Century 19.5:
An Interregnum for Military Technology Evolution

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Aeroplanes and tanks ... are only accessories to the man and the horse,
and I feel sure that as time goes on you will find just as much use for the horse ...
as you have ever done in the past.
- Field Marshal Sir Douglas Haig, 1926. (Ellis, 1975, p. 17)

Thesis Statement

Patterns and styles of warfighting have usually been grouped and analyzed century-by-century. But that norm has drifted in modern times. Dr. H.P. Willmott (2006, p. 1) has suggested that "... rather than seeing the First World War as the first war of the twentieth century, it is possible to see the Second World War as the last war of the nineteenth century."

This paper extends the Willmott conjecture by postulating a *'Century 19.5'* extending from the beginning of the American Civil War through the end of the Second World War. The analysis finds military technology developments over this period to be substantially evolutionary, not revolutionary. The introductions of the machine gun and the atomic bomb are the technological 'Revolution in Military Affairs' (RMA) endpoints bounding *Century 19.5* in this study.

Introduction

In a conversation with Dr. Ned Willmott this past year, as to which technological advance had the greatest impact on the craft of war, I argued for the printing press, fostering the spread of operational arts and doctrine documents.

Dr. Willmott countered with a most interesting view that it was, indirectly, the development of railways: the control of traffic required the publication of schedules.

There were in the early 19th Century no standards for coordination of local times, and hence no way to produce timetables usable for the train crews, station agents, and passengers. Local times were whatever the parish priest or his counterpart decreed for the church steeple or town hall clock.

To use a cliche, that's no way to run a railway. It was the creation, albeit in stages, of international time standards that allowed for coordination of railroads as well as for war efforts -

and thus for the globalization of war - which provided the most significant 'Revolution of the Military Art'. (H.P. Willmott, personal communication, Nov. 2005)

Brigadier Peter Young, DSO MC, in his study *The Machinery of War* presents a valuable insight into the changes in warfare which took place at the beginning of the *Century 19.5*:

> The American Civil War, a long slogging match between improvised armies, seemed to demonstrate that while strategy - with its new adjuncts, the electric telegraph and the railway - was becoming swifter and sure, the art of tactics was becoming infernally difficult. The effects of long-range rifle fire on troops who still clung to the close order formations of Waterloo were devastating. Now men resorted to the axe and the spade, and though the fortifications they constructed were rudimentary compared to those of the present [20th] century, they effectively slowed down the forward movements of formations that on occasions outnumbered the defenders by as much as three to one. (Young, 1973, p. 83)

From studying Robert Gilpin's, *War & Change in World Politics* discussion of 'Stability and Change' we know, as much as anything can be known, that military innovations give only a time-limited advantage. The impact of explosive shells on wooden hulls (offensive advantage) in naval warfare was offset by ironclad and iron or steel hulls (defensive advantage). The impact of machine guns in trench warfare (defensive advantage) was offset by the tank, a mobile machine gun fortress (offensive advantage). (Gilpin, 1981, pp. 50-105)

Analysis and Presentation

Combat Weapons

The development of breech-loading weapons, modern cartridges which combined bullet, propellant, and percussion cap, and rifled barrels (first hand-crafted some four centuries earlier) all came together in the early 19th Century. Mass production, with its machining precision and repeatability, led to the common use of the 'modern' rifle in the American Civil War and the demise of the smooth-bore muzzle-loading musket.

The development of a working 'automatic' weapon, even though in its early incarnations hand-cranked for firing and in some fashion hand-loaded, was the realization of many proposed schemes and patents, some wacky, some worthy of thought.

John Ellis, in *The Social History of the Machine Gun*, elaborates:

> [For much of the late 19th Century] machine guns were generally regarded as being little more than mechanical gimmicks, of no real value on the conventional battlefield. In the beginning this lack of interest in the potential of sustained automatic fire was quite understandable. It was always theoretically possible to conceive of a gun that would somehow spew out vast numbers of bullets or whatever in a very short time. But for hundreds of years men lacked the

> technological expertise with which to translate such visions into reality. (Ellis, 1975, p. 10)

The multi-barreled Gatling gun made an appearance in the American Civil War, although it is best seen as a limited field test. The most recognizable names for machine guns were Gatling, Maxim, Browning, and Lewis.

'Semi-automatic' firearms, self-loading from a clip or magazine, one shot per trigger pull, were first produced in the 1890s. In an engineering sense it was a retrograde of the machine gun. It is best exemplified by the M-1 Garand of World War II which could also be used as a grenade launcher.

