Two Springfield Muskets, model 1861, on a background of .58 caliber Minié balls

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Adapted for the CHAB News by Gerald Hawkins

By the time the guns finally fell silent, the Civil War had exacted a human toll without precedent. Indeed, of the three million soldiers who took part in the conflict, Blue and Gray alike, it is estimated that approximately two hundreds thousand of them died on the battlefield and that five hundred thousand others survived their wounds.[1] On the surface, these numbers appear rational if one examines more closely the awesome firepower of the modern war machines used by both sides, such as repeating rifles, long-range artillery and crude machine guns, to name only a few. In spite of their effectiveness, those were however not the weapons that caused ninety percent of the war casualties. The real man killer is to be found in the powerful rifled musket and its devastating ammunition, the Minié ball, a combination of technological innovations that forever changed the face of war. For the first time in military history, the common soldier could aim at a far away target with the likelihood of hitting it. The era of frontal assaults carried out by massed infantry and large bodies of cavalry was definitively over insofar as defenders armed with this new type of musket could now open fire from a concealed position and decimate their foe at a considerable distance. Gone also were the days of grueling hand to hand fighting that traditionally concluded the majority of battles. It is hard to believe that such a relatively simple weapon, which in many ways bore a close resemblance to those of previous decades, decided the outcome of the American conflict. Still, the rifled musket of the Civil War was truly an

[1] *Dyer Compendium, p. 12, 18 ; Long E.B., The Civil War Day By Day , p.710-711.*

innovative weapon that combined all the qualities of its forerunners: not only was it easy to load, it was also fitted with an extremely reliable percussion ignition system that propelled a revolutionary type of projectile at long range and with remarkable accuracy.

The flintlock musket finds its origin in France at the beginning of the XVIIth century. Towards 1610, it favorably replaced the match harquebus and wheel lock musket, two cumbersome weapons whose firing depended on the slow burning of a match or the friction of a spring loaded toothed wheel against a piece of iron pyrite. The new model was loaded from the muzzle, first by pouring gunpowder into the barrel, then by inserting a lead ball that had a diameter slightly smaller than the bore of the gun. Ignition of the powder was achieved by a lock fitted with a hammer that held a small piece of flint between two jaws. When the gun was fired, the trigger released the hammer that swung forward under the effect of a spring, and its flint scraped the hardened steel face of the frizzen to produce a shower of sparks. At the same time, the frizzen kicked backward, uncovering a small cavity, known as the flash pan, which contained the priming powder. The sparks then ignited this powder and the consequential flash propagated through the touch hole, a small opening that connected the flash pan with the main powder charge in the barrel. The British army officially adopted the flintlock musket in 1682. It thereafter became the regulation weapon of the European and American infantries and was the soldier's best friend until its replacement, in the early 1850's, by the rifled musket.

If the flintlock musket remained the dominant infantry weapon for almost two centuries, it is because it was easy to handle. Indeed, with a minimum of training, an infantryman could load and fire four times per minute, a remarkable rate of fire at the time. Since the barrel was not rifled, its round projectile could be cast with a diameter slightly smaller than the gun's bore. This permitted the easy introduction of the ball into the muzzle and its resting on the powder charge by simple gravity. To load such a musket, the soldier opened his cartridge box and took out a paper cartridge that contained the black powder and the projectile. After having torn one end of the paper wrapper with his teeth, he primed the lock by pouring a small amount of the gunpowder into the flash pan that he subsequently closed with the frizzen. He then emptied the remainder of the powder into the barrel before inserting the round lead projectile from the muzzle. Finally, using a metal ramrod, he pushed the paper of the empty cartridge down the barrel to maintain the ball in place, thereby creating a packing sufficiently tight to prevent it from rolling out of the gun but loose enough to allow its proper discharge when the weapon was fired. All that was left to do was to cock the hammer and pull the trigger.

