

U.S. ARMY RIFLE AND CARBINE ADOPTION
BETWEEN 1865 AND 1900

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ABSTRACT

U.S. ARMY RIFLE AND CARBINE ADOPTION BETWEEN 1865 AND 1900, by MAJ John C. Davis, 103 pages.

This thesis covers a period of transformation in the Army between the large Civil War Army armed primarily with muzzle-loading percussion arms to an Army numbering in the tens of thousands armed with magazine-fed bolt-action repeating rifles by 1900. This document covers the boards, trials, procedures, political and economic constraints involved in selecting new arms during this period, as well as the arms considered and selected. This document concludes with an analysis of the decisions made and how similar considerations affect decisions regarding the small arms carried by America's soldiers today.

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CHAPTER 1

INTRODUCTION

During the Civil War, American arms designers from both the U.S. arsenals and the civilian sector produced an enormous selection of new carbine and rifle designs. The needs of a wartime Army combined with advances in industrial techniques and processes saw the rapid development of both breech-loading and repeating-cartridge firearms by the war's end. The Ordnance Department's postwar decision to adopt the "Trapdoor" Springfield series of single-shot breechloaders after it purchased and issued the Spencer and other repeating rifles and carbines during the Civil War seemed like a step backwards. Likewise, the department's decision to adopt the M1892 .30-caliber Krag rifle in 1893, while Spain adopted the improved Mauser in 7-by-57 millimeter appeared a similar example of poor decision making in the post-Civil War period.

What factors contributed to Ordnance Department selection of standardized rifles and carbines between 1865 and 1900? This thesis is organized into three periods based on the weapons adopted as standard by the U.S. Army: the immediate post-Civil War era during which a number of wartime weapons were still in use and the Allin conversion; the 1872 trials of breech-loading rifles and carbines which resulted in the adoption of the .45-caliber 1873 Trapdoor Springfield; and the rifle and carbine trials which selected the Krag-Jorgenson as the standard U.S. Army rifle and established the .30-caliber (7.62 millimeter) which remained the standard for U.S. military rifles well into the 1960s. The .30-caliber rifle has resurfaced during the current war on terrorism as units clamor for M14s or other .30-caliber rifles for issue to designated marksmen.

While allegations of corruption, Ordnance Department parochialism, and favoritism continue today, the truth is somewhat less straightforward. The large number of serviceable Springfield rifled muskets on hand and a period of shrinking budgets in the immediate post-Civil war era, as well as the great expense of the war itself played roles in the decision to adopt the breech-loading Springfield variants. On 3 September 1872, a board convened under BG Alfred H. Terry to select a single breech-loading system for use by the Ordnance Department for the production of all rifles and carbines. The result of this board,¹ which examined over one-hundred arms, was that variants of the Trapdoor Springfield continued to be the primary issue rifle and carbine until 1894.

In 1890, a board convened which resulted in the selection of the Danish Krag-Jorgenson system as the first U.S.-issue repeating rifle utilizing smokeless powder. Initially adopted as the Model 1892, the Krag remained the primary Army service rifle until the adoption of the Mauser based Model 1903 Springfield.² If the Ordnance Department indeed based its decisions to adopt the Trapdoor Springfield and Krag rifles on department bias or parochialism, then both decisions had at least the tacit approval of members of the combat arms who served on these boards and found themselves in command of troops carrying these rifles.

Advances in all facets of small-arms ammunition provided the foundation for the numerous advances in small-arms technology. The development of self-contained cartridges, the switch from rimfire to centerfire cartridges, and in cartridge materials from copper to brass, and the development of smokeless powder suitable for use in rifles all supported advances made in other areas of rifle design. Without suitable ammunition, the

most technologically advanced firearm is nothing but an expensive club, and a fairly fragile one at that.

In an attempt to discover the deciding factors involved, each of the three periods will be discussed in five relevant questions: What were the other options available? What test and evaluation criteria resulted in the selection of the weapon in question? What preexisting conditions or outside factors influenced decisions made by the Ordnance Department? What effect did small-arms ammunition development and manufacturing techniques play in the selection process across this period? How did the Ordnance Department selections compare to arms adopted by contemporary armies? Chapter five will employ the same five questions in reference to how similar considerations affect today's small-arms acquisition process.

¹The 1872 board was composed of BG Terry, one Ordnance Officer, one Cavalry Officer, one Infantry Officer, and one Artillery Officer.

²The selection of the Model 1903 Springfield followed a subsequent board convened in 1901.

CHAPTER 2

THE POST-CIVIL WAR ERA AND THE ALLIN CONVERSIONS

The end of the Civil War saw a massive drawdown in American military manpower and budgets for procurement of all types of military equipment. Volunteers who had entered the Army to preserve the Union wanted to go home to their families, and Congress saw no need for the large Army required to fight the Civil War. Congress wanted an immediate decrease the Army's size and budget. However, the requirements of reconstruction, continued problems with the plains tribes, and the threat posed by the French presence in Mexico under Maximilian, imposed an eighteen-month delay in reaching desired levels. In May of 1865, there were 1,052,038 volunteer soldiers in service. By June 1866 these requirements abated and the army had discharged more than one-million soldiers resulting in an end-strength of 11,043. General in Chief of the Army General Ulysses S. Grant wanted to increase the Regular Army to 80,000 men, but neither Secretary of War Stanton nor Congress agreed. In July of 1866 Congress set the authorized strength of the Regular Army at 54,302 in order to fulfill the requirements of reconstruction and Western expansion.¹ The Army's size never exceeded 57,000 until 1898. In 1869, Congress cut the number of infantry regiments to 25 and the authorized strength to 45,000. With the end of reconstruction in 1876, Congress further reduced authorized troop strength to 27,442 where it remained until the Spanish-American War.²

In September of 1863, Brigadier General George D Ramsay assumed the post of Chief of Ordnance after General James Wolfe Ripley's retirement. In September 1864, Brigadier General Alexander Byrdie Dyer assumed the post, succeeding Ramsay following his retirement. General Dyer commanded Springfield Armory during the Civil

War where he received credit for raising production of the Springfield rifle to 1,000 per day. Dyer remained Chief of Ordnance until his death in 1874.³

Contractors and inventors sought to have their arms adopted by the Army during the war, and felt their designs had not received due consideration. While allegations against Civil War Chief of Ordnance James Wolfe Ripley, who held the post between 1861 and 1863, may have had some merit, the bitter feelings these entrepreneurs carried toward the Ordnance Department into the postwar period posed a threat to progress. Congress appointed a joint committee to investigate their allegations. Dyer requested a court-martial based on the committee's report drafted by of the plaintiffs which reflected unfavorably upon him. The Army denied Dyer's request although it did grant his subsequent request for a court of inquiry. The court of inquiry exonerated General Dyer and even "held him up as an example worthy of the imitation of all army officers."⁴ The real damage produced by the congressional committee's investigation was establishment of precedent for those who later felt cheated by the Ordnance Department decisions. Later ordnance boards expended great amounts of time, money, and effort to test arms which in many cases did not deserve the attention and warranted immediate rejection.⁵

The large stockpile of war material on hand at the conclusion of the Civil War tended to cause even the most hawkish legislator to wonder how the Army justified the expense of new weapons. A summary statement of purchases and fabrications from 1 January 1861 to 30 June 1866,⁶ lists a total of 1,472,614 Springfield rifles and 396,896 breech-loading carbines.⁷ While a great number of these were undoubtedly unserviceable, obsolete, or failed to survive the Civil War, all sources agree that the U.S. Army possessed more serviceable Springfield rifles than required by the small postwar

Army in 1866. The Ordnance Department sold large quantities of surplus Civil War arms to commercial arms merchants after the Civil War. These merchants subsequently resold many of these weapons to foreign governments. These surplus weapons continued to appear in conflicts around the world. One of the largest arms merchants during the postwar period was Francis Bannerman of New York City. Bannerman Broadsheets, a document much like modern sales flyers, still offered Civil War era surplus weapons at the dawn of the twentieth century.

Technological advances in small arms design and the development of self-contained ammunition made it apparent that breech-loading and repeating arms represented the future for military rifle and carbine designs. Based on the size of the Army, the number of Springfields on hand, and the small budgets of the postwar era, it is no surprise that the most commonly issued infantry arm in the postwar era was the muzzle-loading Springfield rifle and that the pursuit of a new standardized breechloader focused on economical conversions of the Springfield.

The period immediately following the Civil War saw the majority of Army infantry soldiers armed with the Springfield rifle of either the 1861 or 1863 patterns. Cavalry units carried a mixture of breech-loading or repeating carbines with the Spencer being most prevalent. All muzzle-loading .58-caliber Springfield rifle muskets fired a 500-grain⁸ Minié ball wrapped in a paper cartridge which also held the standard 60-grain charge of black powder. The Minié ball was a soft lead bullet of slightly smaller diameter than the rifle bore and featured a hollow base. The smaller-diameter bullet allowed for the quicker reloading of rifled arms and had led to them replacing smoothbore muskets prior to the Civil War.

The shooter ripped open the cartridge and poured the powder down the barrel after which the end of the cartridge containing the bullet was inserted and rammed home. This process was dependant on gravity and the ability to force the bullet down the length of the barrel with the rammer, which forced the person loading the weapon to stand. The shooter placed a primer on the nipple and cocked the hammer making the arm ready to fire. When the shooter pulled the trigger, the hammer dropped igniting the powder charge due to the flash of the percussion cap. The expanding gasses forced the rear skirt of the Minié ball to form a seal and engage the rifling.

All Springfield Models 1855 through 1863 rifles and parts, including those manufactured under government contract utilized the "American System" of interchangeable parts manufacture. Many components were initially die formed and finish milled to near identical tolerances on specialized tooling. After heat treating and polishing, this system required parts to fit any weapon without hand fitting or they were rejected. This helped the arsenals and contractors to better support the rapid production of weapons required during the Civil War Army. In addition, it simplified the task of repairing damaged arms and allowed the use of spare parts to manufacture later weapons.

The Model 1861 Springfield rifle, commonly referred to as the Springfield based on its principal place of production, was the primary shoulder arm used by the U.S. Army during the Civil War and served as the standard for most arms made for war use. This rifle was an improved version of the Model 1855 which eliminated the patch box and the Maynard tape primer system which had proven troublesome in both production and field service. These changes reduced both manufacturing costs and time which was necessary

for a country at war and in desperate need of firearms. The Springfield had an effective range of approximately 500 yards and was favored for its range, accuracy, and reliability.

The basic Springfield rifle musket had a 40-inch, .58-caliber rifled barrel with a round profile which was unfinished or left “bright” during wartime production. Three barrel bands positioned by retaining springs mount the barrel to the stock. The stock was made of walnut with a channel under the barrel for the steel ramrod. It utilized a blade front sight which doubled as the locking lug for the triangular socket bayonet. The rifle employed a flip up, double leaf rear sight graduated for 300 and 500 yards.⁹ Some contractors continued to produce the 1861 until the end of the war, never converting to production of the Model 1863. The Ordnance Department listed government production of Springfield rifles at 801,997¹⁰ at a cost of approximately \$12 per rifle. The government arsenals were unable to produce a sufficient number of Rifles to meet demands, so in addition to purchasing arms of different types, the Army contracted with some civilian arms manufacturers to build rifles of the Springfield pattern. By the end of the Civil War, the Ordnance Department records indicate that the government purchased an additional 670,617 rifles at a cost of approximately \$19 each.¹¹ Colt Firearms Manufacturing produced contract Model 1861 Springfields and many improvements they made on the rifles, including redesigned barrel bands, a new hammer, and a redesigned bolster,¹² were adopted by the Ordnance Department and incorporated into the Model 1863 rifle-musket¹³.

The Model 1863 Springfield rifle introduced the redesigned barrel bands, new hammer, and redesigned bolster from the Colt rifle, and a new ramrod and case-hardened steel lock (as opposed to iron). The Model 1863 Springfield (Type 2), often referred to as

the Model 1864, was the final muzzle-loading rifle musket produced by U.S. arsenals as production began on the first Allin breech-loading conversions the following year. The Model 1863 (Type 2) introduced limited changes from the Model 1863 which included another change to the barrel bands, setting the nipple bolster out a bit further, incorporating a clean out screw instead of an angled flash hole, and modifications in the method used to retain the ramrod. The accuracy and long range of .58-caliber rifles firing Minié balls forced dramatic changes in linear tactics of massed formations used since before the advent of firearms. At ranges of several hundred yards, a decent marksman could hit a target of his choosing rather than aiming at the large body of men opposite him. With the production of the Springfield rifle and other contemporary arms, muzzle-loading firearms reached the pinnacle of their development. By the end of the Civil War, however, it became obvious that the future lie with breech-loading firearms firing self-contained cartridges. Muzzle-loaders were capable of sustained rates of fire of approximately two to three rounds per minute and required soldiers to stand to reload. A soldier with a breechloader provided a much heavier volume of fire and was able to reload from firing positions including the prone, which allowed him to fire more accurately and limited the silhouette he presented to the enemy.

The Springfield Joslyn was the first breech-loading rifle produced at the Springfield Armory. In 1865, the Armory produced 3,005 of these rifles which fired a .56-50 rimfire cartridge loaded through a breechblock which pivoted counterclockwise. This early breech-loading Springfield conversion saw limited postwar service, most notably on the east coast with the 5th U.S. Veteran Volunteer Infantry during 1865-1866.

The Model 1865 Springfield "First Allin" conversion was the first in a series of breech-loading rifles commonly referred to as Trapdoor Springfields. Erskine S. Allin, for whom the conversion is named, was the Master Armorer at Springfield Armory. The rifle fired a self-contained metallic cartridge equivalent to the standard rifle load but inserted from the breech, which markedly increased the rate of fire. Allin's prototype design concept, developed and produced at the Springfield Arsenal, allowed the conversion of a muzzle-loading rifle to a breechloader, at relatively low cost compared to the construction or purchase of an entirely new weapon.

