in jeopardy. And it is clear that we are presently living in an era of revolutionary technological change not only for society but for military institutions as well.

Over the past four hundred years, armies and navies (and eventually air forces) have been involved in ever faster processes of change and adaptation. In periods of great social and technological changes, those processes have resulted in military revolutions or revolutions in military affairs.² One of the crucial enablers in those processes has been

¹ I am indebted to LtGen Paul Van Riper, USMC (ret.), for this point and for a wider understanding of the relationship between history and the new sciences that depend on nonlinearity.

² For a recent view of what has actually been involved in so-called “Revolutions in Military Affairs,” see MacGregor Knox and Williamson Murray, *The Dynamics of Military Revolution, 1300–2050* (Cambridge, UK: Cambridge University Press, 2001), especially chapter 1. In the case of military revolutions, massive changes in the political landscape, such as the creation of the concept of the modern state, the French Revolution, and the Industrial Revolution, have created changes so vast and fundamental that military institutions themselves have been altered in fundamental ways, and the entire social, political, and economic basis of war altered as well. Such military revolutions are so vast and all encompassing that military institutions have had little ability to control their own fates. Revolutions in Military Affairs, on the other hand, have been more discreet in their forms and outcomes. While there are considerable uncertainties in their evolution, military institutions, given the right circumstances and leadership, can exercise considerable control over their own transformation. For the

the use of experimental units to explore the possibilities and provide a guide to difficult and uncertain tactical and operational problems. This has been the case in times of both war and peace, where the establishment and success of experimental units have played a major role in the emergence of new concepts and approaches raised by either technological change or changes in the nature of war.

This paper focuses on the creation and utility of experimental units in the military history of the first half of the twentieth century. Among the examples studied by the author were:

- ▶ Experimental units in World War I: (1) The German Army's Stormtroop experiment. (2) The British Army's experimental tank corps.

- ▶ Experimental units in the interwar years: (1) The creation of the German panzer force. (2) The failure of the British experimental tank force. (3) The US Navy's carriers experiment.

This paper explores the dynamics by which military institutions have used experimental units to examine the potential of new technologies, tactics, and operational concepts. Confronted with a dynamic environment in which technological and tactical change was the order of the day, some military institutions have used experimental units not only to point the way to the future but as a means to further the doctrinal and conceptual possibilities. But even in war, with its direct feedback, the ability to learn and adapt by using such experimental units has proven difficult. Nevertheless, experimental units have proven to be an essential part of the processes of successful transformation and innovation in the twentieth century.

processes involved in the latter case, see Williamson Murray and Allan R. Millett, *Military Innovation in the Interwar Period* (Cambridge, UK: Cambridge University Press, 1996).

Experimental Units in World War I

If experimental units were of considerable use in the early periods of Western military history to extend and develop combat capabilities, they have played a crucial role in developing concepts and doctrine throughout the course of the twentieth century.³ Technological change had an enormous impact on the conduct of World War I, as military organizations grappled with seemingly insoluble problems. In peacetime, military institutions confront the fact that technological change might well require very different solutions to the tactical and doctrinal problems they confront. In war and peace, experimental units proved have extended combat capabilities, and, in some cases, created the basis for revolutionary transformation.⁴

The German Army's Stormtroop Experiment

World War I presented the most difficult set of tactical and technological problems that military organizations have ever confronted.⁵ The Battle of the Somme in 1916 best represents the tactical futility of that war, where masses of men slaughtered each other in battles marked by a lack of imagination on the part of military leaders and their staffs. Towards the end of that battle the new Quartermaster General of the German Army, General Erich Ludendorff, initiated a wide-ranging reassessment of German doctrine and battlefield concepts in reaction to the British Army's overwhelming materiel superiority.⁶

³ For a discussion of the role of experimental units before 1900, see the appendix to this document.

⁴ Or what in current terminology is called a "Revolution in Military Affairs."

⁵ As Paul Kennedy has suggested about World War I, "[B]ecause soldiers simply could not break through a trench system, their generals' plans for campaign successes were stalemated on each side; these operational failures in turn impacted upon the strategic debate at the highest level, and thus upon the strategic options being considered by national policy makers; and these *pari passu* [at an equal pace; side by side] affected the consideration of ends versus means at the political level, the changing nature of civil-military relations, and the allocation of natural resources." Paul Kennedy, "Military Effectiveness in the First World War," in *Military Effectiveness*, vol. 1, *The First World War*, edited by Allan R. Millett and Williamson Murray (London: Allen & Unwin, 1988), p. 330.

⁶ Ludendorff was in fact not a logistician at all but rather the equivalent to the chief of staff to the new leader of the German army, Field Marshal Paul von Hindenburg. Moreover, Ludendorff under the German system possessed far greater powers (to include those of dual command) than any chief of staff in the British or American systems.

After an exhaustive examination of the deficiencies that had appeared in the German Army's conduct of the Somme, Ludendorff had the General Staff issue a new doctrinal concept, "The Principles of Command in the Defensive Battle in Position Warfare."⁷ The new doctrine moved a substantial portion of the defenders rearward out of the range of enemy artillery, since by 1916 artillery had emerged as the war's great killer. To hold a defensive position, the Germans now relied on thin screen of machine gunners, a number of fortified positions with interlocking fields of fire, and counterattacks launched from positions out of the range of enemy artillery fire. The key component in the new German scheme of defensive warfare would be the *counterattack*.

Here Ludendorff and the proponents of the new doctrine found the development of "Stormtroop" experimental units during 1915 and 1916 of enormous utility. The Stormtroop units had emerged from raiding units organized to handle the exigencies of trench warfare in 1915. On April 1, 1916, on the basis of successes gained by the assault companies in the initial assault on Verdun, the high command on the Western Front had ordered the concentration of specialized units into a special experimental battalion, Assault Battalion "Rohr," named for its innovator and commander, Captain Willy Martin Rohr. Along with Rohr's new battalion, the Germans also converted four *Jäger* battalions to the same pattern.⁸

During his visit to the Western front in September 1916, Ludendorff came across these experimental units and was immediately convinced of their value.⁹ As he indicates in his memoirs:

On the Eastern Front we had for the most part adhered to the old tactical methods and the old training which we had learned in days of peace.

⁷ For a brilliant short discussion of the processes through which the Germans went in developing a new way of fighting the defensive battle, see Timothy Lupfer, *The Dynamics of Doctrine: The Changes in German Tactical Doctrine During the First World War*, Combat Studies Institute, Leavenworth Papers, July 1981. In his memoirs Ludendorff made clear that his expectation from his interviews of front-line commanders and soldiers was to hear "their real views and have a clear idea of the true situation, not a favorable report made to order." Erich von [sic] Ludendorff, *Ludendorff's Own Story, August 1914–November 1918*, vol. 1 (New York: Harper & Brothers, 1919), p. 24.