Because of its ease of loading, the rate of fire of the flintlock musket was impressive but the likelihood of hitting an aimed target was faint. Indeed, the precision and range of this firearm left a lot to be desired. In fact, discharging such a flintlock was like firing a modern shotgun loaded with a large ball. No sights had been provided because there was no need for any. At a distance of 40 meters, the ball of a flintlock musket could usually hit a target measuring 30 cm², but at a distance of 300 meters, a projectile out of twenty barely managed to hit a 5.5 m² wooden board. Colonel George Hanger, a British officer who fought during the American Revolution, said in 1814 that *"a good musket will kill a man at 80 feet, perhaps even hundred ; but a soldier must be a very unlucky person to be hit by a musket directed at him from a distance of 400 feet, even if his enemy aims correctly ; as for firing on a man at 600 feet with an ordinary musket, you* *could as well shoot at the moon with the same hope of striking your target. I maintain and will prove, if I am invited, that no man was ever killed at 600 feet by the musket of a soldier who aimed at his target carefully."*[2]

The probability that a smoothbore musket hit an object beyond a stone's throw was thus remote, but there existed at the time a firearm that overcame this limitation: the rifled gun. The famous Kentucky flintlock, for example, the favorite rifle of the bushwhackers and sharpshooters of the American Revolution, was extremely accurate at long range. The favorite targets of the *minutemen*[3] usually consisted in the head of a nail at 20 meters, that of a turkey at 100 meters and the entire bird at 200 meters. This remarkable skill is still a challenge today for a shooter equipped with a modern rifle and scope. At 400 meters, an American militiaman armed with a Kentucky rifle could easily hit a horse, feat which often exasperated His Majesty's cavalrymen.[4]

Notwithstanding its range and superb precision, the performance of the rifled gun was hampered by its complicated and relatively slow loading process. As its ammunition was manufactured to tightly fit the rifling of the gun, the soldier often pained to introduce the ball into the muzzle of the rifle, particularly in combat situations when powder residues fouled the grooves of the barrel. There was then no alternative than to hammer the ball home with his ram rod. This resulted in a shooting tempo that was reduced to a third of the rate of fire of a smoothbore musket, which rendered the weapon unbefitting for sustained service. Under these conditions, it was preferable that the troops fire at a rate of three to four shots per minute in the general direction of the approach of the enemy rather than fire once per minute at individual targets, with a high degree of accuracy.

What the common infantryman really needed was a weapon that combined the best of the smoothbore musket and rifled gun, in other words a weapon that was easy to load and sufficiently accurate to hit a small target at 200 meters. Following decades of experimentation, this wish materialized in the form of a muzzle loading rifle that expelled a conical projectile of an innovative design. But before such a weapon could really be effective, improvements to its firing lock remained a priority.

In 1807, Alexander Forsyth, a Presbyterian clergyman of Belhelvie, Scotland, patented a new firing mechanism. Rather than igniting the powder contained in a flash pan by a shower of sparks, Forsyth used a flat nose hammer to strike a pellet of fulminate of mercury, which after exploding under the impact, ignited the main powder charge located inside the barrel. In 1814, Joshua Shaw of Philadelphia improved Forsyth's design by encapsulating the fulminate in a small tin case that he fitted on a hollow nipple in direct contact with the interior of the barrel. In 1816, he replaced the tin capsule by a copper one. Thus was born the first modern percussion cap that, in addition to its practical use and ease of production, was waterproof and indifferent to the whims of the wind.