The conversion involved machining away a portion of the rear of the barrel and installing a hinged breechblock that rotated up and forward to open the breech of the rifle and permit insertion of a cartridge. Although the Model 1865 Springfield is properly referred to as the "First Allin", the movement required to operate the action resulted in the Trapdoor appellation that was attached to the entire series of weapons. The Springfield Armory converted 5000 Model 1861 rifles to evaluate the design. The Model 1865 Springfield rifles chambered a metallic self-contained .58-60-500-caliber (.58-caliber, 60 grains of black powder, 500-grain bullet) rimfire cartridge. This caliber required the least modification to the original rifle musket since it used the same projectile and powder charge that the rifle had originally been designed for.

The Model 1866 Springfield rifle illustrated in figure 1, commonly referred to as the "Second Allin," addressed problems encountered with the Model 1865. The rifle employed an improved version of Allin's Trapdoor breechblock design. Springfield Armory built approximately 52,300 Model 1866 rifles between 1867 and 1869 from Model 1863 (Type 2) rifles.



Figure 1. Model 1866 Springfield "Second Allin" Conversion
Photographs by John Spangler

The conversion process involved reaming the original barrels to remove the rifling and brazing¹⁵ in a .50-caliber liner. The Armory milled away the rear portion of the barrel for the hinged Allin breechblock. The Allin breechblock and hinge assembly were case hardened while the rear sight and trigger assemblies remained blued, and the rifle retained the bright or unfinished barrel. The original stock required alteration to provide clearance for the extractor and ejector mechanisms. The Model 1866 chambered the .50-70 also called the .50-70-450 cartridge. The cartridge designation is composed of the bullet diameter (.50-caliber), the powder charge (70 grains of black powder) and the bullet weight (450-grains). Despite a new extraction system employed on the Model 1866 which replaced the problematic ratchet extractor of the Model 1865, case extraction continued to be a problem and frequently resulted in the expended copper shell casing remaining lodged in the chamber after firing, which disabled the weapon.

U.S. troops issued Model 1866 Springfields in 1867 soon demonstrated the value of breech-loading firearms during fighting on the Western frontier. The superiority of

breech-loading weapons was a factor in both the Wagon Box and the Hayfield Fights along the Bozeman Trail in 1867. The rapid rate of fire produced by soldiers armed with breech-loading rifles surprised attacking Sioux and Cheyenne forces. The Fetterman Massacre resulted from a similar engagement just a few months earlier where soldiers armed with earlier muzzle loading rifles were wiped out. The higher rate of fire produced by these new rifles, the ability to reload while prone or moving, and the elimination of the window of vulnerability (during which a soldier was busy reloading a muzzle loading rifle) contributed decisively to the outcome in these engagements where soldiers were heavily outnumbered.

The Model 1868 Springfield was the first U.S. Army rifle utilizing Allin's Trapdoor breechblock design completely manufactured as a breech-loading arm. All previous models were converted from stocks of Civil War production muzzle-loading rifles. The Model 1868 was also the first of the Trapdoor models to use a separate receiver, and once the stocks of .58-caliber muzzle loader barrels dried up, the remainder utilized new rather than converted barrels. Springfield Armory manufactured approximately 52,000 Model 1868 breechloaders with the majority produced in 1869 and 1870. The remaining stocks of Civil War era rifles and parts continued to provide the locks, butt plates, trigger guards and barrels helping reduce costs for the small post-Civil War Army.

Model 1868 barrels were 4 inches shorter than the earlier models since the barrel length did not include now separate breech and barrel length remained 32.6" for all subsequent models of Trapdoor infantry rifles. The new barrel length resulted in a lighter rifle and eliminated the requirement for the third barrel band. Model 1868 sights were

graduated for engaging targets out to a range of 900 yards. The Model 1868 was also the first Springfield rifle to be serial numbered.¹⁶ The Model 1868 served as the basis for the .45-caliber Model 1873 Trapdoor Springfield series of rifles and carbines which became the standard military longarms of the United States Army until 1894.

Despite the large number of Springfield rifles and breach-loading conversions available in the post-Civil War era, U.S. armories issued other arms for use by the infantry until the standardized adoption of the 1873 Trapdoor Springfield. The Remington “Rolling-Block” breech-loading rifles of the post-Civil War period possessed a strong and simple action. The hammer locked the breechblock upon firing. To reload the rifle, the shooter first drew the hammer to full cock, and then drew back the breechblock which rotated back away from the chamber. The shooter extracted the fired round, inserted a new one, and closed the breech preparing the rifle to fire. The largest drawback to this design, in the eyes of the Ordnance Department, was the requirement to load the weapon at a full cock. An arm loaded fully cocked as opposed to half cock is prepared to fire as soon as a soldier chambers a round and closes the breech. The Army considered this arm during several boards but required that Remington provide a modification allowing it to be loaded at the half cock. By the time Remington provided a model which was loaded at the half cock, the Army had widely fielded the Trapdoor Springfield and the Remington offered no obvious advantage.

The origin of the Model 1870 Springfield conversion Sharps rifle was the Model 1859 Sharps rifle of the Civil War. The Sharps rifle utilized a falling block breech which a soldier lowered by pulling down the trigger guard. The original Sharps utilized a paper or linen wrapped black powder cartridge and percussion caps. The Sharps carbine proved

popular with both Union and Confederate cavalry troops and was issued in much larger numbers than the full length rifle. The Infantry rifle was largely issued to specialty troops such as skirmishers and the troops of Major General Hiram Berdan's two regiments of United States Sharpshooters. The falling block action of the Sharps was particularly suitable for conversion to the new metallic cartridges developed both during and after the war and was the basis for subsequent Model 1870 Springfield conversion Sharps rifles and carbines. While the Ordnance Department struggled to develop and produce sufficient quantities of reliable breechloaders it began refurbishing and converting quantities of Sharps on hand at the arsenals. Many of these converted carbines in .50-70 Gov't were used during the Indian Wars until the fielding of the Model 1873 Trapdoor Springfield was complete.

The Ward-Burton U.S. Rifle Model 1871 was a single shot, bolt action rifle firing the .50-70 centerfire cartridge from a 32 5/8 inch barrel. Springfield armory re-barreled these rifles using the same method employed in the "Allin Conversions." The .58-caliber muzzle-loading barrels were bored over and had a .50-caliber liner brazed in place. The armory produced 1,015 Ward-Burton rifles and 313 carbines for field trials but they were unpopular due to their relative fragility.¹⁷

U.S. Armories never produced a carbine variant of the Springfield rifle musket or the Allin breech-loading conversions for use by cavalry until the standardization of the Model 1873. In 1863 two small arms companies delivered examples of repeating carbines, the Henry and Spencer, to the U.S. government. Both weapons fired self-contained metallic rimfire cartridges held in tubular magazines. The Henry employed a 15 round magazine mounted under and parallel to the barrel while the Spencer's

magazine contained 7 rounds and was located in the stock. Most U.S. Cavalry units carried the Spencer repeating carbine during the postwar period until the adoption of the .45-caliber Model 1873 Trapdoor Springfield Rifle Musket and its carbine variant.

The most successful non-Springfield produced rifle issued to Army infantry in the postwar era was the Spencer rifle illustrated by the patent drawing in figure 2. Soldiers of 3rd U.S. Infantry carried Model 1865 Spencer rifles until they exchanged them for .50-Caliber Springfields in 1868 and fewer than 150 Spencer rifles remained in field service by the end of 1870. Spencer carbines continued to see service with the cavalry. The Spencer Repeating Rifle Company designed their repeating rifles and carbines for military service. The Ordnance Department listed 94,196 carbines and an additional 12,471 rifles on the summary statement of purchases and fabrications from 1 January 1861 to 30 June 1866.¹⁸ Purchases by the Ordnance Department also fail to account for purchases by states and militia units. Model 1863 Spencers sported a .52-caliber barrel and employed a .56-.56¹⁹ rimfire cartridge developed in 1861 by Crittenden and Tibbals Manufacturing Company. Crittenden and Tibbals of South Coventry, Connecticut manufactured ammunition and cartridges during the Civil War.²⁰ In an attempt to make militarily useful ammunition, the 56-.56 rimfire featured the largest case possible to form at the time. The round approached the performance of the standard .58-caliber rifle-musket when fired from a rifle.

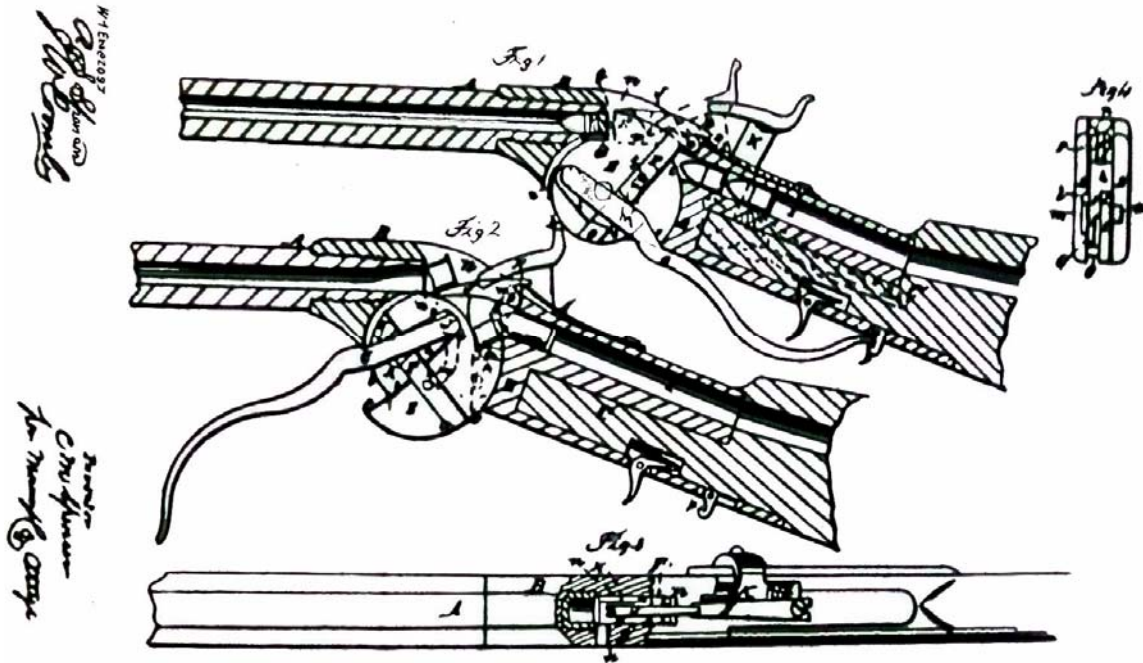


Figure 2. Patent Drawing of the 1863 Spencer Action

The Ordnance Department developed the .56-.50 rimfire cartridge used by the 1865 and later Spencers following the Ordnance Board of 1863. The Board established .50-caliber as the preferred caliber for carbines due to: 1) the ability to throw a bullet of sufficient weight to be effective against both men and horses; 2) retaining reasonable accuracy at extended ranges; 3) not being overly punishing when fired from a light, short barreled carbine. The introduction of the .56-.50-caliber rimfire in March of 1865 occurred too late for service in the Civil War.

The Spencer rifles and carbines issued to soldiers during the postwar Era were the Model 1865. The significant changes, which differentiate this model from the model 1863, include a bore reduction to .50-caliber and a change in barrel length for carbines from 22 to 20 inches. Rifle barrels remained 30 inches in length. The limiting factor in

the Spencer design was its heavy cast receiver, which was unable to safely fire a more powerful cartridge and placed a limit on overall cartridge length. The action was incapable of feeding cartridges longer than 1.75 inches. The .56-.50 improved ballistic performance compared to the .56-.56. The .56-.50 employed a longer, smaller diameter bullet propelled by a larger powder charge to achieve better performance. The .56-.50 cartridge reached the practical limit that the Spencer breech could handle.

The Spencer Repeating Arms Company produced the Model 1863 rifles and carbines with a .52-caliber barrel of 22 inches and 6 groove rifling. Between late 1865 and the early 1870's, the Springfield Armory refinished and converted over 11,000 1863 Spencers to .56-.50-caliber. The Armory equipped most conversions with Stabler's patent magazine cutoff. When engaged, the Stabler cutoff prevented the breach from dropping sufficiently to load a round from the magazine, thus allowing the weapon to function as a single shot. Springfield conversions are identifiable due to the three groove rifled barrel liners.

There was considerable debate during development of the .56-.52 and .56-.50 between the arms designer, Christopher Spencer, and Captain Steven V. Benet of the Frankford Armory. Benet argued that a longer cartridge case provided better protection for the bullet. Spencer believed that using a heavy crimp²¹ on the cartridge mouth damaged the bullet or strip of material required to engage the rifling thus ruining accuracy. Spencer and the Ordnance Department each produced the version they favored resulting in two cartridges which are different but interchangeable for 50-caliber Spencers. The .56-.50 preferred by Benet represented the first inside lubricated rimfire cartridge adopted for general issue. The cartridge case covered the bullet's grease

grooves and resembled cartridges still in use today. Spencer's .56-.52 left the bullet's grease grooves exposed ahead of the cartridge crimp. The Ordnance Department predominately issued the Springfield designed .56-.50 ammunition manufactured in its own plants or by commercial suppliers. The rate of fire of the .56-.56-caliber Spencers proved beneficial in several Civil War battles where the short ranges were within the capabilities of the cartridge. Nevertheless, the short cartridge case dictated by the Spencer action proved ineffective at the longer ranges on the plains.