Grenades, which had usually been seen only in the hands of assassins, returned as a common weapon of the World War I trench warfare, while Greek Fire, a weapon of the Byzantine Empire, returned in the form of German flame-throwers. (Young, 1973, pp. 87-91)

Artillery weapons - Mortars, Howitzers, Guns, Cannons - continued to grow larger and become more mobile over the year, with scant real changes.

Rocket propulsion was employed quite extensively in World War II, with many variants upon the ancient Chinese fireworks technology. Examples are the American 'Bazooka' rocket-propelled grenade, the German *Nebelwerfer* 150mm and 210mm artillery rockets (known to Allies as the *Screaming Mimi*), and the German V-2, a true liquid-fueled rocket (September 1944 - March 1945).

Land mines were in use throughout *Century 19.5*, with some World War I mines employing poison gases. There is now a 1999 Ottawa Treaty to outlaw all anti-personnel mines; the United States has accepted a less-stringent accord. Uncleared mines following a war even now cause heavy casualties in the lesser developed countries of the world.

The most significant *Century 19.5* technology revolution was, of course, the atomic bomb, employed only twice and hastening the end of World War II against the Japanese Empire. By its very nature the atomic force was revolutionary and started a new epoch. There was much speculation about further losses which might have been incurred by the Allies in the war against Japan if we had not used the atomic bomb, but that is beyond the scope of this report. Suffice it to say that 'A-bombs' and 'H-bombs' became the spectres of the 'Cold War'.

At the battle of Messines, France, on 7 June 1917, almost as a preamble to the atomic bombs at Hiroshima and Nagasaki,

> ... The British Second Army under General Herbert Plumer put mines containing over one million pounds of explosives [in tunnels] under the German front lines and blew holes several hundred feet wide and over a hundred feet deep in place, with a blast that could be felt as far away as London. Plumer's victory was the

> greatest the British had won so far. But the problem was still exploitation. (Young, 1973, pp. 91-92)

A somewhat comparable incident in World War II involved 907,000 pounds of bombs dropped on the Abbey of Monte Cassino, Italy in four hours on 15 February 1944. (Hapgood and Richardson, 1984, p. 211)

Combat Vehicles

Military forces have taken advantage of the same vehicle types as civilians over the ages, with an emphasis on ruggedness, armor, and installed weapons.

Tanks in World War I were the response to the challenge of machine guns and trench warfare. They were mobile fortresses to take their own machine guns forward to the enemy. In World War II they became bigger, heavier, better armed and armored. Tanks and other armored tracked vehicles had many variations, such as bridges (think of that in the sense of 'leap-frog'), bridge layers, minesweeping flails, front line bulldozers, personnel carriers, self-propelled guns.

Special adaptations were made for amphibious and all-terrain use. The US Army had, in World War II the very unstable Seep - a Jeep with a hull - and the DUKW, a 2-1/2 ton 6x6 truck likewise surrounded with a hull; the DUKW was extremely successful in combat beachhead operations. The US Marine Corps and British Royal Engineers each had significant World War II success developing amphibious and amphibious tracked vehicles.

The list of all their configurations goes on and on. It is probably safe to say that if a special use for a vehicle could be posited, the military engineers and ordnance artificers could and would 'make it happen'. (And it still happens today!)

Naval Engineering

The last half of the 19th Century was a heyday for Naval Engineering. Yet none of the significant events here are considered 'revolutionary'. They evolved from existing arts and sciences which were fostered by the 'Industrial Revolution'.

1817 USN was authorized steam-engined ships (*Fulton II*).
1840 Explosive shells were introduced into the naval arsenals.
1845 A 'tug-of-war' between paddle (the norm) and screw (the novice) propulsion was handily won by the screw-driven sloop *HMS Rattler*.
1856 Rifled guns were placed in service: breech loaded Armstrong "screw guns".
1858 The interrupted screw breech mechanism was adopted by the French and German navies.
1859 Re-introduction of the ram.
1859 Ironclad French battleship *La Gloire* launched, as a response to explosive shells.
1860 The first iron-hulled armoured warship, the steam frigate *HMS Warrior* was launched.
1860 Center-line placement for main guns begun, initially firing fore and aft.
1860 Production of internal combustion engines.