Because of its reliability, the new percussion lock immediately seduced the European and American military. The British army adopted it in 1834 after evaluating the results

[2] *Serven E.J., The Collecting of Guns, p. 169.*

[3] *There is often confusion between "minutemen" and militiamen. At the time of the first American War of Independence, the "minutemen" were members of local companies of militia, who had been selected to form commando units. Roughly one third of the men of each militia outfit were selected "to be ready to move or to fight within the minute".*

[4] *Kauffman J.H., The Pennsylvania and Kentucky Rifle, p.74.*

of 6.000 shots fired by both flint and percussion muskets: the flintlock guns failed 922 times (15 %) compared with 36 times (0.6 %) for percussion models.[5] In 1841, the American army followed the British example. The following year, the US arsenals started to convert their stockpiles of flintlock muskets into percussion models. This was however to be a long-term undertaking. Consequently, during the war of 1846 with Mexico, the majority of American soldiers were armed with flintlock muskets. Likewise, thirteen years later, at the beginning of the Civil War, the Federal and Confederate authorities distributed thousands of obsolete muskets to the young volunteers of their armies.

Although the percussion lock contributed significantly to the reliability of the regulation infantry musket, the combination of ease of loading, shooting accuracy and acceptable rate of fire remained unfeasible until the advent of a new projectile: the Minié ball. Improved during decades, its final development resulted from independent experiments carried out simultaneously in Great Britain, France and the United States.

In 1818, in Great Britain, Captain John Norton of the 34th Regiment of Foot designed a new type of projectile. Posted in the British India colonies during many years, Norton closely observed the natives hunting with blowpipes. He discovered that the base of their darts was covered with a kind of elastic gum. When these darts were fired, the gum became distorted and formed a seal against the interior wall of the bamboo blowpipe. Inspired by this technique, Norton developed a conical lead bullet that had a rounded nose and a hollow base. Moreover, he cast the projectile with a diameter slightly smaller than the bore of the gun, which allowed its effortless introduction into the barrel. Upon firing the main powder charge, he noticed that the gas pressure generated by the combustion of the powder caused an expansion of the base of the lead ball, forcing it against the wall and grooves of the barrel of the gun while inducing it to spin.

In 1836, William Greener, an arms manufacturer of London, tried to improve Norton's invention. He inserted a small wooden plug in the cavity of the projectile, which was projected forward when the weapon was fired. This acceleration forced the base of the bullet to expand and tightly fit the rifling of the gun, allowing for a smooth, regular and accurate shooting. The British military closely examined the rifle and ball designed by Norton and improved by Greener. After numerous tests considered inconclusive, the old school officers rejected the new weapon and its ammunition. Their conservative opinion no doubt prevented the armies of His Majesty from adopting a weapon well ahead of its time.

While Norton was improving his projectile, French arms manufacturers were working on a similar design. In 1826, Captain Henri-Gustave Delvigne developed a new rifle capable of firing the conical bullet conceived by his predecessors. He built a gun whose breech possessed a narrow powder chamber, which was separated from the remainder of the barrel by a circular shoulder beyond which could pass the powder, but not the projectile. In a first prototype, after having filled the chamber with black powder, Delvigne inserted a round lead ball into the bore of the weapon, and then rammed it with a metal rod against the breech shoulder until it was sufficiently deformed to fit the grooves of the barrel. He quickly discovered that his hammering had distorted the ball to the extent that it seriously affected the accuracy of the gun's firing.

[5] *Markham George, Guns of the Empire, p.12.*

To overcome this flaw, he designed a conical projectile with a flat base that also deformed under the repeated blows of the ramrod. Unfortunately, the fowling of the barrel and powder chamber rendered the weapon unusable after a few shots. Moreover, the distortion of the ball was yet again unacceptable for any accurate shooting. Following the recommendations of his friend, Colonel Pontcharra, Delvigne eliminated these shortcomings by attaching a sabot to the conical ball, whose role was to scrape the interior of the barrel after each firing. The new ammunition finally gave satisfactory results with respect to fowling and accuracy. The Delvigne-Pontcharra rifle was subsequently adopted by France in 1838 and would claim its hours of glory during the French Algerian campaigns shortly to come.