⁸ Bruce I. Gudmundsson, *Stormtroop Tactics, Innovation in the German Army, 1914–1918* (New York: Praeger, 1989), p. 77.

⁹ D. J. Goodspeed, *Ludendorff, Genius of World War I* (Boston: Houghton Mifflin, 1966), p. 194.

Here [in the west] we met with new conditions, and it was my duty to adapt myself to them.¹⁰

Ludendorff ordered Rohr to conduct schools in stormtroop tactics and concepts so that the German armies on the Western Front could begin training Stormtroop companies for their divisions, and eventually for the regiments within each division.¹¹

The recasting of German defensive doctrine also resulted in efforts to expand the experimental Stormtroop force. With Ludendorff's energy and support behind the program, by February 1917 German forces on the Western Front possessed fifteen assault battalions and two independent assault companies, all trained in the new concepts of combined-arms fire and maneuver, which had been developed by the Stormtroop units.¹²

The battles of 1917 tested these new formations, and the German Army, to the breaking point. Hitherto, whether in company or battalion form, the Stormtroop units had been regarded largely as raiding parties. Now, their essential role was to serve as the lead units of the counterattack forces—in other words they were no longer the initiators of action but responders to the enemy's actions. The demand placed on them to develop new tactics, techniques, and procedures was that much greater; and they held the key role of serving as instructors to the regular infantry formations with which they served.

The continued experimental nature of the Stormtroop units in the organizational framework of the German Army was underlined by the fact that they remained provisional units “with no home barracks, no district from which to draw recruits, no connection to a particular locality, no genealogy like those which linked many other units in the German Army to eighteenth and even seventeenth century regiments, and no colors.”¹³ But this did not mean that they did not continue to draw the elite of the

¹⁰ Ludendorff, *Ludendorff's Own Story*, vol. 1, p. 324. As for the Stormtroop formations, Ludendorff writes that “the formation of storm troops from the infantry, which had begun during the war, had not only to be regularized, but to be adapted to the common good. The instruction formations and the storm battalions had proved their high value both intrinsically and for the improvement of the infantry generally. They were examples to be imitated by the other men. But for this it was necessary to have a training-manual prepared, and this had not yet been done.” Ludendorff, *Ludendorff's Own Story*, p. 323.

¹¹ Gudmundsson, *Stormtroop Tactics*, pp. 80–81.

¹² Gudmundsson, *Stormtroop Tactics*, p. 84.

¹³ Gudmundsson, *Stormtroop Tactics*, p. 86.

officer corps, non-commissioned officers (NCOs), and enlisted ranks. Moreover, the insignia of some Stormtroop units was the same as the Prussian Guards, the most prestigious unit in the German Army.

By the end of 1917, the Germans had developed enough expertise and effectiveness in the Stormtroop units to be able to launch corps-sized counterattacks. In November 1917, the British gained a major victory at Cambrai through the use of tanks; their attack ruptured defensive positions held by second-rate German infantry units. Ten days later the German Second Army launched its counterattack with thirteen divisions against the newly dug British defenses. Using its one Stormtroop battalion along with the assault companies of the attacking divisions, the Germans were able to win back all the territory they had lost and then some. The assault by the Stormtroopers heralded the wider adaptation of infiltration, exploitation, and decentralized tactics that would reintroduce maneuver to the battlefield. The Second Army's counterattack represented a stunning victory for the Germans, coming so shortly after the success of British tanks at Cambrai.¹⁴

Aiming to achieve victory in spring 1918, before the Americans could arrive on the Western Front in substantial numbers, Ludendorff now took the lessons learned by the experimental Stormtroop units and applied them to retraining and reorganizing a substantial portion of the units on the Western Front.¹⁵ What is particularly interesting in this effort was the ability of the German General Staff system to produce a new doctrinal manual based on the actual experiences of the experimental Stormtroop units (and others), establish schools for training officers (from generals down to lieutenants) and NCOs in the new concepts, and then train the attack divisions with carefully selected personnel from the company to the division level.¹⁶ On January 1, 1918, the German High Command issued its new doctrine of the attack, *The Attack in Position*

¹⁴ Gudmundsson, *Stormtroop Tactics*, pp. 139–141.

¹⁵ Until relatively recently, historians attributed the German successes in spring 1918 to reinforcements received from the Eastern Front, divisions released by the collapse of Tsarist Russia and the seizure of power in that country by the Bolsheviks. In fact, Ludendorff kept most of the forces in the east for much of the year for two reasons: first, because he continued to pursue his megalomaniacal territorial goals; and second because a substantial number of the troops had already become infected by Bolshevik propaganda and were deserting in droves from the troop trains that moved them across Germany from the Eastern Front to the Western Front.

¹⁶ For the processes, see in particular *Reichsarchiv, Der Weltkrieg, 1914 bis 1918*, vol. 14, *Die Kriegführung an der Westfront im Jahre 1918* (Bonn: Bundesarchiv, 1956), pp. 41–42; see also Ludendorff, *Ludendorff's Own Story*, vol. 2, pp. 200–211.

Warfare.¹⁷ Less than three months later, on March 21, 1918, the German Army launched its massive offensive against the British armies in Flanders and northern France.¹⁸

The Germans were to achieve an enormous tactical success in that offensive, entirely breaking through the British defenses along a wide front and for a short time threatening to drive the French and British armies apart. Ironically, those tactical victories of March 1918 did not lead to impressive operational gains, and instead placed the Germans in an even more difficult strategic situation than they had been before their offensive in the west.¹⁹ What is important here is the fact that the Germans succeeded over the course of World War I in inventing the tactics, techniques, and procedures of combined-arms maneuver warfare—least at the tactical level—largely due to the experiences gained by the experimental Stormtroop units.

To all intents and purposes, the Germans succeeded in inventing modern war through the use of the Stormtroop experimental units. The key enabler to that process began with the establishment of experimental raiding units in 1915 at the platoon and company level, and then in 1916 the concentration of experimental Stormtroop and assault units at the battalion level. The ability of the Germans to use feedback loops to build an accurate picture of the battlefield was indeed admirable.²⁰ But equally important was their willingness to empower and then build on experimental units, whose culture, tactical concepts and doctrine, and even weaponry were quite different than the regular line infantry units.