1862 CSA Navy *Merrimac* was the first ship to discard masts and sails.
1862 US Navy *Monitor* was the first ship with a revolving turret.
1866 At the Battle of Lissa the Italian battleship *Re d'Italia* was rammed and sunk by the Austro-Hungarian *Ferdinand Max*.
1876 Finally there came a realization that gun calibers had to be limited because of weight considerations: the Italian *Duillio* had four 100-ton 17.7 inch muzzle loaders.
1887 The quick-firing breech mechanism was introduced.
1898 Coliberti of Italy and Sims of Britain proposed that effectiveness of long-range firing was improved by spotting the shot splashes of coordinated armaments; all main guns of a ship now adopted the same caliber and type to support this finding.
1900 First US Navy submarine commissioned.
1903 Steam turbines started replacing reciprocating engines.
1906 *HMS Dreadnaught* became the archetype of major warships.
1909 Oil-fired boilers replaced coal in the US Navy.
1911 The first aircraft landing and takeoff on a ship (*USS Pennsylvania*).
1911 The first seaplane flight (Curtiss).
(Harris, 1965, p. 134-143; Macintyre and Bathe, 1968, pp. 75-146)

The "Old Ironsides" name given in 1812 to the *USS Constitution* - commissioned 1797 and currently 'homeported' in Charlestown MA - referred not to an iron or ironclad hull, but to the strength and resilience of her 'live oak' hull.

Before leaving naval matters, there is one aspect of support in World War II that must be highlighted: the LST - Landing Ship, Tank. It was the Navy's answer to the ferry. Roughly a thousand were in service in the theaters of war. They were the backbone of logistic support for the many beachheads, bringing men, equipment, vehicles across deep seas and landing them directly on contested beachheads. Some 100,000 sailors, merchant mariners, and coast guardsmen manned these vessels. (LST 325, personal communication, 2005 June)

Aviation

Airships, as in 'lighter-than-air', powered by various means, were setting powered-flight aviation records prior to *Century 19.5*; the development of aircraft and their evolution were more a matter of engineering rather than invention. (The internal combustion engine dates from 1860.)

The airplanes grew ... and grew ... and went higher and faster: fighters, bombers, and transports - the DC-3 morphed into the C-47 Dakota, as important in its own way as the LST and Liberty Ship. Planes also went low and slow: Piper Cubs were used by artillery forward observers in World War II

The revolution in aviation came at the end of World War II. Jet propulsion, although long studied and with many variations patented, was one of the few technologies that can be considered as having been developed within the span of *Century 19.5*. Combat deployments in World War II were principally by the pulse jet V-1 'buzz bomb' and the turbojet Messerschmitt

Me 262 fighter. Their appearances in mid-1944 were technologically significant, but in hindsight too late to affect the war's outcome.

The next revolution in aviation came when we strapped a plane to a rocket and called it the 'Space Shuttle'.

Logistics

Introduction. Advances in communication and transportation capabilities lead directly to a virtual compression of time and space in warfare, and thus to more effective logistic support of combat forces.

Yet improvements in communication only changed the nature and scope of uncertainties. More detailed information coming in simply leads to a new level of questions to be addressed.

Logistic support of combat forces have been enhanced by a great number of technological innovations over the period of *Century 19.5*. Yet there are none that might be considered a technological revolution. 'Common sense', engineering, packaging, process and procedures accounted for much of the innovation, all the while taking advantage of the faster communication and greater transportation capabilities.

> The wars of 1861-1865 and 1866 were, we recall, the first in history fought by men lying flat on their stomachs rather than standing erect on their feet. With their units spread out over spaces larger than ever before and the troops diving for cover instead of marching about in dense array, commanders from the level of battalion upward found themselves unable to exercise the control of old. The realization that a company is the largest unit that can be directly commanded by a single man under the conditions of dispersion and mobility characteristic of the modern battlefield led to the system of command that stood behind many of the German successes in both world wars ... . (Van Creveld, 1985, p. 44)

The productivity of national resources and maintenance of the modern industrial society are directly impacted by technological advances:

> Significant increases in the efficiency of transportation and communication have profound implications for the exercise of military power, the nature of political organization, and their pattern of economic activities. Technological innovations in transportation and communications reduce costs and thereby increase the expected net benefits of undertaking changes in the international system. (Gilpin, 1981, p. 56)

Management. Logistic support for the field armies required business management procedures and tools in the home-front factories and offices. Attempts to extend this process forward toward the front-lines in World War I failed.