The U.S. Army purchased few Henry rifles for issue although many state units and individuals purchased and used them with great effect during the Civil War. Benjamin Tyler Henry had not designed the rifle as a military arm. The Henry rifle employed a .44-caliber rimfire cartridge held in a 12 round tubular magazine under the barrel. The rifle had a 24 inch barrel with an octagonal profile and an overall length of 43.5 inches. Military models had sling swivels on the left side of the rifle and weighed a relatively light 9.25 pounds. Confederate soldiers frequently referred to the Henry as that damned Yankee rifle that can be loaded on Sunday and be fired all week, which probably stemmed from Confederate General John Singleton Mosby's comment that "as for these guns they could wind up on Sunday and shoot all week, it was useless to fight against them."²² Between 23 July 1863 and 7 November 1865, the Army purchased approximately 1,731 Henry rifles and 4,610,400 cartridges due to the shortage of firearms. By the end of the war the Department of Washington listed 657 government owned Henry rifles in field service. Elements of the 1st D.C. Cavalry carried government issue Henry rifles and 627 were purchased for issue to Veteran Volunteer Infantry regiments but failed to reach the troops before the end of the war.²³ The Henry rifle

continued to be popular with militia troops and civilians hired by the Army during the post-Civil War period and after a number of improvements, including moving the loading gate from the muzzle to the right side of the receiver, found lasting fame as the 1866 Winchester.

The Army issued General Order Number 60 requiring the Ordnance Department to convene an Ordnance Board at St. Louis, Missouri in June of 1870. Major General John McAllister Schofield presided over the 1870 Board and directed its meeting on or about 15 September 1870 at Fort Leavenworth, Kansas, and elsewhere as required for the examination of available small arms and accoutrements. Arms manufactures and designers submitted designs for 35 rifles and eight carbines for consideration by the Board.²⁴

The Board established nine tests to evaluate the reliability and effectiveness of the weapons submitted. The first test was an evaluation of the arms construction. The Board sought to rate the weapons simplicity of construction. To do this, board members disassembled each weapon, examined and counted the components, and recorded the results. The Board arranged the next two tests to determine the accuracy potential and speed each weapon could be loaded. In the second test, the Board required each weapon to be fired for 15 rounds from a rest at a target 100 yards away. By employing a rest this test reflected the accuracy potential of the rifle in question by removing shooter error from the results. The third test determined the relative speed the weapons under consideration could be reloaded and fired at a target without consideration for accuracy. The standard employed was the time required for a soldier to load and fire 25 rounds at a target 100 yards away.

The fourth test involved firing 500 rounds through each weapon in a fixed rest at a target 100 yards away to determine the durability of each weapon. The Board allowed for a cooling period after each 100 rounds, but dictated that the weapons were not to be cleaned during the test. Board representatives were instructed to clean and inspect the weapons at the conclusion of the test to determine any damage or wear caused by the test.

The fifth test subjected each of the weapons to exposure to firing and weather over 4 days without cleaning. Test personnel fired 100 rounds a day through each weapon and then placed it in the weather until the next day. Test personnel applied water to the weapons if the weather did not cooperate. At the end of the 4 day test, test personnel cleaned and examined the rifle to determine if it had incurred permanent damage.

The Board then tested the ability of the weapons to resist the effects of foreign material and corrosion. The sixth test required the application of sand and dust to the breach to determine the effect foreign material would have on weapon function. This tested the effect of fine sand on the mechanism when open and closed. Test personnel could not clean the weapon before attempting to fire it, but could remove excess material by shaking it or brushing it with their hand. As in the previous tests, test personnel cleaned and examined the rifle to determine if it had incurred permanent damage. The seventh test was similar to the previous test. This test required the application of salt water to the action. Test personnel placed the rifle in a brine solution for three hours. The tester had to ensure that the solution covered the breech and chamber. The Board then required testers to expose the weapon to open air overnight and fire 50 shots through it the following day.

The Board employed the last two tests to determine what effect defective or over loaded cartridges could have on the weapons. Test eighth involved firing 6 defective cartridges through each weapon with the cartridges mutilated in accordance with standards established by the Board.²⁵ The Board intended to determine if firing defective ammunition would result catastrophic failure or the weapon becoming disabled. The Board established the final test to attempt to determine the strength of the breach mechanism. In an attempt to determine the durability of the action, a board representative remotely fired the weapon after loading two over-charged rounds. The first round contained twice the normal powder charge while the second round had 3 times the powder charge of a service cartridge.

The Board reported on the results of these tests as applied to six of the principle breech-mechanisms received for testing. The six systems tested and reported were the Remington, Springfield Breech-loading, Sharp's, Morgenstern, Martini-Henry, and Ward-Burton rifles. The Small Arms Board completed its experiments and submitted a report on 10 June 1870 which recommended the following six rifles for service in order of merit: Remington, Springfield, Sharp's, Morgenstern, Martini-Henry, Ward-Burton. The Small Arms Board also recommended the same arms and order of merit for cavalry carbines with the caveat that the Remington carbine be adapted to allow it to be loaded at the half-cock. The Board's report also stated that of the weapons considered "the Board are unanimously and decidedly of the opinion that the Remington is the best system for the Army of the United States."²⁶

The Army convened a Field Trials Board in 1871 which was tasked to select a number of breech-loading designs and get them in the hands of troops for actual use in

the field. The 1871 Field Trials Board selected four systems for limited experimental production and issue for field trials. The weapons the Board selected were the Remington, Sharps, Ward-Burton, and Springfield Model 1870 rifles. The weapons produced for the trials fired the .50-70 centerfire cartridge. The Board decided to produce and issue an equal number of the weapons to units for field trials. Officers of the units issued these weapons were required to submit monthly reports answering the following questions:

1. Number, kind, and caliber of arms in company.
2. Number of each kind rendered unserviceable, (included in question No. 3.)
3. Number and names of parts of each of the above kinds which have broken or become unserviceable during the month.
4. What modifications or improvements do you suggest for each arm?
5. Number and kinds of musket-cartridges fired from each kind of arm, and number of failures in each arm.
6. Which of the four systems of breech arrangement would you prefer for uniform use in the rifle muskets and carbines of the military service?

Responses to these questions are tabulated in Table 1 below.

Table 1. Reports of 1871 Field Trials				
Weapon	Remington Model 1870	Sharps Model 1870	Ward-Burton Model 1870	Springfield Model 1870
Number of Arms Tested	1,502	2,470	1,039	1,828
Principal Parts Breakage Expressed in 1,000 guns Over 1,000 months	66.82	44.07	162.0	28.34
Number of Cartridges Fired	89,828	76,629	40,070	96,479
Number of Cartridges failed	2,595	2,699	970	1,882
Percentage of Missfires	2.9	3.5	2.4	1.96
Commanders Preference for breech arrangement	10	1	0	84

The Ward-Burton failed to receive a single recommendation from field commanders and was subjected to numerous negative reports particularly regarding its reliability during the 1873 Modoc War. The Ward-Burton already had a reputation for fouling after several firings and reports from units indicated that the rifles became totally disabled, while the Trapdoor Springfield continued to function. Based on the votes of preference from commanders, reliability, and the low number of misfires, the Model 1870 Springfield emerged as the clear favorite. The 1872 Board on Breech-Loading Small Arms referred to the results of the 1871 trials and the poor showing of the single-shot Ward-Burton harmed its magazine-fed descendants.

The wide variety of weapons issued to soldiers during the immediate post-Civil War era created a logistical nightmare for those tasked with supporting soldiers in the field. Maintenance of the various weapons frequently required tools and parts which were specific to the weapon in question. The most telling issue was ammunition compatibility. There is at least one recorded case of soldiers being sent the wrong ammunition and being forced to whittle down the bullets in question during combat. This option was not possible with weapons chambered for metallic. The logistical problems involved led to the pursuit by the Ordnance Department of a standardized action firing a single cartridge.

¹The Army Historical Foundation. *U.S. Army: A Complete History*, 440.

²Center of Military History. *American Military History, Army Historical Series*, 283.

³Arlington National Cemetery Website, Alexander Byrdie Dyer; Major General, United States Army, <http://www.arlingtoncemetery.net/abdyer.htm>.

⁴Theo [Philus] F[rancis] Rodenbough, and William L. Haskin, *The Army of the United States Historical Sketches of Staff and Line with Portraits of Generals-in-Chief*, 133.

⁵Ibid., 133.

⁶published by the Ordnance Office on 23 October 1866.

⁷Berkley R. Lewis, *Small Arms and Ammunition in the United States Service*. 277.

⁸Slightly over one ounce.

⁹Colonel Arcadi Gluckman, *Identifying Old U.S. Muskets, Rifles and Carbines*, 195-197.

¹⁰Lewis, 277.

¹¹\$13,089,855.73 divided by 670,617 rifles produced. Lewis, 280.

¹²*Bolster or Cone Seat*. This component serves as the percussion chamber and connects the nipple of a muzzle loading percussion firearm cap to the breech. *Nipple or Cone*. A component of a black powder percussion firearm on which the percussion cap is placed and presented to a blow by the hammer.

¹³Gluckman, 197.

¹⁴The motion required to open the breech was reminiscent of a trapdoor resulting in the design being referred to as the Trapdoor Springfield although this was never the official designation.

¹⁵To solder metal together using a hard solder with a high melting point.

¹⁶The Armory dropped the practice with the Model 1870 but reinstated it for the Model 1873.

¹⁷Ibid., 261-262.

¹⁸Lewis, 277.

¹⁹The difference in calibers between the rifle and ammunition was the standard of measurement. The barrel was measured at the narrowest point between the lands. Chamber diameter dictated the bullet caliber.

²⁰John Walter, *The Greenhill Dictionary of Guns and Gunmakers*, 136.

²¹The crimp is the indentation of the case mouth employed to retain the bullet in the cartridge. A heavy crimp holds the bullet more securely by reaching further into the canelure or groove in the bullets surface.

²²Martin Pegler, *Firearms in the American West: 1700-1900*, 107.

²³John D. McAulay, *Rifles of the U.S. Army: 1861-1906*, 36-41.

²⁴Rifles

Remington rifle, caliber .50", No. 286, from Springfield Armory;
Springfield breech-loading rifle musket, caliber .50", model 1868, from Springfield Armory;

2 Peabody (Wessely) rifles, caliber .42" (withdrawn);
Peabody (Wessely) rifle, caliber .42";
Peabody (self-cocking) rifle, caliber .42";
2 Peabody (Spanish) rifles, caliber .43";
2 Peabody (Roumanian) rifles, caliber .45";
2 Peabody (Springfield) rifles, caliber .50";
Remington rifle, caliber .42", No. 2;
Remington rifle, caliber .44", No. 3, sword bayonet;
Remington rifle, caliber .50", No. 4;
Remington rifle, caliber .51", No. 5, triangular bayonet;
Remington (Spanish) rifle, caliber .43";
Remington (Ryder) rifle, caliber .50";
Remington (modified) rifle, caliber .50";
2 Roberts' (Springfield) rifles, caliber .50, U.S. bayonets;
Roberts' (Springfield) rifle, caliber .50", No. 4, U.S. bayonets;
Roberts' (Jackson's improvement) rifle, caliber .50";
Roberts' (Starr's improvement) rifle, caliber .50";
Roberts' center-lock rifle, caliber .50";
Berdan's rifle, caliber .42";
Colt's rifle, caliber .42", triangular bayonet;
Colt's rifle, caliber .50", triangular bayonet;
Thieme (Baxter's) rifle, caliber .50", U.S. bayonet;
2 Triplett & Scott rifles;
Sharp's musket, caliber .50", U.S. bayonet;
Ward-Burton rifle, caliber .42", triangular bayonet;
Ward-Burton rifle, caliber .45", sword bayonet;
Ward-Burton rifle, caliber .50";
Hubbell rifle, caliber .50";
Martini rifle (long block), caliber .45";
Martini rifle (short block), caliber .45";
Morgenstern rifle, caliber .42";
Morgenstern rifle barrel, caliber .50";
Conroy rifle, caliber .42".

Carbines

Remington carbine, caliber .44", No. 1;
Robert's center-lock carbine, caliber .50";
Sharp's carbine, caliber .50";
Remington carbine, caliber .50", from Springfield Armory;
Sharp's carbine, caliber .50", from Springfield Armory;
Spencer carbine, caliber .50" (Stabler attachment), from Springfield Armory;
Springfield carbine, caliber .50" (Stabler attachment), from Springfield Armory;

Conroy carbine, caliber .45”.

²⁵The six cartridges were rendered defective in the following manner: 1st, one cut longitudinally from the end of the case to the rim, and placed in the chamber with the cut upwards. 2^d, one cut longitudinally from the end of the case to the rim, and placed in the chamber with the cut downwards. 3^d, one to be cut helically from the end of the rim. 4th, one to be cut at the base, so the firing pin will pierce it. 5th, one to be pierced through the base at four points. 6th, one to be filed through the rim.

²⁶Ordnance Office, *Ordnance Memoranda No. 11: Board of Officers at St. Louis, MO., June 10, 1870*, 14-15.

CHAPTER 3

.45-CALIBER RIFLES AND CARBINES

On 6 June 1872, Congress approved the “Act making appropriations for the support of the Army for the year ending 30 June 1873, and for other purposes.” Section 1 of the appropriations act included an authorization:

For manufacture of arms at the national armory, one hundred and fifty thousand dollars: *Provided*, That no part of this appropriation shall be expended until a breech-loading system for muskets and carbines shall have been adopted for the military service, upon the recommendation of the board to be appointed by the Secretary of War, which board shall consist of not less than five officers, as follows: One general officer, one ordnance officer, and three officers of the line, one to be taken from the cavalry, one from the infantry, and one from the artillery: *And provided further*, That the system, when so adopted, shall be the only one to be used by the Ordnance Department in the manufacture of muskets and carbines for the military service; and no royalty shall be paid by the Government of the United States for the use of said patent to any of its officers or employés, or for any patent in which said officers or employés may be directly or indirectly interested.¹

The specifics of the appropriations act required the adoption of a standardized action for both rifles and carbines. The officers detailed for the Board were Brigadier General Alfred H. Terry, U.S. Army; Colonels Peter V. Hagner, Ordnance Department and Henry B. Clitz, 10th Infantry; Major Marcus A. Reno, 7th Cavalry; Captain LaRhett L. Livingston, 3rd Artillery. Terry’s name, the Board he presided over, and the findings of that Board became intertwined resulting in references to the “Terry Board.” Major Reno remained with the 7th Cavalry after the conclusion of the Board and gained lasting disdain for his actions during the Battle of Little Big Horn.