The British Army's Experimental Tank Corps

Another interesting employment of experimental units to develop new approaches to war during the conduct of campaigns in World War I was the British Army's creation of a tank force, which was to play a major role in the Allied victory in late summer and fall

¹⁷ For a concise, clear explanation of the new doctrine, see Lupfer, *The Dynamics of Doctrine*, pp. 41–49.

¹⁸ For more about that, see Martin Middlebrook, *The Kaiser's Battle, 21 March 1918: The First Day of the German Spring Offensive* (London: Penguin Books, 1978).

¹⁹ That failure reflected a number of peculiar factors in the German way of war, including the understandably narrow focus in 1918 by all the armies engaged in the fighting on the Western Front on solving the tactical problems raised by trench warfare. On the peculiarities of the German “way of war,” see Williamson Murray, *German Military Effectiveness* (Baltimore, MD: Nautical and Aviation Publishing, 1992).

²⁰ Feedback loops create the ability of an organization to pass accurate information up the chain of command so that commanders at higher levels and their staffs can gain an accurate picture of what is actually happening on the battlefield.

1918. The tank did not exist as a weapon or even as a concept—at least in the minds of military men—before the outbreak of the conflict. It received its initial impetus for development from Winston Churchill in 1914, when Churchill was still First Lord of the Admiralty.²¹

The first tanks were developed by desperate innovation in the United Kingdom. The greatest difficulties the British confronted in employing were the harsh realities that

- ▶ no organization existed to employ or maintain such vehicles,
- ▶ no tactical conceptions yet existed for their employment in combat, and
- ▶ no means yet existed for tanks to cooperate with infantry, much less artillery.

Given the lack of reliability of a new technology and weapons system, just getting tanks to the battlefield in France from the factories and training facilities in the United Kingdom represented a considerable challenge.

Recent research has shown that the postwar view propagated by British armored war advocates J. F. C. Fuller and B. H. Liddell Hart—namely that Field Marshall Sir Douglas Haig and the British High Command displayed little interest in tanks—was not true. In fact, Haig, the commander of the British Expeditionary Force in France, was quite supportive of the development of the tank, along with a number of other weapons systems.²² As Fuller grudgingly admitted after the war, Haig’s use of the first experimental tank unit at the Somme in September 1916 was an absolute necessity in order to examine the tactical utility of the armored fighting vehicle as well as its mechanical limitations.²³

²¹ The most thorough and careful reconstruction of the development of the tank in the British Army is J. P. Harris, *Men, Ideas, and Tanks: British Military Thought and Armoured Forces, 1903–1939* (Manchester, UK: Manchester University Press, 1995).

²² In February of 1917, Haig placed tanks as his number three priority after the Royal Air Service—soon to become the Royal Air Force—and 188 locomotives to support the light railways behind British lines. With those exceptions Haig noted, “the prompt and continuous delivery of Tanks at the greatest rate at which they can be turned out and shipped to France should be ensured.” Harris, *Men, Ideas, and Tanks*, p. 73.

²³ After the war Fuller commented on the first use of the tanks on the Somme to Liddell Hart in the following terms: “The use of the tanks on 15 September [1916] was not a mistake. Serious mechanical defects [were] manifested. No peace test can equal a war test.” Quoted in Harris, *Men, Ideas, and Tanks*, p. 74.

Discovering the best way to employ such a radically new weapons system demanded the creation of an experimental unit. The establishment of the experimental tank unit in Britain received the initial title of “the Heavy Branch Machine Gun Corps”—the title undoubtedly an effort to provide security about the development of a new weapon. In July 1917, with the tank now having received considerable publicity in the British press, and undoubtedly known to the Germans by its use in battle, the experimental unit received a Royal Warrant constituting it as the “Tank Corps.”²⁴ The new title came at a time when the fortunes of the tank hardly appeared bright. Armored fighting vehicles had proven of some use on the Somme, but in the Messines attack of June 7, 1917, out of sixty-nine tanks used, only nineteen proved of any use to the attacking infantry, while forty-eight of the tanks ditched (i.e., stuck in trenches) and seventeen broke down entirely.²⁵

A number of factors contributed to the initial difficulties the British encountered in utilizing the new weapon:

- ▶ First, there was little commonality of experience between the tank crews and the front-line infantry, as there had been between the Stormtroops and the front-line German infantry.
- ▶ Equally important, the initial commitment involved the tanks in terrain that had been thoroughly chewed up by artillery bombardments, straining vehicles that were already mechanically unreliable.

Nevertheless, initial setbacks were not sufficient to end the British Expeditionary Force’s support for continued development of the weapons system.²⁶ Moreover, the experimental Tank Corps attracted and then nurtured a number of imaginative and innovative advocates for the further development and employment of the tank. Foremost among these was J. F. C. Fuller.

In November 1917, Haig supported a major blow by the Tank Corps against German positions at Cambrai. Here there was no long preliminary bombardment to alert the Germans and wreck the landscape. Rather after a short, sharp bombardment, over three

²⁴ Harris, *Men, Ideas, and Tanks*, p. 101.

²⁵ Harris, *Men, Ideas, and Tanks*, p. 99.

²⁶ And that support, which placed tanks lower in priority than other weapons systems such as aircraft, must be seen in the light of the tank’s performance to that point in the war rather than in the light of what tanks proved able to do decades in the future.

hundred tanks struck out across no-man's land, with fifty-four held in reserve. The attack succeeded in entirely rupturing the German front lines. The success must be seen as a sign of the emergence of combined-arms warfare rather than a singular success for the Tank Corps.²⁷ By now the crews in the Royal Tank Corps were learning how to work with the infantry, while the artillery bombardment, predicated on new techniques of indirect fire and off-the-map shooting, was able to make major contributions. Finally, the Royal Air Force rolled in with the first true use of massed close air support in the war.

The Cambrai success was such that the Tank Corps would have an even more important role in 1918. But it still remained very much an experimental unit. Above all, it still was not a regiment, the key mark of permanence in the British Army's scheme of organization. Moreover, in the defensive fighting that marked the first half of 1918 on the Allied side, it remained of limited utility because of its lack of speed and mechanical reliability. Nevertheless, by 1918 the experimental force had reached quite respectable proportions. Reorganized after the Battle of Cambrai, the Tank Corps was to have two heavy groups and one light group, each heavy with two brigades, each with 288 tanks. The light group was to consist of 410 of a new, more mobile armored fighting vehicle.