In 1828, Colonel Louis-Etienne Thouvenin improved the design of Delvigne's rifle. He replaced the shoulder of the powder chamber by a solid metal tube that he screwed into the breech of the weapon. When loading, he noted that the base of his conical ball rested perfectly against the face of the tube, allowing for its uniform expansion in the grooves of the barrel after firing. Although Thouvenin's design was only a modest improvement to that of Delvigne, the French Army nevertheless showed interest in his weapon that was subject to extensive tests carried out in the early 1840's. The verdict came without appeal : the combination of the rifle and its ammunition was inapt for military use. It was indeed most difficult to clean the breech of the weapon and the shoulder of the powder chamber had a tendency to deform. Thouvenin however did not give up and in 1844, he conceived a radically new rifle. Doing away with the special powder chamber, he screwed a steel pillar ("tige") into the bottom of the breech, which was machined with a pointed or spherical head. After inserting a solid base conical bullet into the barrel, a few energetic blows of a steel ramrod of suitable shape were sufficient to deform the lead bullet so that it correctly fitted the rifling of the barrel. Although the pillar had sometimes the tendency to bend or to break, Thouvenin's rifle nevertheless attracted the attention of the French Army, which adopted it under the name "model 1846". This weapon, in .70 caliber, provided good and faithful services during the Crimean War and even found its way on the battlefields of the American Civil War whose belligerents imported a few thousand of them.

The work of Delvigne and Thouvenin encouraged Captain Claude-Etienne Minié to develop a more reliable and effective ammunition. In 1849, he designed a projectile that resembled more Norton's prototype than Delvigne's bullet: it was in fact a conical ball with a cylindrical hollow base and a rounded nose. In the same way that Greener had modified the design of Norton, Minié also inserted a plug in the hollow base of the ball, which acted like an expansion wedge. However, he substituted Greener's wooden plug by an iron truncated cone. When firing the weapon, the explosion of the powder propelled the metal wedge forward, causing the projectile to swell and forcing it to marry the rifling of the barrel. Curiously, the French ignored Minié's invention until 1853. On the other hand, the British Ordinance Department was quick to react and immediately adopted this projectile for its model 1851 Enfield rifle, and paid the French inventor 20.000 £ for the acquisition of his patent. Paradoxically, the British Army was compelled to compensate William Greener the sum of 1.000 £ after the latter won a lawsuit "for abuse of his own invention". A few months later, the military of the New World also decided in favor of the new projectile, which they baptized "*minyay ball*" or "*minnie ball*" whereas ironically, the invention of the French captain was not a ball but a conical shaped bullet with a hollow base.

In 1850, James H. Burton, the chief superintendent at the arsenal of Harper's Ferry, Virginia, gave the Minié ball its final shape and dimensions. By slightly lengthening the projectile, thinning its base wall and providing several rings on its circumference, Burton managed to do away with Minié's metal wedge. The improved bullet expanded like the inventor's original prototype and in addition, it was much simpler to manufacture and cheaper to mass produce. Burton's version of the projectile had a diameter of .58" (1.47 cm) and weighed 500 grains (32.45 g). The complete ammunition incorporated the ball and its powder charge of 60 grains, which were jointly wrapped in a piece of paper folded or twisted at both ends. While on campaign, each infantryman was provided with four packs of ten of these cartridges.

Towards the mid-1850's, Burton's was responsible for the development of a brand new weapon chambered specifically for the Minié ball, and as easy to load as the old smoothbore while having the precision of the rifled gun. Being the combination of its two predecessors, it was commonly known as the "rifled musket". In 1855, Jefferson Davis, the Secretary of War and future president of the Confederacy, endorsed the design of the model 1855 rifled musket and recommended its adoption by the American army. An improved version, the model 1861, manufactured by the Federal arsenal of Springfield, Massachusetts, would become one of the major weapons of the Civil War, one that hundreds of thousands of Union soldiers would carry on all the battlefields. The Confederates captured a countless number of these muskets, which they efficiently turned against their foe. Between 1861 and 1865, the Springfield arsenal manufactured approximately 800,000 model 1861 rifled muskets, and private firms built 880,000 more; 500,000 additional rifled muskets, in majority models slightly modified in 1863 and 1864, came out of Federal arsenals before the end of the war. In total, the North produced no less than two million Springfield muskets chambered for Captain Minié's ball. On the Confederated side, the model 1853 Enfield rifle was by far the best weapon available in Southern arsenals, which the troops considered, rightly so, equal to the Springfield rifle. The Confederacy bought approximately 400,000 Enfields from Great Britain, the majority in .577 caliber.[6] The North imported a similar number for its own armies.