In conjunction with the Board on Breech-Loading Small Arms, The Army appointed the “Board of Ordnance Officers for the Purpose of Determining the Proper

Caliber for Small-Arms.” This Board was established under Special Orders Number 107 dated 7 May 1872 and consisted of Majors James G. Benton and T.J. Treadwell,² and 1st Lieutenant William Prince all of whom were members of the Ordnance Department. The Board met at Springfield Armory on 14 May 1872 and received a letter of special instructions from the Chief of Ordnance.

The Small Arms Caliber Board conducted a series of experiments with cartridges of .40, .42, and .45-caliber with powder charges ranging from 60 to 80 grains in 5-grain increments with the .50-caliber service cartridge serving as a control. In addition to caliber and charge variations, the Board also experimented with different bullet cannelures,³ seating depths, lubricants, and cartridge cases to include straight walled and bottlenecked forms. In addition to the experimental cartridges considered, the Board also considered several foreign cartridges, but established that only the .45-caliber English Martini-Henry and .42-caliber Russian Berdan warranted further consideration.

During testing, the Board set a record for best average for 20 rounds each on six consecutive targets with. This feat was accomplished with one of the .45-caliber experimental cartridges firing a 400-grain hardened lead bullet (lead alloyed with tin) propelled by 70 grains of black powder. The Board discovered that the .45-caliber appeared to provide the best combination of penetration, accuracy, and flatness of trajectory with minimal fouling. Based on their experiments, the Board found that:

- 1st. The .45” caliber is preferable to lesser calibers.
- 2nd. The 24” twist is preferable to 30” twist for .45” calibers⁴
- 3rd. Flat grooving is preferable to ratchet grooving.
- 4th. The 75 grain charge is preferable to 80 or 70 grains.
- 5th. The heavier bullets are preferable to the lighter ones

6th. The performance generally is not superior in accuracy to the service ammunition, caliber .50”, though the flatness of trajectory is, of course, greater for 500 yards, the charge being heavier and the bullet lighter.⁵

The Annual Report of the Chief of Ordnance to the Secretary of War for the Fiscal Year Ended June 30, 1873 reflected the recommendation submitted by the Small-Arms Caliber Board that “all small-arms-rifles, carbines, and revolvers-should hereafter be of .45 inch.”⁶ And furthermore that this decision reflected that their “exhaustive report of the trials and experiments made at the National Armory and at the Frankford Arsenal, for the determination of the best caliber for accuracy, penetration, and for giving the least load to the soldiers with the greatest efficiency, is appended in connection with the report of General Terry’s Board, by which the caliber was recommended for the infantry arm.”⁷ The report of the Small-Arms Caliber Board is 64 pages in length documenting the cartridges tested as well as the tests employed and their results in a table format.⁸

The Ordnance Department developed two different but interchangeable service cartridges based partially of the Small-Arms Caliber Board’s recommendations. The rifle cartridge’s designation was .45-70-405. The designation reflects that it utilized a .45-caliber, 405-grain bullet which was propelled by 70 grains of black powder. The rifle cartridge produced a muzzle velocity of 1350 feet per second in the rifle but when fired in the carbine produced brutal recoil. The Ordnance Department developed a lighter carbine load designated .45-55-405, which held only 55 grains of powder for use in short barreled carbine. The .45-55-405 cartridge produced a correspondingly reduced muzzle velocity (1100 feet per second) and reduced effective range.

Both the rifle and carbine cartridge cases were initially formed from copper. Copper tended to develop a form of corrosion known as verdigris with a distinctive green coloration. Problems with corrosion were compounded when soldiers utilized locally produced cartridge belts which held the cartridges more securely and readily than the issue cartridge box. These cartridge belts left the cartridges exposed to the elements and chemical residues in the leather. When a corroded cartridge case was fired, the case expanded and the verdigris immediately set, jamming the expanded case in the chamber. A jam required manual extraction. The manual directed that a ramrod and a plug be rammed down the barrel to clear the weapon. If this method failed to clear the jam the only official remedy was service by the armorer. According to period accounts, soldiers frequently resorted to the use of their knives in combat situations to clear a jam. As the problem became widely known, the Ordnance Department developed brass cartridge cases which were stronger than their copper predecessors.

The Ordnance Board for Selecting a Breech System of 1872, or Terry Board established a set of protocols⁹ based on those developed by the 1870 Board to test the repeating arms submitted for consideration during its meeting on 5 September 1872.¹⁰ Before firing any of the rifles, the Board conducted an examination of each of them. The purpose of this examination was to determine the details of construction, and the speed and difficulty of disassembly and reassembly. The Board also required each manufacturer to fire ten rounds through the rifles to test the weapons safety. The Board configured the tests to determine the ease of loading and extracting cartridges, the effect of foreign material on the action, and the effect of water and consequent rust on the rifles. The

Board assigned either an employee of the Armory, or a soldier detailed by the War Department to conduct each of the tests.

To test the ease of loading and extracting cartridges, the Board submitted the rifles to trials of Rapidity with Accuracy and Rapidity at will. The Board determined the effect of foreign material on the action by employing the Dust test developed by the 1870 Board but replaced the dusting technique used during that trial with a purpose built box. The Board also modified the test for the effect of water and rust on the action by reducing the amount of time the action was submerged in brine while increasing the time it was left exposed to air to two days.

The Board also submitted the rifles to tests designed to determine the effects of firing defective cartridges and cartridges containing excessive powder charges through them. The Board determined each rifle's performance based on these tests although they provided arms designers the option of displaying the potential of their rifles and having the performance noted in the record. The Board specified that the service-cartridge was to be used in all cases if practical except for demonstrations conducted by the designers. The Board also dictated that they would allow no one to attend tests except for designers, their agents, or visitors specifically invited by the Board.

The Board eliminated eight weapons¹¹ prior to testing. Designers submitted 29 weapons¹² to the board which they submitted to the initial series of tests. The Board received the remaining 57 weapons¹³ after starting initial testing or they were modifications to weapons previously submitted.¹⁴ Of the weapons submitted, several were repeaters but the Board did not select any of these and none had undergone field

trials. The Ward-Burton magazine-fed rifle survived all three stages of testing but the single shot Ward-Burton had participated in the 1871 field trials where it failed to receive a single vote of preference.

The Board established a supplemental series of tests during its meeting on 30 January 1873. The supplemental tests included:

- 1st. To be fired with two defective cartridges Nos. 1 and 2, and then to be dusted five minutes, the mechanism being in the mouth of the blow-pipe and closed, the hammer being at half cock; then to be fired 6 shots, the last two defective Nos. 1 and 2, then without cleaning to be dusted with the breech open and fired 4 shots. The piece to be freed from dust only by pounding or wiping with the bare hand.
- 2nd. To be rusted for 4 days after immersion as before and then fired 5 rounds with the service cartridge; then without cleaning to be fired 5 rounds with 120 grains powder and a ball weighing 1,200 grains; the gun to stand twenty-four hours after firing, without cleaning, and then to be thoroughly examined.
- 3rd. Facility of manipulation by members of the Board.¹⁵

The Board selected seven rifle designs to receive further testing after alteration to accept the .45-caliber cartridge. The weapons selected were the Elliot, Peabody, Springfield (Model 1870), Remington, Sharps, Ward-Burton, and Freedman rifles. The Board decided on a test of comparative rapidity of fire. The Board established this using the average of five trials at 20 minute intervals during which a single individual was to load and fire 24 aimed shots from a cartridge belt suspended from the waist.¹⁶ Both experienced soldiers and recruits fired the weapons during the final series of tests and the average shots per minute established as illustrated in table 2. The Board dropped the Elliot breechloader from this final series of tests due to problems with cartridge extraction, but felt that its method of operation was of interest for cavalry since soldiers could operate it with one hand.

Table 2. Results of Rapidity of Fire Trial for 1872 Small Arms Board						
	Freeman	Peabody	Remington	Springfield	Ward-Burton Single Shot	Ward-Burton Magazine Fed
Experienced Soldiers						
Avg. Shots per minute	12.37	9.94	13.02	11.59	12.12	
Order of rapidity	2	5	1	4	3	
Recruits						
Avg. Shots per minute	9.75	8.53	10.08	8.51	11.43	22.92
Order of rapidity	3	4	2	5	1	

After completing the testing of 5 of the 6 rifles and deliberation, the Board selected the Springfield based on its testing as well as the results of the 1871 Board. During its deliberation, the Board submitted an inquiry to determine the possibility of recommending multiple rifles, which was denied due to the specifications of the act of Congress which had authorized the Board. Therefore, the Board recommended the Springfield for production and general issue, but also recommended further development, limited production, and field trials of the Elliot breechloader and the Ward-Burton magazine rifles and carbines. The Elliot breechloader's action provided the ability to chamber, load, and fire the arm with one hand. Despite extraction problems during the final series of tests, the Board felt this capability significantly beneficial for cavalry carbines that it included the recommendation to pursue further development and testing.

The commonly held perception that Chief of Ordnance Dyer overturned the Board's recommendation in favor of the Trapdoor Springfield was at best misguided.¹⁷ The Board clearly recommended the adoption of the Springfield as the standard issue

weapon. The section of the report that reflected this read, “Resolved that the board recommended that the Springfield breech-loading system be adopted for the military service of the United States, in accordance with the provisions of the act of Congress entitled *An Act Making Appropriations for the Support of the Army for the year Ending June 30, 1873, and for other purposes*, approved June 6, 1872.”¹⁸ The portion of the Board’s recommendation that Dyer overturned was its recommendation that a limited number of Elliot and Ward-Burton magazine rifles and carbines be produced for field trials. Based on the act of Congress, Dyer accepted the Board’s recommendation regarding the Springfield, but stated that the production of these other systems violated the act which specified the adoption of “a single system.”¹⁹

The U.S. Army adopted its first standard-issue breech-loading rifle and carbine with the Model 1873 Trapdoor Springfield. The Army had initially issued the Model 1866 Second Allin conversion Trapdoor on a limited basis to troops in the West during 1867 but the Model 1873 was the first action produced and issued as standard for all regular troops in both rifle and carbine variants. The Model 1873 was widely used on the Western frontier in fights against Native Americans, including the Battle of the Little Bighorn.

The Model 1873 was the fifth iteration in the Allin design, named for the hinged breechblock which pivoted towards the muzzle like a trapdoor. The Model 1873 was essentially the Model 1870 action chambered for the .45-70 cartridge produced in two versions. The infantry rifle with featured a 32 and 5/8ths inch barrel, while the barrel of the cavalry carbine was 22 inches in length. During its service as the standard system for

rifles and carbines the Trapdoor was produced in several other variants including the Models 1879, 1884, and 1888 as well as, Officer and Cadet variants. Many of these involved minor changes including improved sights and the addition of sight hoods in the 1888 model.

The adoption of the .30-caliber smokeless cartridge finally ended development of the Trapdoor Springfield family. The Army attempted to produce .30-caliber Trapdoors, but found that the action was prone to opening under the force of the more powerful cartridges. If armorers modified the angle of the locking shoulder to prevent this problem, the action jammed solidly closed.

The .45-caliber Trapdoors firing black-powder cartridges continued to serve in the hands of volunteers well after their removal from active service. Volunteer units carried the Trapdoor alongside active units armed with the Krag during the Spanish-American War and the Philippine Insurrection. The Army did not completely remove the Trapdoor Springfield from service until after the turn of the 20th century when it replaced the Krag with the Model 1903 Springfield. The state of Kansas reported possessing 1,605 Springfield rifles on 30 June 1900, 1,374 of which remained in the hands of troops in the 1st and 2nd Kansas Regiments.²⁰

The Army appointed additional boards in 1878 and 1881 to examine and report on magazine fed rifles. The 1878 Board met from 3 April to 23 September 1878 to examine the suitability of magazine arms for military service. The Board selected the Hotchkiss for experimental testing and field trials. The U.S. Model 1878 Winchester-Hotchkiss bolt action magazine rifle fired the .45-70-405 cartridge from a 28 and 5/8ths inch barrel. The

Model 1878 Hotchkiss is 48 and 5/8ths inches long and had a five round tubular magazine in the butt loaded through a trap in the butt-plate. A coil spring pushing a piston against the base of the rearmost cartridge fed cartridges into the action. The rifle employed a magazine cut-off which allowed soldiers to employ it as a single shot breech-loader. Secretary of War George W. McCrary approved the allocation of \$20,000 for the manufacture of Hotchkiss rifles for trial purposes and the Springfield Armory produced 1000 Model 1878 Winchester-Hotchkiss rifles in 1879.²¹ Springfield Armory sent 500 First Model Hotchkiss rifles to units for field trials and required company commanders to be submit a bimonthly report on the rifles performance. Commanders reported extensive problems with parts breakage most commonly with the stock. One commander even requested that the Hotchkiss repeaters issued to his company be replaced with Trapdoor Springfields and recommended that the Hotchkiss be rejected for military service. Of 28 Hotchkiss rifles Fort Lincoln turned in to Springfield Armory, 27 had cracked or broke stocks, and only 10 had bolts which would open.

For the 1881 Board, designers submitted 53 designs for consideration by September of 1882. Of the 53 designs submitted, the Board approved three for experimental production and field trials based on the results of their tests. The three rifles selected for field trials were the U.S. Model 1878 Winchester-Hotchkiss, the U.S. Model 1882 Remington-Lee, and the U.S. Model 1882 Chaffee-Reese.