In the first major British offensive of 1918, the Amiens attack beginning on August 8, 1918, the Tank Corps was able to make a substantial—if not decisive—contribution to a victory that Ludendorff later described as the “blackest” day of the German Army in the war. A sudden, massive artillery barrage, the skillful use of gas, and 430 tanks, working with infantry with whom they had carefully trained, destroyed six German divisions in a day.²⁸

Succeeding British attacks over the course of the next three months were not able to utilize the tanks quite so effectively, due in part to losses suffered in the Amiens attack and in part to the speed with which conventional attacks now moved against a collapsing and defeated German Army. Nevertheless, the experimental Tank Corps made a substantial contribution to the successive British victories. It paid for its success in blood: of the 7,200 fully trained officers and men on the rolls of the Tank Corps on August 8, with a further 500 men in training, 561 officers and 2,627 Other Corps Ranks became casualties in three months of fighting.²⁹

²⁷ Which is how Fuller and Liddell Hart would see it throughout the interwar period.

²⁸ Harris, *Men, Ideas, and Tanks*, pp. 169–179.

²⁹ Harris, *Men, Ideas, and Tanks*, p. 186.

In the long term, the experimental tank unit was responsible for creating an entirely new weapons system and opening one of the avenues through which modern combined-arms, mechanized warfare would emerge in the 1940s. From the beginning, British innovators confronted enormous difficulties:

- ▶ They first had to develop a new weapons system on a weak technological base;
- ▶ they had to figure out how to integrate that weapons system into an emerging and complex system of war; and
- ▶ they had to build up a support and training and logistics base to support the continued employment of a weapons system, the technology of which was also undergoing rapid change.

As one tank officer suggested with some pride shortly after the war:

Taking it all in all, I doubt if there can be anything, even in the exceptional records of the war, to equal in extent and variety the growth of the technical, instructional, and supply branches of the Tank Corps during the last two years [of the war].³⁰

³⁰ Harris, *Men, Ideas, and Tanks*, p. 188

Experimental Units in the Interwar Years

The period between the two world wars (1919–1939) is rich with the use of experimental units to expand and develop new concepts and technologies. Experimental units were used in creating mechanized, combined-arms warfare; carrier warfare; airborne assault; amphibious warfare; and strategic bombing. For brevity's sake, this paper will concentrate on the first two: the development of mechanized, combined-arms warfare and of carrier warfare. Experimental, or provisional, units proved to be crucial in taking concepts emerging from World War I and translating those concepts into a form usable by the larger force structure.³¹ In the two cases recounted here, the combat forces that evolved from those initial experimental units came to dominate the conduct of war by the armies and navies of World War II.

The Creation of the German Panzer Force

As the German Army emerged from its defeat in World War I, it took a number of important steps to prepare for the next conflict.³² Its new commander-in-chief after the Kapp Putsch in 1920, General Hans von Seeckt, set about changing the culture of the officer corps during the downsizing demanded by the victorious Allies. At the same time he set in motion a major lessons-learned analysis of the army's combat experiences in World War I, spearheaded by fifty-seven different committees. This latter effort resulted in the promulgation of a new basic doctrine, codified in 1932 into *Die Truppenführung*, perhaps the most realistic and influential doctrinal manual ever written. Even though the German Army possessed no tanks in 1932 and had had only the most limited experience with armored fighting vehicles during World War I, *Die Truppen-*

³¹ Historians have often argued that military institutions tend to study the last war and that is why they do badly in the next. Nothing could be further from the truth: military institutions rarely study the past war honestly or carefully. Rather they look to past wars to justify their current concepts and beliefs, which all too often have little to do with the harsh world of battlefield experience.

³² For a more extensive examination of the development of mechanized, combined-arms warfare, see Williamson Murray, "Armored Warfare," in *Military Innovation in the Interwar Period*, ed. by Williamson Murray and Allan R. Millett (Cambridge, UK: Cambridge University Press, 1996).

führung makes explicit reference to the contribution that tanks could make not only in the breakthrough phase of major operations but in the exploitation phase as well.³³

However brilliant the Germans' theoretical musings on the possibilities of mechanized warfare when rearmament began in January 1933, the Germans still had virtually no experience with tanks.³⁴ German industry still grappled with the problems of producing a brand new weapons system (the first modern tanks would not reach the *Wehrmacht* until late 1938). Moreover, the German Army also confronted a host of problems from the tactical to the operational and logistic.

Ever the careful professionals, the Germans established a number of experimental mechanized and motorized units to explore the possibilities. These experimental units included independent tank battalions (largely aimed at supporting the infantry), independent tank regiments (with an emphasis on all-armored formations), motorized infantry divisions (to explore increasing the maneuverability of the infantry), light divisions (to explore the use of cavalry and armor working together as a reconnaissance force), and armored divisions. All received provisional status within the framework of the regular army buildup, but clearly the intention was to discover through experiments and exercises, what worked and what did not.

While these units were establishing themselves, the Chief of the General Staff, General Ludwig Beck, had his staff explore their use at operational levels. In 1935 Beck conducted a General Staff ride on how the army might make use of a panzer corps; the next year the General Staff ride examined the operational possibilities of a hypothetical panzer army. By the end of 1935, Beck was recommending that panzer divisions—established only a few months earlier—be used for attacks against long-range objectives, acting as an independent force “in association with other motorized weapons.”³⁵

By the late 1930s the work with the experimental units had begun to pay off, as the winners and losers became clear. The clearest winner was the panzer division, the first

³³ *Die Truppenführung* explicitly stated that “when closely tied to the infantry, the tanks are deprived of their inherent speed”—a very different outlook from that which the French possessed throughout this period. Chef der Heeresleitung, *Die Truppenführung* (Berlin, 1933).

³⁴ In his memoirs the German tank pioneer Heinz Guderian claims that he had never seen the inside of a tank when tasked to teach tank tactics; the General Staff rectified this weakness by packing him off to Sweden for four weeks' service with a Swedish tank unit. Heinz Guderian, *Panzer Leader* (New York: Da Capo Press, 1996), p. 23.

³⁵ Wilhelm Deist, *The Wehrmacht and German Rearmament* (London: MacMillan, 1981), pp. 42–43.

three of which had been established in 1935.³⁶ In late summer 1938 the army leadership established three additional panzer divisions, folding into them the previously independent experimental tank regiments and battalions. A year later, the campaign against Poland revealed that the four light divisions did not possess sufficient punch. In the aftermath of the German victory, these divisions were immediately converted into panzer divisions, one of which, the 7th, Erwin Rommel led with such success during the ensuing French campaign. The senior army leadership decided to keep a limited number of the motorized infantry divisions because they could perform a useful bridge between the rapidly moving panzer formations and the slower infantry divisions that made up the bulk of the German Army.