The model 1861 Springfield musket was a .58 caliber rifled percussion weapon that weighed almost five kilos and cost approximately 15 $ to manufacture. Its overall length was roughly 1.5 meters, its barrel nearly one meter long and it was provided with a 45 cm triangular socket bayonet. Although the musket discharged its projectile at the relatively slow speed of 2.4 m/s, its imposing energy and lethal precision at long range compensated this imperfection.[7] Armed with a Springfield musket, a trained infantryman could hit the center of a 70 cm diameter target at a distance of 450 meters, the best performance at the time for a regulation weapon. A marksman could easily group his shots on a 10 cm² target located some 180 meters away, and a 150 cm² target at 450 meters. At 900 meters, he could hit a 250 cm² board most of the times.[8] These figures by no means imply that the average Civil War soldier

[6] *This caliber was almost identical to the .58 caliber of the 1861 Springfield, and allowed the use of .58 ammunition coming from existing Southern arsenals or captured from the enemy..*

[7] *The speed of a .58 caliber Minié ball is similar to that of a .22 bullet fired from a modern rifle. However its energy is approximately 12 times that produced by the small .22 caliber rim fire cartridge (energy = mass x speed²/2).*

[8] *Edwards W.B., Civil War Guns, p.184.*

could hit just anything at the most extreme distances but, compared with the performances of the smoothbore musket, they illustrate the frightening accuracy of the weapon, even when it was put in the hands of an inexperienced combatant.

One of the properties of the Minié ball fired by the Springfield musket was its devastating capabilities. Although its initial muzzle speed was modest, its important mass conferred it such energy that the projectile became deformed at the time of its impact. It penetrated the body of its victim by shattering the bones or by severing the arteries and other organic tissues that were on its trajectory. These ghastly wounds fueled the most incredible rumors that spread in campaign hospitals where the most common treatment consisted in amputation. Actually, these stories resulted more from the limited medical knowledge of the time than from the devastating nature of the Minié ball.

A new military technology had thus appeared a little before the Civil War, but the tactics of the Napoleonic era, those still taught at West Point or in the military manuals at the beginning of the conflict, were obsolete at the time because they had not evolved to take into account the innovations in armament. Shortly after the bombardment of Fort Sumter in 1861, the officers of the facing armies were trying to apply proven but outmoded strategies whereas their forces had been equipped with the latest Enfield and Springfield rifled muskets. These powerful weapons revolutionized the art of warfare by modifying the tactical balance that previously existed between an offensive and defensive army. The traditional frontal attacks carried out by the infantry on fortified positions became suddenly suicidal. Thanks to the accuracy and long range of their rifled musket, the defenders of an earthwork could now open fire on their attackers at a respectable distance with the likelihood of hitting them. Since charging troops could no longer afford to pause and return fire on their foe, they suffered more losses than they inflicted.