> First, the network of communication that is vital to the functioning of modern management was absent from World War I battlefields. ... To put it differently, Haig's system of command represented an attempt to turn battle itself into an industrial type of operation, but he did not possess the communications system that alone makes industrial production possible.
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> The second ... factor working against the extension of industrial controls is the nature of battle itself. Although modern works on military matters are fond of comparing command with management ... the difference between them consists precisely in the great uncertainty governing war, the most confused and confusing of all human activities. (Van Creveld, 1985, pp. 186-187)

Communication. The electric telegraph, invented in 1832, was first used heavily by the railways. In military applications it filled a need for rapid messaging up and down the chain of command. But it did not significantly change visual and courier communications in the combat zones.

From Peter Young, in *The Machinery of War*, we find the drawback:

> All this progress did create some fresh pitfalls, however. Commanders, for instance, now found themselves for the first time at the end of a direct line to their political overloads; and there were some who thought this an unattractive proposition. (Young, 1973, p. 82)

But with Martin Van Creveld, in *Command in War*, we find where the greater value lies:

> [In the early movement of troops and supplies], technology - the telegraph - played a vital role: it alone made possible the smooth mobilization and deployment of the armies, and it permitted some degree of control over forces 200 miles apart. The telegraph's importance should not, however, be exaggerated. During the period of mobilization its role was larger than during actual hostilities, and the nearer the enemy, the smaller the role it played. (Van Creveld, 1985, pp. 145-146)

Civilian Perspective. Radios were used for military communications among headquarters in the rear during World War I, but commercial broadcasting was not yet on the scene. Thus, from a civilian viewpoint, news communication had not really changed between the Spanish-American War and World War I.

However, in World War II almost every home had a radio; we listened to President Roosevelt in the White House and Edward R. Murrow in London. The effect was not so much that public perception and opinions impacted military decisions, but that we, the public, felt that we were a part of the war effort.

Another aspect of war which has greatly advanced during *Century 19.5* is the public perception of events in detail, in 'real time'. The telegraph existed in the time of our Civil Way, but newspapers were still set by hand, one character at a time. In the late 19th Century the Linotype™ machine came into play, speeding the production of newspapers, and there were many thousands of newspapers simply because they were the principal public communication medium. Radio then raised this speed of access to a higher plateau.

Normandy. The concerns of many historians and armchair generals about the delays in breaking out of the Normandy sector needs only the fairly basic answer: logistic, logistic, logistic.

70,000+ vehicles were landed at Normandy in June 1944. These, and the later landings of more vehicles, required massive supplies of petrol every day. Hundreds, perhaps thousands, of planes were shifted to French bases in 1944; requirements of aviation fuel for all the planes also had to be factored in. We also brought railroad equipment, including loaded trains on LSTs.

Men and horses and mules kept going in the wars even without food or fodder for some time. But trucks, tanks, trains, planes just stopped. Fuel requirements set the limits for moving forward, or even backwards.

> In 1944 Anglo-American forces established themselves on a 50-mile beachhead in Normandy by amphibious assault and in the next two months stocked that beachhead. At the same time they met and defeated an enemy that in number of divisions was always superior and on terrain that favored the defense and which the defense was held for four years. ... [After the breakout they had to repair and move] across a wrecked transportation system: 97% of the French rail system had been destroyed by September 1944. (Willmott, 2002, p. 103)

Operation PLUTO (Pipe Lines Under The Ocean), England to France, known to the French as *le sang rouge de la guerre* (the red blood of the war) was an adaptation of submarine cables without the core wiring. It was deployed in 10 hours from the Isle of Wight to Cherbourg, 70 miles, on 12 August. Prior to that, Operation TOMBOLA, started on 14 June, moved petrol by pipeline from tanker ship anchored offshore. Additional PLUTO lines were laid later, the most productive being Dungeness to Boulogne.

Assessment and Conclusion

The analyses here support the thesis that technological developments, substantially evolutionary rather than revolutionary, are consistent with a *Century 19.5* military era, roughly 1860 to 1945. The base of technology at the beginning of the American Civil War, with its evolution over the next eighty years, was the platform upon which World War II was waged.

It is very tempting to postulate a 'Revolution in Military Affairs' (RMA) for just about any significant technical change to the operational mode, scope, or tempo. But when you really look at the technological advances and technical assets behind such RMAs - the hardware, software, thinkware from our laboratories, universities, factories, and military systems centers - we see in this case that we just had a generally effective understanding and management of complexities on top of an engineering evolution.