Several points about the way the Germans worked up and evaluated these experimental units deserve emphasis:

- ▶ First, the experimental units remained connected to an expansive and intelligent basic doctrine—*Die Truppenführung*—that emphasized maneuver, exploitation, and decentralized leadership.
- ▶ Second, in their experiments and exercises the Germans tested the concepts and tactical framework of the experimental force to the maximum. The lessons-learned analysis aimed at discovering what actually would happen on the battlefields of the future, not at “validating” the current doctrine (or, in the case of the French Army, dogma).
- ▶ Third, the Germans were even more rigorous and demanding in their examination of what had actually happened in combat. Their lessons-learned processes were not exercises aimed at making generals look good.³⁷
- ▶ Finally, when the results of experiments and exercises indicated that experimental units were not working out, the Germans did not hesitate to disband them. Two such instances were the independent panzer regiments and the

³⁶ On the initial decision to establish the panzer divisions, see Robert O’Neil, “Doctrine and Training in the German Army,” in *The Theory and Practice of War*, ed. by Michael Howard (New York: Fredrick A. Praeger, 1966), p. 157.

³⁷ For how the German lessons-learned analysis process worked with chilling efficiency, see Williamson Murray, “The German Response to Victory in Poland: A Case Study in Professionalism,” *Armed Forces and Society*, Winter 1981.

light divisions, both of which the Germans decided to fold into the proven experimental unit—the panzer division.

The Failure of the British Experimental Tank Force

The British emerged from World War I with the most experienced armored force, one that as we have seen played a major role in the British victories of 1918. But with the drastic downsizing in the war's aftermath, the Tank Corps shrank to a few insignificant units. From the first, the politicians made clear to the British Army's leadership that it would receive only minimal funding in order to defend the empire's distant outposts. The army would certainly *not* receive the resources required for a role on the continent, fighting at the side of Britain's World War I allies.³⁸ Despite the considerable constraints both in mission and in resources, Lord Milne, the Chief of the Imperial General Staff (commander-in-chief of the army), established an experimental armored force for the 1927 maneuvers out of the hodgepodge of motorized and tank units present in the army.³⁹ Milne gave the experimental force the broadest directive and was willing to appoint the army's leading tank advocate and expert, Lieutenant Colonel J. F. C. Fuller, to command the force. Astonishingly, Fuller turned the assignment down—the worst decision of his career.

Nevertheless, the 1927 experiment with the provisional tank force proceeded. Its course did indicate some of the difficulties in waging operations with mobile forces. But at the same time, the light tank force executed a stunning twenty-five-mile march that entirely dislocated the opposing force and brought the maneuvers to a halt. Succeeding maneuvers with experimental forces over the course of the next two years, and then again in 1934, suggested the operational parameters within which mechanized warfare might operate. These British experiments were the most imaginative and innovative of the interwar period. Unfortunately, it was the Germans who learned the most from

³⁸ This would remain the situation until March 1939, in the aftermath of the German occupation of the Czech Republic. For its impact on the army, see Williamson Murray, *The Change in the European Balance of Power, 1938–1939, The Path to Ruin* (Princeton, NJ: Princeton University Press, 1984), particularly chapter 2.

³⁹ For an insightful report on the implications of the initial British experiments with mechanized war, see in particular Reichswehrministerium, Berlin, 10.11.26, "Darstellung neuzeitlicher Kampfwagen," National Archives, T-79/62/000789.

these efforts. They watched the British experiments carefully and used them as the jumping-off point for developing their concepts of large-scale mechanized operations.⁴⁰

The cause of this failure of the experimental force to contribute to British preparations for war lay in three areas:

- ▶ First, as already mentioned, the army focused on serving as a colonial force, with little thought or effort made to prepare for war on the European continent.
- ▶ Second, the experimental force was not closely connected to the army as a whole, in either a cultural or an organizational sense. The tankers remained outsiders, innovators who appeared to aim at disturbing the army's traditions and culture.
- ▶ Third, the officer corps was intellectually lazy, preferring polo and tennis to studying seriously the profession of arms.⁴¹

With no coherent vision or concept of war into which the efforts of the experimental tank force could fit, the experiments were quickly forgotten, making barely a dent in the army's overall culture. (Interestingly, the British Army only constituted *a single committee* to study the lessons of World War I, and that in 1932—14 years after the war's end. Thus, the British had to begin anew in 1939 to build a mechanized force that could meet the Germans on equal terms in northwest Europe—a task they failed to accomplish even by war's end.

⁴⁰ A contributing factor was the fact that German officers had been brought up in a common doctrine—*Die Truppenführung*—that emphasized maneuver, exploitation, speed, and decentralized operations within a combined-arms framework.

⁴¹ On the culture of the British Army, see Brian Bond's brilliant study, *British Military Policy Between the Two World Wars* (Oxford: Oxford University Press, 1980). In 1939, British tank pioneer Percy Hobart commented in a letter to his wife on his difficulties in getting his officers up to snuff in the newly formed armored division in Egypt: "I had the cavalry CO's in and laid my cards on the table. They are such nice chaps, socially. That's what makes it so difficult. But they're...so easily satisfied with an excuse if things aren't right, so prone to blame the machine or machinery, and unless someone upsets all their polo, ...it's so hard to get anything more into them or any more work out of them." Quoted in Murray, "Armored Warfare," *Military Innovation in the Interwar Period*, p. 23.

The Carrier Experiments of the US Navy

The US Navy emerged from World War I as one of the two great naval powers in the world (Britain being the other). Nevertheless, the late entry of the United States into the war robbed its navy of opportunities to participate in significant naval action outside of anti-submarine warfare. Moreover, the Royal Navy, its rival in the 1920s, emerged from the war with the first flush deck carrier and considerable experience in launching aircraft off ships. Yet twenty years later, at the outbreak of the Second World War, the US Navy would possess capabilities in its carriers significantly superior to those of the Royal Navy, and these capabilities would provide the essential element for victory in the Pacific.⁴²

The first U.S. carrier was the USS *Langley*, converted from the collier *Jupiter* in the early 1920s. The *Langley* was clearly seen as an experimental ship. The *Lexington* and the *Saratoga*, both converted from the hulls of battle cruisers made excess by the 1922 Washington Naval Treaties, were experimental units at first. Their experimental nature is suggested by the fact that both ships were initially equipped with 8-inch guns in the belief that they might well participate directly in surface fleet actions. The 8-inch guns would not be removed until the early 1940s, shortly before the war.