The U.S. Model 1882 Remington-Lee bolt action magazine rifle fired the .45-70-405 cartridge from a 28.5 inch barrel with an overall length of 52 inches. The Remington-Lee employed a detachable five round vertical magazine with the magazine release under

the breech. The Remington-Lee did not employ a magazine cut-off or safety latch. Once a soldier cycled the action, the weapon remained at full cock and the only means available to render the weapon reasonably safe was to ease the striker forward onto the cartridge primer and then manually retract it to the half cock position. This produced one of two dangerous situations with a soldier either carrying a fully charged weapon or being forced to try to ease the striker into contact with the primer risking an accidental discharge.²²

The U.S. Model 1882 Chaffee-Reese bolt action, magazine rifle fired the .45-70-405 cartridge from a 27 and 7/8ths inch barrel. The Model 1882 had a five round magazine located in the butt and employed a magazine cut-off which allowed the rifle's employment on single shot. The Model 1882's magazine employed a novel, if problematic, ratchet system which separated the cartridges preventing the possibility of a magazine explosion. Magazine explosions occurred in tubular magazine equipped weapons when the bullet from one round ignited the primer of the round ahead of it if the weapon received a significant jolt.

Springfield Armory produced Model 1882 rifles like the example pictured in figure 3 in response to requirements established for repeating rifle trials authorized by the Ordnance Board of 1882. They produced 753 Model 1882 Chaffee Reese bolt action magazine rifles in 1884. Normal production of experimental trial rifles was in lots of 1,000, but the fixed sum authorized for the production of the Chaffee-Reese was only sufficient for the production of 753. The Model 1882 competed in trials against the Remington Lee and the Winchester Hotchkiss bolt action repeaters. Results of the field trials were inconclusive and the Board declared that none of the rifles in question

provided a significant improvement over the model 1873 Trapdoor Springfield. The Chaffee-Reese was the first bolt action repeating rifle manufactured entirely at Springfield Armory although they assembled some of the Winchester Hotchkiss rifles with parts produced by both the Armory and Winchester.²³



Figure 3. U.S. Model 1882 Chaffee Reese Bolt Action Magazine Rifle
Photographs by John Spangler

¹Government Printing Office, *Annual Report of the Chief of Ordnance to the Secretary of War for the Fiscal Year Ended June 30, 1873*, 63.

²Available sources fail to identify Major Treadwell's first name listing only his first and middle initials in accordance with practices of the period.

³*n.* A groove around the cylinder of a bullet.

⁴Refers to the number of inches barrel rifling takes to make one full turn.

⁵*Ibid.*, 437.

⁶*Ibid.*, 5.

⁷*Ibid.*, 5.

⁸*Ibid.*, 379-440.

⁹Before firing

1. Examination of the mechanical construction, facility and rapidity of dismounting and reassembly.
2. Facility of loading and extracting shells.
3. Effect of dust in impeding the mechanism.
4. Effect of water and consequent rust on mechanism.

Tests for a Gun Which the Board Have Decided to Subject To Trial

1. The piece to be first fired ten rounds by the exhibitor, or with a lanyard, as a test of safety.
2. The firing to be then continued according to the rules annexed, by an employee of the Armory, or a soldier detailed by the War Department. The record to be based upon this firing, though exhibitors may have the privilege of displaying the powers of their guns if desired, and of having their performance noted in the record.
3. The service-cartridge to be used in all cases where the gun is chambered for it, except in the special trials made by exhibitors.
4. No persons will be admitted to the firing ground but agents or exhibitors of the gun immediately under trial, and such other persons as may be specially invited by the Board.

Tests

I. Rapidity with Accuracy. The number of shots which, fired in one minute, strike a target 6 feet by 2 feet at a distance of 100 feet. Any cartridges missing fire in this or other tests to be tried with a prick-punch, or opened to ascertain the cause of failure. The test to begin with an empty chamber or magazine, the cartridges to be disposed at will on a table.

II.*Rapidity at will.* The number of shots that can be fired in one minute, irrespective of aim.

III.*Endurance.* Each gun to be fired 500 continuous rounds, without cleaning. The state of the breech-mechanism to be examined at the end of every 50 rounds.

IV.*Defective Cartridges.* Each gun to be fired once with each of the following defective cartridges: 1. Cross-filed on head to nearly the thickness of the metal. 2. Cut at intervals around the rim. 3. With a longitudinal cut the whole length of the cartridge from the rim up. A fresh piece of white paper marked with the number of the gun being laid over the breech to observe the escape of gas, if any occurs.

V.*Dust.* The piece to be exposed in a box prepared for that purpose to a blast of fine sand-dust for 2 minutes; to be removed, fired 50 rounds, replaced for 2 minutes, removed and fired 50 rounds more.

VI.*Rust.* The breech-mechanism and receiver to be cleansed of grease and the chamber of the barrel greased and plugged, the butt of the gun to be inserted to the height of the chamber in brine for 10 minutes, exposed for two days to the open air standing in an open rack, and then fired 50 rounds.

VII.*Excessive Charges.* To be fired once with 85 grains of powder and one ball of 450 grains of lead; once with 90 grains and one ball; and once with 90 grains and two balls. The piece to be closely examined after each discharge.

¹⁰Ibid., 65, 70-71.

¹¹No. 1. Sleeper;
No. 3. Scott Magazine-Carbine;
No. 6. Worrell;
Nos. 16 and 17. Wohlgemuth;
No. 33. Snell (withdrawn);
No. 36. Whittemore (withdrawn);
No. 37. Kirk.

¹²Nos. 2 and 28. Roberts (selected for supplemental tests);
No. 4. Evans (incomplete);
No. 5. Sharps (selected for supplemental tests);
Nos. 7, 8, and 9. Peabody;
Nos. 10, 11, and 13. Whitney;
No. 14. Greene (incomplete);
No. 15. Morgenstern (incomplete);
No. 18. Broughton;
Nos. 19, 20, 21, and 22. Remington;
No 23. Remington (incomplete);
No. 24. Elliot;
No 25. Freeman;

Nos. 26 and 27. Ward-Burton;
No. 30. Spencer (incomplete);
No. 31. Remington bolt-gun;
No. 32. Smoot;
No. 34. Van Choat (incomplete);
No. 35. Robertson (incomplete);
No. 38. Dexter (selected for supplemental tests);
No. 40. Joslyn-Tomes (incomplete).

¹³No. 41. Remington-Spanish;
No. 42. Updegraf (selected for supplemental tests);
No. 43. Remington;
No. 44. Thomas (incomplete);
No. 45. Broughton;
No. 46. Westley Richards (withdrawn);
No. 47. Remington Schofield (???)
No. 48. Springfield, Model 1870;
No. 49. Bealis (wooden model, not tested);
Nos. 50 and 51. Milbank (both incomplete);
No. 52. Stetson Magazine (incomplete);
No. 53. Lee (incomplete);
No. 54. Lee;
No. 55. G.R. Remington (wooden model, not tested);
No. 56. Helm (withdrawn);
No. 57. Berdan-Russian (selected for supplemental tests);
No. 58. Ward-Burton magazine-carbine (selected for supplemental tests);
No. 59. Freeman;
No. 60. Muir-Monstorm (not tested)
No. 61. Lee (selected for supplemental tests);
No. 62. Snell (not tested);
No. 63. Peabody (selected for supplemental and final tests);
No. 64. Roberts;
No. 65. Earnest (incomplete);
No. 66. Springfield-Stillman (selected for supplemental tests);
No. 67. Remington-Ryder (selected for supplemental tests);
No. 68. Springfield-Allin;
No. 69. Springfield (selected for supplemental tests);
No. 74. Rumsey (wooden model, not tested);
No. 76. Freeman (selected for supplemental and final tests);
No. 77. Whitney (selected for supplemental tests);
No. 78. Winchester magazine-musket (selected for supplemental tests);
No. 79. Broughton (selected for supplemental and final tests);
No. 80. Elliot (selected for supplemental and final tests);
No. 81. Sharps (selected for supplemental tests);

No. 82. Remington locking-rifle (selected for supplemental tests);
 No. 83. Merrill (incomplete);
 No. 84. Conrad (withdrawn)
 No. 85. Remington navy-rifle (selected for supplemental and final tests);
 No. 86. Remington (selected for final tests);
 No. 87. Gardner Magazine-Arm (incomplete);
 No. 88. Springfield (selected for final tests);
 No. 97. Ward-Burton magazine-musket (selected for final tests);
 No. 99. Springfield (selected for final tests);
 No. 101. Snell (not tested);
 Barnekov-Greene (withdrawn);
 Burgess Magazine (exhibited, not fired or photographed);
 Chassepot, French (not tested);
 Dreyse Improved Needle-Gun, German (not tested);
 Martini (selected for supplemental tests);
 Mauser, German (not tested);
 Prussian Needle-Gun (not tested);
 Prussian Needle-Carbine (not tested);
 Vetterlin Magazine-Musket, Swiss (not tested);
 Werndl (selected for supplemental tests);
 Werder, Bavarian (not tested).

¹⁴Gaps in the numbering system reflect several entries including Numbers 29, 39, 70-73, 89-96, 100 which were parts or accessories submitted to the Board rather than complete arms. Numbers 75 and 98 can not be accounted for in the report of the Board and may reflect weapons or components which were submitted to the board and withdrawn without testing, or weapons or components which withdrawn for modification and resubmitted and recorded under a different number.

¹⁵Ibid., 83.

¹⁶Ibid., 89.

¹⁷John Walter, *The Rifle Story: An Illustrated History from 1756 to the Present Day*, 84.

¹⁸Government Printing Office, *Annual Report of the Chief of Ordnance to the Secretary of War for the Fiscal Year Ended June 30, 1873*, 4-5.

¹⁹Ibid., 63.

²⁰John D McAulay, *Rifles of the U.S. Army: 1861-1906*, 184.

²¹John D McAulay, *U.S. Military Carbines*, 195-202.

²²Arcadi Gluckman, *Identifying Old U.S. Muskets, Rifles and Carbines*, 279-280.

²³*Ibid.*, 289.

CHAPTER 4

.30-CALIBER RIFLES AND CARBINES

Like militaries around the world, the U.S. Army was searching for a new rifle in the early 1890s to take advantage of a technological breakthrough which had occurred in France. In 1886, French government chemist Paul-Marie-Eugène Vieille perfected the first smokeless powder practical for use in rifle caliber arms. Nitro-cellulose and gun-cotton were developed in the 1830s and 1840s but were unsuitable for use in small arms in their original form. France then adopted the bolt-action 8mm Lebel in 1887 to take advantage of this new development.¹

Despite the desire to develop a magazine-fed arm chambered for the new smokeless powder cartridges, the Ordnance Department faced significant difficulties in acquiring sufficient smokeless powder during the early 1890s to both develop a smokeless cartridge and arms, let alone field the new weapons. Numerous American companies and the Army arsenals worked feverously to develop their own smokeless powder formulas. For initial cartridge and weapon development, the lack of suitable alternatives forced the Ordnance Department to rely on small quantities of powder it procured from Europe most of which came from Belgium. American chemists finally developed suitable smokeless powders in the early 1900s that supported the adoption of a weapon chambered for smokeless cartridges. The lack of suitable powder caused the Chief of Ordnance to state in his Annual Report for fiscal year 1889:

In the absence of a suitable small-arms powder there has been no substantial progress in the matter of a small caliber rifle beyond what was heretofore reported except in the negative gain resulting in the apparent abandonment, or tendency that way, abroad of all powders but the so-called smokeless. This change, involving the return to a grained powder, is, if

permanent, an appreciable gain for all in the economy and efficiency of the product used in the manufacture of small-arms cartridges, and may have been brought about as much from the difficulty of obtaining uniform and satisfactory results in the way of velocities and pressures with the compressed powders as from the more valuable properties of the smokeless.

No American has yet submitted for trial a smokeless powder, and experiment with compressed powders has shown the same eccentricity as was developed abroad, tending to destroy confidence in the final production of a serviceable compressed powder cartridge. All effort, official and otherwise, to date, to obtain a smokeless powder has been abortive, and American powder makers and chemists have not yet awakened to the lucrative opportunity presented to them.²

In Colonel Adelbert R. Buffington's report to the Chief of Ordnance dated 7 October 1890, he indicated that Springfield Armory's selection of .30 inch as the caliber for the new smokeless round was, by all accounts, arbitrary. Buffington, commanding officer of Springfield Armory stated "The even .30-caliber was chosen as being the smallest admissible, all things considered, not from any special principle involved, 7 ½ and 8 millimeters being generally the calibers adopted abroad."³ In June, 1892, after a series of experiments involving both rimmed and rimless cartridge cases, bullet construction, and powders, Frankford Arsenal in Philadelphia settled on a suitable cartridge. This round featured a rimmed case (for ease of extraction) firing a 220-grain round nose bullet at 2,000 feet per second utilizing Belgian Wetteren powder. By May, 1894 American manufacturers⁴ developed nitroglycerin type or double-base smokeless powder formulas and these largely replaced the foreign powders in service.⁵

The 1890 Board examined 53 rifles of which 24 were foreign designs (some of which were then in use with other nation's armed forces) with trials held at Governors Island, New York.⁶ The government armory at Springfield submitted three .30-caliber breech-loading Springfields for control purposes. The Board discovered that the Springfield action was insufficiently strong to contain the force of the new smokeless

rounds. The action burst open upon firing and an attempt to correct this problem by changing the angle of the locking shoulder resulted in the weapon jamming solidly closed upon firing. Among the domestic rifle designs submitted for trial were the Chaffee-Reece, two models from Savage, three from Lee, and a pair from Captain Andrew H. Russell and his partner William R. Livermore.