During the major part of the conflict, and despite the devastating effects of the rifled musket, the commanders of the opposing armies persevered in grouping their men into compact blocks or lines, which they then sent hurling through open ground in foolish offensives. For example, at the battle of Fredericksburg in December 1862, Burnside's troops attacked the Rebel defenses of Marye's Heights in appalling frontal charges. The rolling fire of the artillery and the volleys of Confederate musketry easily mowed down the fourteen Federal assault waves that succeeded one another at an infernal pace. Likewise, in July 1863, during Pickett's charge at the battle of Gettysburg, more than 6,000 Confederates were killed or wounded during their progression on open ground towards the fortified Union positions. At the times of Washington or even Napoleon, such maneuvers would have proven judicious since a charging infantry would only have been exposed to the enemy's fire during the last stage of its advance, at a distance of eighty or perhaps fifty meters. But when the defendant was armed with a rifled musket, he could start shooting when the enemy was at three times that distance. The rules and tactics of traditional warfare were definitely no longer consistent with the efficiency of modern armament.

The combination of the rifled musket and the Minié ball rendered the saber and bayonet almost useless. At the time of former conflicts, the bayonet was generally the weapon that decided the outcome of the battle because the limited range of the flintlock musket allowed the attackers to approach the enemy and finish him in vicious hand to hand fighting. This was no longer possible during the Civil War since charging waves of infantry had little chance of making any physical contact with concealed defenders firing deadly long range volleys of musketry. In fact, the surgeons treated very few bayonet wounds during the conflict. For example, after the terrible battle of Cold Harbor, in the summer of 1864, the Federal doctors reported only 37 injuries caused by cold steel. Likewise, official statistics reveal that out of the hundreds of thousands of casualties treated in Union hospitals during the conflict, less than a thousand were caused by the saber or bayonet.[9]

The rifled musket also seriously reduced the effectiveness of field artillery. During his great campaigns at the beginning of 19^{th} century, Napoleon often placed his guns in the front line to provide a direct support to the infantry, even while his army was on the march. This would have been suicidal during the Civil War, since the artillerymen handling the guns in such a place were easy preys for a defensive force equipped with rifled muskets. The artillery gunners of both sides were thus usually confined to the rear of the battlefield, from where it was more difficult to pound the enemy without exposing the front infantry line to friendly fire.

Following the same logic, the rifled musket relegated the importance of the cavalry to a minor role. Napoleon frequently used his cavalry in frontal attacks by sending his dragoons trample the enemy's infantry equipped with cumbersome and inefficient muskets. The soldier of the Civil War armed with his Springfield or Enfield rifle could drop a man at a distance ranging between 100 and 200 meters. A rider on his mount was an even easier target. Consequently, the colorful cavalry charges of the Napoleonic era suddenly became obsolete. In practice, as the conflict progressed, the cavalry generally fought as mounted infantry, the troopers using their horse for mobility and dismounting to fight on foot.

The appalling death rate on the battlefields of the Civil War resulted from the dreadful effect of the armament used by both sides. Its effectiveness is assessed as follows. During the 10,455 skirmishes and engagements of the conflict, the Federals suffered 110.000 killed and 275.000 wounded and the Confederates, 94.000 killed and 194.000 wounded.[10] Ninety percent of these fatalities were caused by bullets of the Minié type. Artillery projectiles caused the death of less than nine percent of the victims. As for sabers and bayonets, their blows account for less than one percent of all casualties.

The above statistics plainly reveal that the deadliest weapons of the American Civil War were not those that stemmed from the fertile imagination of ingenious inventors, such as repeating rifles, volleys guns, torpedoes and other infernal machines. It was the modest rifled musket and its humble companion, the Minié ball, which decided the outcome of the great battles. Whereas the American conflict began with traditional Napoleonic style frontal attacks carried out by tightly massed troops, the performance of the rifled musket transformed the struggle between brothers into a cruel war of attrition where both belligerents soon entrenched to protect themselves from the devastating volleys of the enemy's musketry. This evolution ominously predicted the bloody stalemate on the Western front during the Great War.

The chivalrous era of the glorious cavalry and bayonet charges was indeed a thing of the past.

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[9] *The Irish Brigade - http://www.roberteleecwrt.org/present/bilby.html*
[10] *Dyer Compendium, p. 582 ; Long E.B., The Civil War Day By Day , p.718-719.*