The rapid development of American carrier capabilities began with analytic war games conducted at the Naval War College in Newport, Rhode, Island, in the early 1920s under the guidance of Admiral William Sims. The results indicated that air power launched from carriers should come in “pulses” of combat power rather than “streams,” as was the case with naval gunfire.⁴³ This insight, gained at a time when the US Navy did not possess a single carrier, had implications of enormous importance. It indicated that in a battle between carrier forces, the side with the ability to get the largest number of aircraft into the air would enjoy an important advantage. As the Second World War would prove, this was as true in the ability to defeat attacking enemy formations as well as it was in the hitting power of the attacking forces.⁴⁴

⁴² For an outstanding examination of the factors that drove carrier innovations in the US Navy and the Royal Navy, see Thomas C. Hone, Norman Friedman, and Mark Mandeles, *American and British Aircraft Carrier Development, 1919–1941* (Annapolis, MD: Naval Institute Press, 1999). See also Barry Watts and Williamson Murray, “Military Innovation in Peacetime,” in *Military Innovation in the Interwar Period*, chapter 10.

⁴³ Hone, Friedman, and Mandeles, *American and British Aircraft Carrier Development*, p. 34.

⁴⁴ In 1923, only the hitting power was obvious.

Thus, when the *Langley* joined the fleet, even before completion of the larger *Saratoga* and *Lexington*, Captain Joseph Reeves pushed his new command to develop more rapid launch and recovery procedures. Reeves's efforts were further intensified by the pressures placed on naval aviation by the Morrow Board, which was examining the role of naval aviation within the context of overall air power policy in the United States, and the court martial of General "Billy" Mitchell. Within a six-month period, Reeves demonstrated a significant improvement in the *Langley's* ability to launch and recover aircraft.⁴⁵ The result of his intensive experimentation on the *Langley* was the innovative use of arresting wires and crash barriers, and the creation of deck parks.

A comparison of the *Langley's* complements of aircraft in 1926 and 1927 reveals how much Reeves was able to achieve in a relatively short period. In 1926, the *Langley* had carried only fourteen aircraft; one year later it could operate forty-eight.⁴⁶ But Reeves' achievement went well beyond increasing the number of aircraft a carrier could carry and use. It provided the Navy with the evidence to convince the Morrow Board that carriers and naval aviation had a significant future, and that Mitchell was wrong about making *all* U.S. air power part of an independent air force.

The status of carriers as experimental vessels, however, continued well beyond Reeves's initial successes. When the *Saratoga* and the *Lexington* joined the fleet in late 1927, Reeves was already advocating that they be used as a fast striking force. Still, it took nearly two years to work the bugs out of the two ships to deal with the complex problems raised by the addition of these two very different ships to a Navy still largely focused on the battleship. Fire-fighting arrangements, how to refuel safely on both the hanger and flight decks, and how to store and load ordnance were only a few among many challenges. Finally, over the course of the 1930s, the increasing power, improved flight characteristics, and lengthening range of new generations of aircraft began to make the carrier a formidable weapon of war.

By 1929 the Navy had worked out many of the technical problems of employing a carrier, but as the authors of the foremost work on carrier aviation in the interwar period note: "The leaders of U.S. Navy aviation, such as Rear Admiral Reeves, realized by 1929 that the proper model for carrier warfare was not the same as for surface ship engagements, but they could not anticipate, from the evidence, what the new world of

⁴⁵ Hone, Friedman, Mandeles, *American and British Aircraft Carrier Development*, pp. 38–43.

⁴⁶ Hone, Friedman, Mandeles, *American and British Aircraft Carrier Development*, p. 45.

carrier warfare would be like.”⁴⁷ It would take a further twelve years of peacetime innovation and development of concepts and doctrine, and then the harsh test of two years of war in the Pacific, before the carrier emerged from its status as an experimental unit, and became the dominant weapon of naval warfare.

⁴⁷ Hone, Friedman, Mandeles, *American and British Aircraft Carrier Development*, p. 51.

Concluding Comments

Confronted with a dynamic environment in which technological and tactical change was the order of the day, some military institutions have used experimental units not only to point the way to the future but as a means to further the doctrinal and conceptual possibilities. In preparing for warfighting in this century, America's military leaders must remember what history has demonstrated in the pursuit of new weapons systems and revolutionary new ways to fight:

- ▶ The capabilities and limitations of radically new weapons systems can best be discovered through the creation of experimental units.
- ▶ The military should use lessons-learned analyses to challenge current concepts and beliefs, and not to justify them or to make their officers look good.
- ▶ Feedback loops should be used to empower and build on experimental units, and help build a more accurate picture of the battlefield.
- ▶ Experimental units should remain connected to an intelligent basic doctrine capable of expansion and flexibility.
- ▶ Concepts and tactical framework of the experimental forces should be tested to their limits. When the results show that the experimental units are not working out, they should be changed.
- ▶ To challenge the traditions and culture of a military service still requires the services of mavericks, usually seen as the outsiders.

Appendix. Experimental Units Before the Twentieth Century

As early as the end of the sixteenth century, the Dutch, under Prince Maurice of Orange, created special units, disciplined and trained to use the Roman orders of command drill to facilitate both movement and performance on the battlefield.⁴⁸ (The Dutch were the first European military organization to use such commands since the fifth century. By the end of the seventeenth century, Europeans following the example of the Dutch had developed a modern day equivalent of the Roman legion—disciplined, obedient battle formations that could and did remain in battle for sustained periods of time. Moreover, these “new model” armies were fully responsive to the civil authorities of the modern state.

What made these new formations so devastating in combat with the world outside of Europe was that their disciplined organization allowed the maximum use of the new technologies of firepower. However, for the next century, from approximately 1700 through to the end of the Napoleonic Wars (1815), a technological *stasis* set in, resulting in few changes to the weaponry with which European armies confronted each other on the battlefield.⁴⁹

The French Revolution

In contrast to the stagnation of weaponry, there was considerable change in the form of units at both the tactical and operational levels, particularly during the French

⁴⁸ The great German military historian, Hans Delbrück, indicates that Maurice of Orange and his commanders “drew from the ancient authors the realization of the value for a unit of a cohesiveness attained through continuous practice, and on the base of the ancient source they created the new drill techniques. If one can ever do so, it is precisely here that we can speak of the renaissance of a lost art” (referring to the ability of the Romans to maneuver complex tactical formations on the battlefield in a disciplined and effective fashion). These experimental units had to work out such basic realities as to what a two-phased command actually involved (as in “Right...Face” as opposed to “right face”). From these experimental units flowed the eventual development of disciplined and responsive military formations on which the creation of the modern state depended, the basic building block in the rise of the West. For further elaboration on this point see Hans Delbrück, *History of the Art of War*, vol. 4, *The Dawn of Modern Warfare*, translated by Walter J. Renfro, Jr. (Lincoln, NB: University of Nebraska Press, 1985), pp. 156–160.