The 1890 Board employed similar primary and supplementary protocols to those established during the 1872 Terry Board.⁷ The Board modified the protocols for evaluating magazine arms and added a test to determine the likelihood of a magazine explosion. The Board directed this test towards arms possessing a tubular magazine where explosions posed a distinct threat to the shooter. The Board selected the Krag-Jorgensen rifle and changes to the 1873 protocols as well as the Krag's performance during these tests follow.⁸

Mr. Erik Jorgensen fired the Krag from the shoulder to demonstrate the arms safety to members of the Board. Mr. Jorgensen fired 10 shots in 32 seconds during this demonstration. In testing rifles for rapidity with accuracy the range and target remained the same as in earlier boards. The Board did modify the arrangement of test ammunition and how it was loaded in the weapons. First, the Board tested how quickly a soldier could accurately fire 20 rounds with the first 15 shots fired as a single shot and the remaining five loaded from the magazine which he had held in reserve. The Krag proved capable of firing 15 shots in 44 seconds as a single loader with the remaining 5 rounds in the magazine fired in 10 seconds for a total of twenty rounds in 54 seconds with 16 hits. Next, the Board tested how many accurate shots the soldier could fire in two minutes using the rifle as a single shot breechloader. The firer was able to fire thirty-eight shots

from the Krag as a single loader in two minutes and chamber a thirty-ninth cartridge while producing 35 hits. Finally, the Board tested how quickly a soldier could accurately fire the rifles as a magazine fed repeating rifle. The two-minute test began with the magazine unloaded. The tester fired forty-three shots and chambered a forty-fourth round with the Krag in two minutes producing 38 hits and inadvertently loaded four rounds rather than five during one of the reloads.

The second set of trials tested the rifles' capacity for rapidity of fire without consideration for accuracy. The Board configured these tests like the previous three with the one significant exception. The testers fired the rifles from the hip and the time limit was reduced to one minute for the second and third trials. The Krag proved capable of firing 15 shots in 32 seconds as a single loader with the shooter firing the remaining 5 rounds in the magazine in 7 seconds for a total of twenty rounds in 39 seconds. The firer was able to fire twenty-nine shots from the Krag as a single loader in one minute with one misfire after two failed attempts on the second trial. The first two attempts resulted in unidentified malfunctions resulting in a failure to chamber. The tester fired thirty-five shots in one minute and inserted one round from the eighth cartridge packet into the magazine during the third trial.

The Board employed the same test to establish the endurance of the rifles as the 1873 Terry Board when used as a magazine fed repeater. The Board declared the Krag's "breech and magazine assemblies worked well and easily in all particulars." The Board also included a secondary endurance test to evaluate the rifles when employed as single shot weapons. This test required the tester to fire the weapons for an additional 100

rounds in single shot mode. The Board found the Krag's "mechanism worked well and easily in all particulars."

The Board employed the same basic dust test to evaluate the rifles but added trials to account for magazine fed repeating rifles. The Board required the rifles be dusted with the magazines both open and closed before the testers fired 20 rounds through each weapon. The Krag's "mechanism worked easily," after a thorough dusting with the magazine empty when exposed. After a thorough dusting while the magazine was loaded, the Board found the Krag failed to feed from the magazine until the point of the first cartridge required manipulation by hand after which the mechanism worked well.

The tests for defective cartridges remained the same as the test established by the Terry Board. The Krag displayed no damage or escape of gas and continued to work well. The Board made the most significant changes to the excessive charges tests. The Board could not merely double or triple due to the superior power of smokeless powder. The Board modified the cartridges employed in this test to produce a chamber pressure approximately one-third greater than that caused by the Frankford Arsenal Experimental cartridge. The Krag manifested no ill effects from the overcharged cartridges and continued to operate smoothly and freely. On the final test which evaluated ease of manipulation, members of the Board declared the Krag's ease of manipulation "satisfactory."

The Board declared that the Krag performed satisfactorily during all regular tests allowing its evaluation during the supplementary tests.⁹ During this series of supplemental tests, the Board modified some of the protocols from those used by the

Terry Board as well as establishing tests combining defective cartridges and dust, and evaluating the likelihood and effect of magazine explosions.¹⁰

To test the rifles when subjected to defective cartridges and dust, the Board required them testers to fire defective cartridges 1 and 2, dusted the rifles for five minutes as before, and then fire the rifles in single shot mode with five standard cartridges. The Krag demonstrated the capacity of chambering and firing the damaged cartridges despite the dusting with no ill effects. The second trial of this test was the same as the first with the exception that the subsequent rounds were to be placed in the magazine before dusting and chambered by operation of the action. The Krag's action operated stiffly due to the dusting and dryness of the action but fed and fired the damaged cartridges without damage to the weapon.

The Board changed the rust test by replacing the brine solution with a solution of sal-ammoniac and increasing the submersion time to 10 minutes. The Board kept the open air exposure time at two days with a 20 round firing phase concluding the test. Once again, the shooter was to load five rounds into the magazine but fire the first 15 round as a single shot, saving the five in the magazine until the end. The Krag exhibited thorough rusting and both the action and magazine were incapable of operation by hand until light blows with a mallet freed both assemblies. Operation of the bolt required light blows from the mallet for the first 3 shots before operation by hand became possible if difficult. Magazine function returned to normal after the initial blows to free the cover. Function of the weapon returned to normal after oiling without disassembly.

The Board created the magazine explosion test due to the distinct possibility of this occurring in repeating rifles equipped with tubular magazines. The test required

testers to subject the rifle to a vertical jolting motion for two minutes with both full and one-half-full magazines. Since the Krag featured a box magazine which did not place rounds end to end, the Board judged the likelihood of this malfunction to be extremely remote. During the phase which examined dismounting and assembling, the Board found disassembly and reassembly of the Krag quick and easy without a requirement for tools.

The Board submitted examples of the Krag, the Lee, and the Mauser rifles that survived the supplementary tests to additional test involving rapidity of fire when handled by average soldiers. This test required three soldiers assigned to the ordnance detachment at the Springfield Armory to fire twenty shots with aim at a standard target one-hundred yards away. The soldiers loaded the magazine and fired the first fifteen rounds from the cartridge belt as a single loader. The soldiers chambered the remaining five rounds from the magazine. The three ordnance detachment soldiers selected to conduct this test included a former Marine, a member of the 10th U.S. Infantry Regiment, and a trooper from the 2nd U.S. Cavalry Regiment. The soldiers obtained average times with the Krag of one minute twenty-four seconds for the first 15 shots and 26 seconds for the remaining five resulting in an overall average for all 20 rounds of one minute fifty seconds. The recorder of the Board managed to complete the test with a time of 55 seconds for the first 15 shots and 10 seconds for the remaining 5 resulting in a total time of one minute five seconds for all 20 rounds with the Krag rifle.¹¹

The Krag's performance during these tests was representative of contemporary arms but the Board felt the Krag displayed superiority in two areas. The characteristics of the Krag that gave it the advantage over the Lee and Mauser rifles included its smooth action and more importantly the capacity for reloading while remaining ready to fire. The

Krag action was smooth, compared to some of the other arms tested, as a result of its single locking lug which became a weakness as higher powered cartridges were developed. At the time of the Board, the Krag had an action of sufficient strength for the current cartridges.

The 1890 Board recommended that the Army adopt the Danish .30-caliber, bolt-action Krag-Jørgensen rifle illustrated in figure 4. The decision to adopt the Danish weapon resulted in numerous protests from domestic inventors and arms manufacturers. Captain Andrew H. Russell and his partner William R. Livermore, who had submitted two designs to the 1890 Board, even sued the U.S. government based on the adoption of a foreign design. As a result, Congress approved the Board's recommendation and appropriated \$400,000 for production of the Krag, but stipulated that the Ordnance Department could not spend the funds until an additional board evaluated arms produced by American inventors. This stipulation delayed production of the Krag for two years pending an additional series of tests focused on fourteen American models.¹²

On 1 March 1893, the Army issued General Order Number 16, which called for a Board for Testing Magazine Rifles of American Invention. This Board took the position that the ability to reload the weapon while keeping the chamber loaded for immediate use was of paramount importance for a military rifle and that tubular magazines were too fragile for military service. While several inventors submitted rifles which met these requirements, the Board recommended the selection of an improved form of the Krag-Jørgensen when it failed to turn up a superior weapon. 14 weapons were submitted to the Board for Testing Magazine Rifles of American Invention.¹³



Figure 4. U.S. Model 1898 Krag Rifle
Photographs by John Spangler

Lee, Savage, Durst, Blake, Russell-Livermore, White, and Hampden submitted either the same rifles, or modified versions of those submitted for the original board. Francis Bannermann, who was one of the post-Civil War arms dealers who purchased a great deal of surplus arms and equipment during the period, only submitted the Spencer-
Lee for the 1893 Board for Testing Magazine Rifles of American Invention.

The Board established 16 specifications¹⁴ for arms to be submitted to it for consideration.¹⁵ Under these specifications, all of the arms submitted to the Board for Testing Magazine Rifles of American Invention exhibited one or more defects which the Board considered significant enough to preclude their adoption for issue to American soldiers. The office of the Board on Magazine Arms submitted a report¹⁶ on 16 May 1893 which listed the problems encountered by weapon:¹⁷

The report of the Board of Ordnance to the Secretary of War dated 16 May 1893 stated that “no American invention has been recommended by it.”¹⁸ The Krag was then officially adopted based on the original Board’s findings. The Springfield Armory produced approximately 479,883 Krag rifles and Carbines of all models between the initial production in 1894 and the production of the last Model 1898 Gallery Practice Rifle in 1907. By 1897, the Army had fielded the Krag to all regular troops, although volunteer or militia units continued to carry the Trapdoor Springfield into the 20th Century.

All models of the Krag produced for U.S. forces chambered the rimmed .30-40 Krag round also referred to as the .30 Army. While the .30-40 Krag represented a technological leap forward and was the first smokeless powder round adopted by the U.S. military it retained the designation model used for black powder cartridges which used the caliber of bullet followed by the powder charge in grains. A cartridge carrying the designation .30-40 fired a .30-caliber bullet utilizing a 40-grain (3 g) powder charge (in this case smokeless).

The Springfield Armory produced Krag rifles and carbines as well as modifications and improvements in 13 variants over the 13 year production run. The primary Krag service models were the Model 1892, Model 1896, and Model 1898. The Krag remained the U.S. Army’s main rifle from 1894 to 1903, when the Springfield 1903 rifle (based on the Mauser design and firing the more powerful .30-03 cartridge) replaced it in active service. The Krag, in turn, replaced the Trapdoor Springfield in the hands of volunteer units. Krag rifles saw action in numerous conflicts including the Spanish-American War, the Philippine Insurrection, and the Boxer Rebellion in China.¹⁹

¹John Walter, *The Greenhill Dictionary of Guns and Gunmakers*, 302 and 537.

²William S. Brophy, *The Krag Rifle*, 3-5.

³Franklin Mallory with Ludwig Olson, *The Krag Rifle Story*, 56.

⁴These included California Powder Works, Leonard, Dupont, and Laflin & Rand
W. A.

⁵*Ibid.*, 170.

- ⁶1. .303 Lee-Speed (Great Britain);
2. 8mm Krag-Jørgensen (Denmark);
3. 8mm Mannlicher (Austria);
4. 7.65mm Mauser (Belgium);
5. 7.65mm Model 1888 Mauser (Germany);
6. 8mm Kropatschek (Portugal);
7. 8mm Murata (Japan);
8. 7.5mm Model 1889 Schmidt-Rubin (Switzerland);
9. 8mm Mannlicher carbine (Austria);
10. 6.5mm Mannlicher (Romania);
11. 7.62mm Model 1891 Mosin-Nagant (Russia);
12. Berthier (France);
13. Mauser No. 2;
14. Sporer;
15. Bruce No. 1;
16. Bruce No. 2;
17. Krag-Jørgensen No. 2;
18. Krag-Jørgensen No. 3;
19. Krag-Jørgensen No. 4;
20. Bruce No. 3;
21. Berthier No. 2;
22. Pitcher;
23. Berthier No. 3;
24. Mauser No. 3;
25. Lee No. 1;
26. Lee No. 2;
27. Mauser No. 4;
28. Krag-Jørgensen No. 5;
29. Krag-Jørgensen No. 6;
30. Ford;
31. Hampden No. 1;
32. Durst No. 1;
33. Larsen;

34. Miles;
35. Savage No. 1;
36. Mullins;
37. Chaffee-Reece;
38. Blake No. 1;
39. Lee No. 3;
40. Hampden No. 2;
41. Russell-Livermore No. 1;
42. Russell-Livermore No. 2;
43. Savage No. 2;
44. Fogerty;
45. Durst No. 2;
46. Mauser No. 5;
47. Blake No. 2;
48. Rubin (Swiss);
49. Schulhoff, Model 1888;
50. Kelton;
51. Springfield, caliber .30 single loader (control);
52. Springfield No. 2;
53. Springfield No. 3.

⁷*Rapidity with Accuracy* – “Piece to be fired from the shoulder at a target 6 feet by 2 feet, range 100 feet, under the following circumstances, with cartridges disposed at will or in packets upon a table.”

a. “Time of firing and number of hits for 20 shots; magazine to be loaded before beginning test and then held in reserve until remainder of cartridges have been fired, using gun as a single loader; then firing those in the magazine.”

b. “Number of shots and hits firing for 2 minutes, using gun as a single loader; test begun with magazine empty.”

c. “Number of shots and hits firing for two minutes, using gun as magazine arm only; test begun with magazine empty.”

Rapidity at will – “Same as test I, except that piece will be fired from the hip, without aim at stop butt at short range; hits not considered, and time of firing for parts b and c reduced to one minute.”

Endurance:

a. “Each gun to be fired 500 continuous rounds without cleaning, using the magazine. The state of the breech mechanism to be examined at the end of every 50 rounds.”

b. “With magazine loaded but held in reserve, each gun to be fired as a single-loader 100 continuous rounds without cleaning; condition of breech mechanism and of the cartridges in magazine to be examined at conclusion of firing.”

Dust – “With the mechanism closed, the piece to be exposed in the box prepared for that purpose to a dusting of fine sand dust for two minutes; removed; surplus sand removed by blowing thereon and wiping with the bare hand, and

then fired 20 rounds under the following conditions.”

a. “Magazine empty when exposed. Before firing, load magazine, fire balance of cartridges as a single-loader, then those in magazine.”

b. “Magazine loaded when exposed. Remove and wipe cartridges, reload and fire as above.”