Personal View

Thoughts after re-reading Admiral Bill Owen's *Lifting the Fog of War* (2000, pp. 97-149): The 'fog' and 'friction' of war - uncertainty and chance - will always be with us. Every generation of warriors and scholars feel there is too much data and not enough analysis. And with new insight and hindsight we can argue the Normandy beachhead every year.

Nonsense. You go with what you've got. No matter how much data you have, how much seemingly useful information is gleaned from it, there will always be uncertainty. In warfare, every assessment of a problem is simply an opportunity for new questions. And when those questions are addressed, there is another layer of them.

There will always, always, be fog and friction in war. And layers of analysts and layers of planners are simply friction producing further fog.

Further to this, Alvin and Heidi Toffler make reference to 'analysis paralysis' (1993, pp. 158-159), where there is so much incoming data that analysts cannot deftly distinguish 'chaff' from 'wheat'. With each level of analysis, some wheat is left on the floor; when the final analysis is presented for decision, little of value is left: witness the reports of WMD in Iraq.

In bringing this report to a close, I went back to Dr. Willmott's thought that triggered my initial interest: "... rather than seeing the First World War as the first war of the twentieth century, it is possible to see the Second World War as the last war of the nineteenth century."

It has been some time since I last focused on the rest of his thought, and it bears repeating:

> How does one understand the Second World War other than in terms of the warring powers drawing upon a hundred years of slowly defined hatreds? The

nineteenth century witnessed the cultivation of hatred: the twentieth century the reaping. The Second World War, by drawing upon ideas that belonged to the second half of the nineteenth century, was the last war of the Victorian era, the final curtain on that century. Queen Victoria, quite contrary to popular belief, died on 15 August 1945, the date when, in historical terms, the twentieth century dawned. (Willmott, 2006, p. 1)

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References Cited

Ellis, John (1975). *The Social History of the Machine Gun.* Baltimore MD: Johns Hopkins University Press. [ISBN 0-9018-3358-2]

Gilpin, Robert (1981). *War & Change in World Politics.* Cambridge England: Cambridge University Press. [ISBN 0-521-27376-5]

Hapgood, David and **Richardson**, David (1984). *Monte Cassino.* New York: Congdon & Weed. [ISBN 0-86553-105-6]

Harris, Brayton, Lt.Cmdr. USNR (1965). *The Age of the Battleship: 1890-1922.* New York: Franklin.

Macintyre, Donald and **Bathe**, Basil W. (1968). *Man-Of-War : A History of the Combat Vessel.* New York: McGraw Hill.

Toffler, Alvin and **Toffler**, Heidi (1993). *War and Anti-War: Survival at the Dawn of the 21st Century.* Boston MA: Little, Brown. [ISBN: 0-316-85024-7]

Van Creveld, Martin (1985). *Command in War.* Cambridge MA: Harvard University Press. [ISBN 0-674-14440-6]

Willmott, H.P. (2002). *When Men Lost Faith in Reason: Reflections on War and Society in the Twentieth Century.* Westport CT: Praeger. [ISBN 0-275-97665-3]

Willmott, H.P. (2006, May 30). *Week 4 Introduction: Military Thought Prior to 1914.* Retrieved July 23, 2006, from Norwich University website at http://norwichwebct.embanet.com/SCRIPT/MMH1_Content_Repository/scripts/student/serve_page.pl/MMH1_Content_Repository/seminar_3/mmh_s3_w04.htm

Young, Peter (1973). *The Machinery of War: An Illustrated History of Weapons.* New York: Crescent. [SBN 517120798]

References Consulted

Beach, Edward L. (1986). *The United States Navy: 200 Years..* New York: Henry Holt. [ISBN 0-03-044711-9]

Geyer, Michael (1986). German Strategy in the Age of Machine Warfare, 1914-1945 [Part Four. From the First to the Second World War. Chapter 19.]. in Peter Paret (Ed.) *Makers of Modern Strategy: From Machiavelli to the Nuclear Age.* Princeton NJ: Princeton University Press. [ISBN 0-691-02764-1]

Millett, Allan R. & **Maslowski**, Peter (1984). *For the Common Defense: A Military History of the United States of America.* New York: The Free Press (Macmillan). [ISBN 0-02-921580-3]

Owens, Bill, Adm. with Offley, Ed (2000). *Lifting the Fog of War.* New York: Farrar, Straus and Giroux. [ISBN 0-374-18627-8]