⁴⁹ One example of technological *stasis*: The “Brown Bess” musket that equipped Marlborough’s English Army at the beginning of the eighteenth century also equipped the Duke of Wellington’s soldiers in their battles against Napoleon’s troops in the first decades of the nineteenth century in the Peninsula Campaign and at Waterloo.

Revolution. In 1792 the politicians in charge of the Revolution in Paris unleashed a war against the *ancien regimes* (the European monarchies). Given the flight of most senior officers of the French Army in the face of a revolution that targeted the French nobility, with a resulting collapse of discipline, the French revolutionaries soon confronted a catastrophic military situation, one which threatened not only the very survival of the Revolution but their own lives and welfare as well. The leaders of the revolution responded in two fashions. In the first case they ripped up the European rule book on how war should be conducted and embarked on a radical rethinking and recasting of the European “way of war.” As Clausewitz suggests in his monumental study *On War*, the French made war a matter of mobilizing the entire resources of the nation as well as its manpower:

Suddenly war again became the business of the people—a people of thirty millions, all of whom considered themselves to be citizens...The people became participants in war; instead of governments and armies as hitherto, the full weight of the nation was thrown into the balance. The resources and efforts now available for use surpassed all conventional limits; nothing now impeded the vigor with which war could be waged, and consequently the opponents of France faced the utmost peril.⁵⁰

Confronted with the mobilization of their population, French military leaders had to figure out how best to use the abundant manpower that the *levée en masse* (the mass conscription ordered in August 1793) had provided.⁵¹ From the first the new volunteers and conscripts ran into considerable suspicion from those members of the *ancien regime's*

⁵⁰ Carl von Clausewitz, *On War*, translated and edited by Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1975), p. 592. Clausewitz also makes clear that the major factor in the eruption of French Revolutionaries and Napoleonic legions on the European scene was largely the result of the failure of the *ancien regimes* to adapt to the changes in war. “Not until statesmen had at last perceived the nature of the forces that had emerged in France, could they foresee the broad effect all this would have on war; and only in that way could they appreciate the scale of the means that would have to be employed, and how best to apply them [in order to affect the forces of Revolutionary and Napoleonic France].” Clausewitz, *On War*, p. 609.

⁵¹ The law for the *levée en masse*, as passed by the Assembly in Paris stated that “From this moment, until our enemies have been driven from the territory of the Republic, the entire French nation is permanently called to the colors. The young men will go into battle; married men will forge weapons and transport supplies; women will make tents and uniforms, and serve in the hospitals; children will make old cloth into bandages; old men will have themselves carried to the public squares to rouse the courage of the warriors and preach hatred of kings, and the unity of the Republic.” Quoted in Stanley Chodorow and MacGregor Knox, *The Mainstream of Western Civilization*, fifth edition (New York: Harcourt, Brace, Jovanovich Publishers, 1989), p. 658.

military forces who had transferred their loyalty to the Republic. Not surprisingly, the raw formations of the *levée en masse* possessed little of the discipline or training of the regular army. The Marquis de Lafayette, in his brief tenure in command of the Army of the North, experimented with combining regular and volunteer/conscript battalions in brigades, the former to provide discipline and organization, the latter the enthusiasm of the citizen.⁵² These experimental units soon evolved into the *demi brigades* on which the new French Army was to be built.

The general lack of eighteenth-century discipline and training in the new units created by the *levée en masse* led to the creation of new experimental tactical units, which were to have a profound effect on the European battlefields of the next two decades. The ill-disciplined but ideologically committed troops of Revolutionary armies formed the basis of experimental units of skirmishers. These units suffered considerably from desertion, but they proved capable of putting out clouds of skirmishers to harry the disciplined mass formations of their opponents. Such soldiers, called *tirailleurs*, thoroughly disconcerted the enemy armies and were soon a major factor in French successes.

The second manner with which the French responded to the challenges posed by the new mass armies was to make changes at the operational level. Here, with the ruthless pressure of their revolutionary masters, who demanded nothing but success on the battlefield, French generals rapidly adapted the proposals of prewar theorists to reorganize the army into all-arms divisions (various combinations of cavalry, artillery, and infantry). As with tactical units such as the *tirailleurs*, the process involved considerable experimentation in actual campaigns as well as on the field of battle. The new experimental units allowed the French greater latitude and speed of movement. Moreover, the new units had the ability to defend themselves while under attack from stronger enemy forces.

A decade later Napoleon took the divisional system and formed experimental units called *corps*, which provided even greater operational latitude for himself and his subordinate commanders.⁵³ The Napoleonic system built on the tactical and organiza-

⁵² For a general discussion of the evolution of French tactics and experimental units, see John Lynn, *The Bayonets of the Republic, Motivation and Tactics in the Army of Revolutionary France, 1791–1794* (Urbana, IL: University of Illinois Press, 1984).

⁵³ This greater flexibility played a major role in the French victory at Auerstadt, when a French corps, under the command of Marshal Davout destroyed the bulk of the Prussian Army. For the Napole-

tional successes of the Revolution to create an even more effective military system. Between 1793 and 1815, the French created the organizational framework within which armies have operated at the operational level over the past two hundred years.

1815–1914: Experimental Units and the Revolution in War

The period between 1815 and 1914 saw enormous technological changes that revolutionized the conduct of war. The great powers and their armies and navies were largely at peace.⁵⁴ The exceptions were a few short periods:

1854–1855, the Crimean War	1866, the Seven Weeks War
1859, the Austrian-French War in Italy	1870–71, Franco-Prussian War
1864, the war over Schleswig-Hollstein	

However, navies when at sea are always at war with nature. The vast changes in technology, particularly at the end of the nineteenth century, meant that virtually every ship type the admiralties constructed represented an experimental unit.

The development of the battleship underlines this fact. John Arbuthnot “Jackie” Fischer’s first ship, on which he served as a midshipman, was the *Warrior*, the premier battleship in the Royal Navy in 1863. The *Warrior* cost £265,000, displaced 9,180 tons, and possessed a top speed of 14 knots. Fifty-one years later, when Fisher was First Sea Lord, the Royal Navy was bringing into service the first of its *Queen Elizabeth* class battleships, ships that cost £2,600,000, displaced 27,500 tons, and possessed a top speed of 24 knots. The main armament of the *Queen Elizabeths* were eight 15-inch guns, the broadsides of which weighed nearly 3,200 pounds, that could reach out twenty-five kilometers, as opposed to the forty 68-pounders with which that the *Warrior* had been equipped.⁵⁵

This revolution in battleship design forced navies to stake enormous resources on experimental units and design—some of which proved their feasibility and some of

onic system of war, see David Chandler, *The Campaigns of Napoleon* (New York: MacMillan, 1966), particularly Part III.