Defective Cartridges – “Each gun to be fired once with each of the following defective cartridges:”

a. “Cross-filed on head to nearly the thickness of the metal.”

b. “Cut at intervals around the rim.”

c. “With a longitudinal cut the whole length of the cartridge from the rim up.”

“A fresh piece of white paper, marked with the number of the gun, being laid over the breech, to observe the escape of gas, if any.”

Excessive Charges – “The piece to be fired five times as a singleloader with cartridges in which the charge of powder is increased as to produce a pressure in the chamber about one-third greater than that caused by the Frankford Arsenal Experimental cartridge.”

Ease of Manipulation – “Facility of manipulation by members of the board. Any gun whose breech action or magazine fails in any of the foregoing tests will not be submitted to further tests.”

⁸William S. Brophy, *The Krag Rifle*, 7-8 and 11.

⁹Ibid., 8-9 and 11-12.

¹⁰*Defective Cartridges and Dust:*

“As a single-loader: to be fired with two defective cartridges, Nos. 1 and 2, and then to be dusted five minutes, the mechanism being in the mouth of the blowpipe and closed, but a full cock; the arm to be fired 5 shots. The piece to be freed from dust only by pounding or wiping with the bare hand.

“As a magazine arm: the same as (a) except that the cartridges for the subsequent firing will be placed in the magazine before dusting, and fired therefrom afterwards.”

Rust – “The breech mechanism, receiver, and magazine to be cleansed of grease, and the chamber of the barrel greased and plugged and breech action closed. The butt of the gun to be then inserted to the height of the chamber in a solution of sal-ammoniac for ten minutes, exposed for two days to the open air standing in a rack, and then fired 20 rounds, loading magazine and holding it in reserve until remainder of cartridges have been fired, using gun as a single-loader, then firing those in magazine.”

Explosion in Magazine – “The liability to accidental explosion of cartridges in tubular magazines will be tested by charging the magazine, then giving the gun a vertical jolting motion for two minutes, repeating with the magazine but half-loaded.”

Dismounting and Assembling – “The comparative ease and relative time required in dismounting and assembling the breech and magazine systems of the different

guns will be determined.”.

¹¹Ibid., 9 and 12.

¹²Ibid., 12.

- ¹³
1. Spencer-Lee;
 2. Lee, Model 1893;
 3. Savage;
 4. Durst No. 1;
 5. Durst No. 2;
 6. Durst No. 3;
 7. Durst No. 4;
 8. Blake No. 1;
 9. Russell-Livermore No. 1;
 10. Russell-Livermore No. 2;
 11. Russell-Livermore No. 3;
 12. White;
 13. Hampden;
 14. Blake No. 2.

¹⁴*First.* It is essential that the arm be susceptible of use as a single-loader with magazine held in reserve, and also well adapted for such use where the magazine is empty.

Second. The cutoff should be so prominent as to be readily observed by the squad leaders, but not so placed as to be liable to be inadvertently operated by the soldier, and must be capable of easy operation, when so desired, whether the magazine be empty or full.

Third. It is desirable that the magazine may be charged whether the cutoff be arranged for single or magazine fire.

Fourth. It is essential that the magazine may be readily loaded or replenished with single cartridges.

Fifth. It is desirable that the magazine be susceptible of easy loading from auxiliary charges or packets, and essential that these chargers or packets form no part of the magazine mechanism.

Sixth. It is essential that the floor of the receiver be of such form that the cartridges can be laid upon it and, without assistance of the hand, pushed by the bolt into the chamber, and this whether the magazine be empty, or charged and held in reserve.

Seventh. It is desirable that the bolt be in one piece, a separate bolt head being considered objectionable.

Eighth. It is essential that the bolt be sustained under the force of discharge by a lug, or lugs, at its forward end, and it is desirable that an auxiliary support be provided further to the rear either by a rib on the bolt, or by the base of the handle, or by both these means.

Ninth. It is essential, for ease of manipulation, that the initial movement in unlocking the bolt and starting the empty shell be given by a motion of rotation, bringing into play the assistance offered by cams in the bolt, breech casing, or receiver, and that the final seating of the cartridge and locking of the bolt be accomplished in a similar manner.

Tenth. It is desirable that the greater amount of compression of the mainspring be accomplished by these two movements.

Eleventh. It is essential that the bolt should be locked before the firing pin can reach the primer.

Twelfth. It is desirable in case of misfire that the piece may be recocked without moving the bolt.

Thirteenth. It is desirable that the extractor be strong and not partake of the bolt's rotation.

Fourteenth. It is desirable that the ejector throw the empty shell clear of the gun and soldier, but without excess of force.

Fifteenth. It is essential that the mechanism be strong and simple, composed of as few parts as possible, readily dismantled without the use of special tools, and assembled with a minimum number of screws or pins.

Sixteenth. It is essential that the easy and smooth working of the mechanism, whether the gun be clean or foul, be not sacrificed for extreme rapidity of action.

¹⁵Ibid., 13.

¹⁶*No. 1, Spencer-Lee.* – Breechblock insufficiently supported for modern cartridges; method of operation awkward and difficult. System unsuited to the military service.

No. 2, Lee, Model 1893. – The direct motion of the bolt a serious defect. Method of locking defective and insecure. Method of compressing mainspring and force required to accomplish it, and to close and lock bolt, undesirable and excessive. The [magazine] cutoff not sufficiently prominent. There being no floor to receiver it is necessary when using the gun as a single-loader, with magazine empty, to insert the cartridges with the fingers well into the chamber; a serious defect. The mechanism is complicated, difficult to dismount and assemble, some of its parts are of insufficient strength, and the system is unsuited to the military service.

No. 3, Savage. – Excessive force required to operate the mechanism, which fails to fulfill most of the previously enumerated requisites. The bolt is moved by a long lever lying below the stock and behind the receiver; a serious defect. The system is unsuited to the military service.

Nos. 4, 5, 6, and 7 (Durst). – All upon the Durst system and having no material points of difference. While conforming to some of the standard conditions the following defects of the system are noted: The locking of the bolt at the rear of the receiver, instead of just back of the chamber. The great force required to operate mechanism when gun is foul.

The difficulty in moving cutoff after magazine is fully charged, or when gun is foul, and yet the possibility, when the gun is clean, of the soldier in rapid firing unintentionally moving the cutoff.

The excessive weakening of the chamber by the three cuts for cartridge stop and extractors.

The compression of the mainspring by direct action.

The use of a double extractor and the method by which the hold of one upon the cartridge is released.

The long separate bolthead.

The long wound magazine spring, which would require in service frequent adjustment of its tension, an operation demanding considerable time and attended with difficulty.

The length of time required to charge the magazine with single cartridges.

The difficulty attending the stripping of cartridges from loading clips and especially the force required to push the last one or two into the magazine.

The guns on this system submitted to the board were arranged for cartridges without flanged heads, which are stripped from clips to the magazine. This method is impracticable for cartridges like the new small-caliber service cartridge of the U.S. Army, the heads of which are flanged.

The system is not suited to the military service.

No. 8, Blake. – The system violates a number of the standard conditions.

Great force is required to operate the mechanism; the cutoff can be moved, and the magazine loaded only when the bolt is in a particular position.

The cartridge packet, besides being an essential portion of the magazine, in its self a serious defect, is bulky and awkward to carry and not easy of insertion in the magazine box.

The system is not suited to the military service.

Nos. 9, 10, and 11 (Russell-Livermore). – All with magazine upon the Russell-Livermore pattern, but with the receiver and entire bolt mechanism the same as on the Lee-Speed, Mark I, of England.

The magazines are of the same general design, differing somewhat in the details of construction. All are awkward to load and operate.

They are not suited to the military service.

No. 12, White. – When subjected to the test of rapid or prolonged firing shown to be of defective construction.

The principal defects of the system are:

The direct motion of the bolt, the method of starting the empty shell, and the method of locking the mechanism.

After the handle has been retracted a short distance, a sudden and increased application of force is necessary to return the handle and repeat the effort.

In closing the bolt a similar difficulty was frequently observed, the same measures to overcome it being required.

The method of locking by a block moving transversly across the bolt.

The cartridge packet forms an essential portion of the magazine and without it magazine fire is impossible.

The cutoff is so situated that it is liable to be moved unintentionally by the soldier.

The magazine springs are uncertain in action.

The bolt is of insufficient strength and not easy to dismount and assemble.

The system is not suited to the military service.

No. 13, Hampden. – The magazine system as developed in this arm (working upon gravity alone) is, in the principle employed and the detailed manner in which it is applied, considered a failure. From its position the magazine limits the field of vision of the soldier and its particularly liable to injury. It is not suited to the military service.

No. 14, Blake No. 2. – This was the only arm submitted after the first period assigned in the original order, and before May 1, 1893. The system being identical with the Blake No. 1, it is, for the reasons previously stated, considered unsuited to the military service.

¹⁷Ibid., 13-14.

¹⁸Ibid., 14.

¹⁹Joe Poyer, *The American Krag Rifle and Carbine*, 12-24.

CHAPTER 5

MODERN COROLLARIES

In *United States Firearms: The First Century, 1776-1875*, David F. Butler states, “The Ordnance Board placed great stress on the ability to withstand extreme abuse. For example, rugged tests with defective ammunition, dusting tests, and rusting tests were included. An extreme example was the strong brine rusting test. It is extremely doubtful if any modern infantry rifle in use by the major powers today could pass so severe a test.”¹ The idea of harsh testing to try the reliability of any arm before issuing it to American soldiers remains as critical today as it was then. Reliability issues, based largely on its sensitivity to foreign material in the action and method of operation which introduces such material, have plagued the M16 family of weapons since its adoption.

The M16 family of weapons, which includes the current M4 carbine, has served as the primary rifle carried by the U.S. military for roughly 40 years. Both The adoption of the M16 and the subsequent removal of responsibility for small arms adoption from the Ordnance Corps failed to result in an overall improvement of the process. While small arms advances over the last 40 years were not as drastic as those during the 35 years covered in this thesis (which witnessed the progression from muzzle loading rifles to magazine-fed bolt-action repeaters firing self-contained smokeless cartridges), significant advances did occur.

Throughout the free world, and specifically within United States, the M16 family became the weapon of choice for not only the military and civilian law enforcement, but also American competitive shooters and modern military rifle collectors as the AR15.

The weapon’s design, while advanced for its period of development during the early

1960s, featured an inherent weakness which plagued it since its inception, the direct gas impingement system.

Prior to the adoption of the Krag in 1893, the Ordnance Department marginalized the significance of soldier complaints regarding the inherent shortcomings of the Trapdoor Springfield. Today's officials charged with arms acquisition commit similar omissions regarding the M16 family of weapons. Weapons designers and experts refer to the M16 family's system of operation as "direct gas impingement". This refers to the method of bleeding gasses from the barrel and directing them to unlock the action without using an intervening piston assembly. In the case of the M16, the system channels gasses through a gas tube into the bolt carrier. For a weapon which is extremely susceptible to foreign material, purposefully directing gasses and carbon into the action compounds the problem and contributes to weapon jams.

Officials at the Infantry Center and School at Fort Benning maintain that soldiers are generally satisfied with the M16 and M4 according to "post combat surveys," and that new weapons, like the XM8, SCAR, or HK416 covered later, are not necessary at this time. Army small-arms officials conduct the post combat surveys, which consist of interviews of soldiers regarding the field performance of their weapons in combat situations. Matthew Cox, in his article entitled "Out of Reach: Why You Won't Get Your Hands on the Army's Best Carbine" published in the 26 February 2007 edition of the *Army Times*, describes Fort Benning officials' unwillingness to release survey data and insistence that survey results indicated no negative trends in weapons performance. Mr. Cox described efforts by the *Army Times* to acquire a copy of Ft. Benning's post combat surveys through the Freedom of Information Act, but had not received it by press time.

The Project Manager Soldier (commonly referred to as PM Soldier) Weapons Assessment Team's 31 July 2003 report contained a similar survey which Infantry Center and School officials had participated in as well as other members of the Army's small-arms community.²

The M16 Family has always required frequent cleaning to prevent jamming. While the Army has decided to replace most of its M16s with the M4 carbine, the problems are inherent in the overall design and the M4 carbine not only fails to address them but may, in fact, further complicate them. When the Army began purchasing M4 carbines in the mid-1990s the intent was to issue them to soldiers operating vehicles where its collapsible stock and shortened barrel make it ideal. The Army never intended to issue the M4 to infantry soldiers who rely heavily on their individual weapons. The Army developed the M4 for support troops who do not require a full size rifle but need more than a pistol.

The same features on the M4 which made it suitable for support troops, its compact dimensions, adjustable stock, and handiness in confined spaces, made it very popular with Special Operations soldiers. However, when the M4 is subjected to more intense and prolonged use than expected by support troops (where it was envisioned as primarily a defensive arm), as well as harsh environments and fewer opportunities for preventive maintenance, the M4s have earned a reputation for poor reliability similar to the original M16 in Vietnam. Cases of World War Two and Korean War soldiers choosing to carry the more compact M1 carbine over the heavier M1 Garand only to find it lacked stopping power and penetration required in combat provides another historical corollary. Like the M4, the Ordnance Corps adopted the M1 carbine for support troops,

but front line troops would exchange their M1 Garands for them due to its light weight, compact dimensions, and high capacity, detachable box magazine.