⁵⁴ America was not yet a great power and its Civil War was the one exception to the pattern of relatively short, decisive wars. Surprisingly, the American armies on both sides displayed relatively little interest in creating experimental units. Perhaps the very scale of the conflict as well as the enormous problems associated in fighting such a war by politics and military organizations that had no experience in fighting wars minimized the very American instinct to innovate and experiment in new directions.

⁵⁵ Holger Herwig, “The Battlefleet Revolution, 1885–1914,” in Knox and Murray, *The Dynamics of Military Revolution*, p. 114.

which failed. Fisher's decision to build the HMS *Dreadnought* in 1904 represented a considerable gamble, which eventually proved advantageous to the Royal Navy in the run up to World War I. That design gave the British the lead in the construction of modern battleships and undermined the German strategy for achieving naval dominance in a sustained naval arms race.

But not all of Fisher's experimental units were so successful. His battle cruiser class, which sacrificed armor for speed, possessed so little protection that its ships were simply not survivable when confronting fully armored battleships in combat. The loss of the British battle cruisers *Indefatigable*, *Queen Mary*, and *Invincible*—each at a cost of more than a thousand sailors and officers—at the Battle of Jutland in 1916 underlines the price to be paid when experimental units fail to live up to expectations.⁵⁶

⁵⁶ For a first class examination of the cultural and technological factors that resulted in the Royal Navy's failures at Jutland, see Andrew Gordon, *The Rules of the Game, Jutland and British Naval Command* (London: John Murray, 1996).

References

- Bond, Brian. *British Military Policy Between the Two World Wars*. Oxford: Oxford University Press, 1980.
- Chandler, David. *The Campaigns of Napoleon*. New York: MacMillan, 1966.
- Chef der Heeresleitung. *Die Truppenführung*. Berlin, 1933.
- Chodorow, Stanley and MacGregor Knox. *The Mainstream of Western Civilization*. Fifth edition. New York: Harcourt, Brace, Jovanovich Publishers, 1989.
- Clausewitz, Carl von. *On War*. Translated and edited by Michael Howard and Peter Paret. Princeton, NJ: Princeton University Press, 1975.
- Deist, Wilhelm. *The Wehrmacht and German Rearmament*. London: MacMillan, 1981.
- Delbrück, Hans. *History of the Art of War*, vol. 4, *The Dawn of Modern Warfare*. Translated by Walter J. Renfro, Jr. Lincoln, NB: University of Nebraska Press, 1985.
- Goodspeed, D. J. *Ludendorff, Genius of World War I*. Boston: Houghton Mifflin, 1966.
- Gordon, Andrew. *The Rules of the Game, Jutland and British Naval Command*. London: John Murray, 1996.
- Guderian, Heinz. *Panzer Leader*. New York: Da Capo Press, 1996.
- Gudmundsson, Bruce I. *Stormtroop Tactics, Innovation in the German Army, 1914–1918*. New York: Praeger, 1989.
- Harris, J. P. *Men, Ideas, and Tanks: British Military Thought and Armoured Forces, 1903–1939*. Manchester, UK: Manchester University Press, 1995.
- Herwig, Holger. “The Battlefleet Revolution, 1885–1914.” In *The Dynamics of Military Revolution, 1300–2050*. Edited by MacGregor Knox and Williamson Murray. Cambridge, UK: Cambridge University Press, 2001.
- Hone, Thomas C., Norman Friedman, and Mark Mandeles. *American and British Aircraft Carrier Development, 1919–1941*. Annapolis, MD: Naval Institute Press, 1999.
- Kennedy, Paul. “Military Effectiveness in the First World War.” In *Military Effectiveness*, vol. 1, *The First World War*, edited by Allan R. Millett and Williamson Murray. London: Allen & Unwin, 1988.
- Knox, MacGregor and Williamson Murray. *The Dynamics of Military Revolution, 1300–2050*. Cambridge, UK: Cambridge University Press, 2001.

- Ludendorff, Erich von [sic]. *Ludendorff's Own Story, August 1914–November 1918*, vol. 1. New York: Harper & Brothers, 1919.
- Lupfer, Timothy. *The Dynamics of Doctrine: The Changes in German Tactical Doctrine During the First World War*. Ft. Leavenworth, KS: Combat Studies Institute, Leavenworth Papers, July 1981.
- Lynn, John. *The Bayonets of the Republic, Motivation and Tactics in the Army of Revolutionary France, 1791–1794*. Urbana, IL: University of Illinois Press, 1984.
- Manstein, Erich von. *Aus einem Soldatenleben*. Bonn, 1958.
- Middlebrook, Martin. *The Kaiser's Battle, 21 March 1918: The First Day of the German Spring Offensive*. London: Penguin Books, 1978.
- Murray, Williamson. "Armored Warfare." In *Military Innovation in the Interwar Period*, ed. by Williamson Murray and Allan R. Millett. Cambridge, UK: Cambridge University Press, 1996.
- Murray, Williamson. *The Change in the European Balance of Power, 1938–1939, The Path to Ruin*. Princeton, NJ: Princeton University Press, 1984.
- Murray, Williamson. *German Military Effectiveness*. Baltimore, MD: Nautical and Aviation Publishing, 1992.
- Murray, Williamson. "The German Response to Victory in Poland: A Case Study in Professionalism." *Armed Forces and Society*, Winter 1981.
- Murray, Williamson and Allan R. Millett. *Military Innovation in the Interwar Period*. Cambridge, UK: Cambridge University Press, 1996.
- Murray, Williamson and Allan R. Millett. *A War to Be Won, Fighting the Second World War*. Cambridge, MA: Harvard University Press, 2000.
- O'Neil, Robert. "Doctrine and Training in the German Army." In *The Theory and Practice of War*. Ed. by Michael Howard. New York: Fredrick A. Praeger, 1966.
- Reichsarchiv. *Der Weltkrieg, 1914 bis 1918*, vol. 14, *Die Kriegführung an der Westfront im Jahre 1918*. Bonn: Bundesarchiv, 1956.
- Reichswehrministerium, Berlin, 10.11.26, "Darstellung neuzeitlicher Kampfwagen," National Archives, T-79/62/000789.
- Watt, Barry and Williamson Murray. "Military Innovation in Peacetime." In *Military Innovation in the Interwar Period*. Murray, Williamson and Allan R. Millett, editors. Cambridge, UK: Cambridge University Press, 1996.

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