In a 2001 report entitled *M4A1 5.56mm Carbine and Related Systems Deficiencies and Solutions: Operational and Technical Study with Analysis of Alternatives*, Special Operations Command documented several problems with the M4. The report concluded that the M4 suffers from an “obsolete operating system,” and recommended “redesign/replacement of current gas system.” It also described the weapon’s shortened barrel and gas tube as being “fundamentally flawed” blamed these modifications from the M16 design for an increased incidence of the issues of “failure to extract” and “failure to eject” which resulted in a jammed weapon.³

Currently, Colt Defense Weapons Systems, a subsidiary of the Colt Firearms Company, manufactures all M4s purchased by the U.S. Military. Lieutenant General William M. Keys, USMC (retired), Colt’s CEO, claims that all Colt M4s meet the government’s standards. While these carbines may meet government quality standards, the inherent faults in the system make that a moot point. M16 rifles and M4 carbines in the hands of American soldiers serve in regions where dirt, sand, and grit are a daily fact of life. These weapons are no longer sitting in racks in clean arms rooms, but rather are in the hands of soldiers fighting The War on Terror in places like Afghanistan and Iraq, where super-fine dust and sand which gets into everything.⁴

PM Soldier habitually downplays the significance of reports of weapons failure or malfunction similar to the Ordnance Department in the late 19th century. They attempt to fix the blame for weapons malfunction on the operator rather than the system. The PM Soldier, Weapons Assessment Team Report executive summary claims that M16s and

M4s “functioned reliably” in the combat zone as long as “soldiers conducted daily operator maintenance and applied a light coat of lubricant.”⁵ Anonymous soldier comments accompanying the report tend to discredit that assertion. One soldier from 3rd Infantry Division stated, “The weapon malfunctions in rough conditions/hard to keep clean,” while another simply said “I know it fires very well and accurate clean. But sometimes it needs to fire dirty well too.”⁶

Officials at the Army’s Infantry Center and School dismiss criticism of the M16 and M4 and argue that there is no statistical data that proves reliability problems with the weapons. Marine Corps testing conducted for Marine Corps Systems Command at Quantico, VA, in late summer 2002 contradicts this claim. Tests revealed that the M4 malfunctioned three times as often as the M16A4. The M4 suffered malfunctions categorized as “magazine,” “failure to chamber,” “failure to fire,” “failure to extract” and “worn or broken part,” 186 times over the course of 69,000 rounds fired while the M16A4 failed only 61 times or roughly one third as often over the course of the testing. Army reliability tests conducted between October 2005 and April 2006, which included 10 new M16s and 10 new M4s resulted in an average failure rate of 5,000 rounds between stoppages during a 35,000 round tests performed under laboratory conditions.⁷

In a recent article entitled “Out of Reach: Why You Won’t Get Your Hands on the Army’s Best Carbine,” *Army Times* columnist Matthew Cox described the events surrounding the plight of the 507th Maintenance Company in Iraq in 2003 during which 11 soldiers were killed and six captured when their convoy blundered into Nasiriyah and ambushed as it tried to extricate itself.

Perhaps the most well-known incident of M16s failing in battle involves the 507th Maintenance Company in 2003 during the opening days of the ground invasion of Iraq. Enemy forces ambushed 507th soldiers outside Nasiriyah, killing 11 and capturing six, when the unit became separated from a supply convoy. Several of the 507th soldiers later complained that their M16s, and other weapons, failed them during the March 23 ambush. The Army responded by revamping Basic Training to make sure soldiers knew how to better maintain their weapons and perform malfunction drills.

What's not so well known is how then-Pfc. Patrick Miller earned a Silver Star for keeping his M16 from jamming long enough to take out an enemy mortar position. "We were taking fire from everywhere," Sgt. Miller recalled in a recent Army Times interview. Enemy fire had knocked out his five-ton truck, forcing him to fight on foot. He dove for cover behind a dirt berm and spotted an Iraqi soldier manning a mortar position across the road. "It looked like he was trying to drop the shell in the tube. That is when I fired the first shot and the guy went down." When he pulled the trigger again, nothing happened.

"After the first shot, the round ejected. When the next round went to go in, it froze up," he said. "It didn't feed all the way into the chamber." Miller pounded on the forward assist, a tiny plunger on the M16's receiver designed to manually push the weapon's bolt into the chamber. He fired his rifle once more, and it jammed again. Miller tried the immediate action drill he learned in Basic Combat Training — he slapped the bottom of the magazine to reseal it, pulled the charging handle back to look into the chamber. When he released, the bolt wouldn't chamber the next round.

Changing magazines didn't work either. "After the third magazine I decided it took longer to change mags than to beat on the forward assist," he said. That worked, but his weapon would only fire a single shot and jam again. "I was beating that thing with the palm of my hand four or five times for each round," he recalled. Miller managed to fire about eight times using this frantic sequence under enemy fire.

It was a valiant, but futile, effort. His fellow soldiers were trying to fight, but their weapons failed them as well. Miller turned around and shot at a target behind him. "When I turned there were about 40 Iraqis that had moved up on the road" approaching his position, he said. "At that time there was not much else I could have done." Miller put down his rifle and surrendered.⁸

Many surviving 507th Maintenance Company soldiers made statements indicating that their M16s failed during their fight for survival on 23 March 2003. The Army's response was to blame the failures on poor weapons maintenance and revamp Army

Basic Training to ensure soldiers understood the importance of weapons maintenance and were sufficiently trained to maintain their weapons and perform malfunction drills.

Similar issues arose in the early days of the M16 during the Vietnam War and the Army's response at that time was to issue a comic book illustrating M16 maintenance requirements.

In the case of the 507th Maintenance Company, many people declared that their complaints of weapons failure merely illustrated a case of a rear echelon unit failing to perform regular weapons maintenance. Cox's article also described an event which occurred on 4 March 2002, in the Shahikot Mountains of eastern Afghanistan. In this case it was not a Combat Service and Support unit, but rather a quick-reaction force of Rangers. An RPG had downed the MH-47 Chinook helicopter carrying the Rangers on a 10,000-foot peak called Takur Ghar. When the helicopter crashed, al-Qaida fighters poured fire into the fuselage killing several Rangers in the wreckage. Captain Nathan Self escaped the wreckage and joined his men but soon experienced a weapons malfunction. Captain Self conducted the immediate action for a jammed weapon but was unsuccessful and even tried to clear the chamber by ramming a cleaning rod down the bore where it broke off. Unable to get his M4 to work and under fire, Self returned to the aircraft and replaced his weapon with that of a casualty in order to return to the fight. The Army has awarded Self the Silver Star for his actions but has still failed to replace the weapon which contributed to his problems. It has been more than five years since that malfunction forced Self to break cover to replace a weapon which failed to function when it was needed most. This was not a case of a rear echelon soldier whose weapon jammed due to lack of maintenance but rather that of a highly trained combat infantryman whose

weapon failed him. If combat arms soldiers from elite units whose weapons are their constant companions can not rely on the M4 then it is likely that the problem rest with the weapon rather than being a case of “operator malfunction.”⁹

Much like the Ordnance Department during the late 19th century, Army officials charged with small arms acquisition site cost and a desire to wait for the next leap in technology as the reasons for keeping an obsolete weapons system in the hands of soldiers. While the Ordnance Department finally retired the Trapdoor Springfield with the development of smokeless powder, today’s officials are waiting for the Objective Individual Combat Weapon (OICW). Colonel Robert Radcliffe, the man responsible for overseeing the Army’s needs for small arms, states that the M16 family is “pretty damn good.” It’s simply too expensive, he said, to replace it with anything less than a “significant leap in technology.”¹⁰ Army officials intended to meet that leap in technology with the XM29 Objective Individual Combat Weapon. The Objective Individual Combat Weapon, or OICW, was envisioned as a dual system featuring a 25mm airburst weapon on top, capable of killing enemy behind cover out to 1,000 meters and a detachable 5.56mm kinetic energy carbine slung underneath but after seven years and more than \$100 million later, the prototype still weighed 18-pounds empty which is far to heavy for an individual weapon.¹¹

Radcliffe stated “We will hold on trying to replace the small-arms fleet, and we will search for technologies that might give us significantly greater capabilities in ... the next 10 years or something like that.” Radcliffe continued “We think that somewhere around 2010, we should have enough insight into future technologies to take us in a direction we want to go for the next generation of small arms.” “We will have M4s and

M16s for years and years and years and years,” he stated. “We are buying a bunch of M4s this year ... and we are doing it for all the right reasons, by the way. It’s doing the job we need it to do.”¹²

Army officials contend that replacing the M16 family at this point would be prohibitively expensive. “The truth is, to change out a fleet takes a tremendous amount of money.”¹³ Infantry Center and School officials contend that the Army would spend approximately \$1 billion to replace M16s and M4s currently in the Army inventory with any of the newer weapons currently available.¹⁴

There are several weapons available today which boast reliability and features not available in the M16 family. Some of these, like the Heckler and Koch 416 or the Patriot Ordnance Factory P416, incorporate a gas piston system into the design of an M16 upper receiver eliminating the gas problem. Both of these systems boast greatly improved reliability when compared to the standard M16 or M4. Designers developed both to retrofit existing M16 style weapons by replacing the old upper receiver and bolt carrier group with the new one. The three systems of note which have received the greatest attention as possible replacements for the M16 are the XM8 which was a spinoff of the OICW program, and the SCAR family and HK416, both of which were developed for the Special Operations community.

The XM8 is a derivative of the Heckler and Koch G36 assault rifle initially designed to fulfill the kinetic energy requirement of the Army’s Objective Individual Combat Weapon or OICW. Internal components and method of operation for the XM8 are almost identical to the G36 in design and function although they differ cosmetically. The XM8 features a short piston stroke, gas operated action, with rotating bolt locking.

The use of the piston keeps gasses out of the action. The design features quick detachable barrels available in several sizes, ranging from 9.5 inches for Compact or Personal Defense Weapon (PDW) version, 12.5 inches for the Basic Carbine version, and two 20 inch barrels, one for Designated Marksman or Sniper version, and a heavier one for Squad Automatic Rifle role equipped with a bipod.

The design employs modular construction centered on the polymer receiver with the bolt group. The designers provided the ability to easily swap the magazine well to provide compatibility with various 5.56mm magazines as well as providing the possibility to tailor the weapon for different calibers in the future. The design supports the installation of different stocks to adapt it for different roles but the weapon comes standard with a telescoping 5 position stock similar to the one on the M4. The top of the receiver incorporates a proprietary sight rail, which can accept an illuminated red-dot (collimator) sight, or other optics as required especially if used in the designated marksman or sniper role. The handguard was designed to be detachable and could either be replaced with others of different sizes and configurations or the XM320 40mm grenade launcher being developed to replace the M203. In an article in the *Army Times* entitled "1 killer weapon: 8 things you'll love about the XM8" published 1 March 2004, John G. Roos described several advantages the XM8 provided over the M16/M4.¹⁵

1. It's light. The baseline carbine model currently weighs in at 6.25 pounds (the objective weight is 5.7 pounds), including an integrated sight with infrared laser and illuminator, red dot reflex sight and integrated mount. By comparison, an M4 modular weapon system with rail attachment, backup sights, M68 Close Combat Optic and standard laser/illuminator systems tips the scales at 8.85 pounds.

2. It comes with a cutting-edge sighting system. The XM8's battery-powered sight houses a red dot close-combat optic that incorporates an infrared laser aimer and illuminator. The shooter controls the sight's functions through a wireless switch that can be mounted anywhere on the weapon. The sight combines all the

capabilities of the separate close-combat optic, AN/PEQ-2 laser and AN/PAQ-4 designator systems normally mounted on M4s.

3. It's easy to zero. The sight has a backup etched reticle and comes factory zeroed. It retains its zero position through a positive-locking mounting setup.

4. It has no rails. Designers fashioned integral, flush-mounting, metal-lined attachment points on the XM8's handguard and receiver. Standard 1913 adapters can be mounted on the attachment points so operators can continue to use lights, lasers and other items already in the inventory.

5. It needs little maintenance. H&K officials say the XM8 can fire more than 15,000 rounds without need for lubrication or cleaning, even under the most extreme operating conditions.

6. It's easy to clean. Unlike the M16/M4 series, the XM8's gas system doesn't blow gases and their carbon-fouling elements into the receiver during firing. Instead, about 90 percent of the gases created during firing are vented through a gas port under the front of the barrel; the other 10 percent are used to cycle the weapon. This new design reduces average cleaning time to four minutes, compared with the 14-minute average cleaning time for an M4.

7. It's tough. Between shooters, H&K officials alternated sticking the carbine in a drum of water and burying it in sand. Despite that treatment and the thousands of rounds put through the weapons at the range, there wasn't a single misfire or stoppage. The weapon's cold hammer-forged barrel has a service life of 20,000 rounds, and has blow-out vents to direct energy and gases from a catastrophic chamber failure forward and away from the shooter.

8. It's ambidextrous. Lefties will find a southpaw-friendly, centrally located charging handle that doubles as a forward assist slide, an ambidextrous magazine release, bolt catch, safety/selector lever and release lever for the multiposition, collapsible butt stock. All shooters will be able to keep their firing hand on the pistol grip while loading, unloading or charging the weapon.¹⁶

Politics and budgets have prevented soldiers from receiving a better rifle or at least receiving one in a timely fashion in a situation reminiscent of the situation facing the Krag in 1893. Several manufacturers filed complaints about non-competitive procurement of the XM8 system from Heckler-Koch USA. In March of 2005, the U.S. Army first opened the bidding to other companies and then on 31 October 2005, the entire XM8, (or OICW Increment 1 program,) along with OICW/XM29 development,

was formally suspended. Department of Defense officials directed a Joint Services effort to review requirements allowing for a larger order and production base of a series of weapons for fielding to all branches of the U.S. military. While the development of the XM8 was suspended, development may resume if the XM8 fulfills the U.S. Joint Service Requirements for a new assault rifle system and Heckler-Koch USA bids for and wins the contract.¹⁷

Much like the late 19th century, suitable alternatives exist. With the Army's decision to delay its move to adopt a replacement for the M16 family, on 15 October 2003, United States Special Operations Command (U.S. SOCOM) issued a solicitation for the procurement of SOF Combat Assault Rifles (SCAR) in both heavy and light. This solicitation requested a new combat rifle, specially tailored for the current and proposed future needs of Special Operations Forces. The SOF needs are somewhat different from normal U.S. Army requirements intended to be fulfilled by the XM8 or OICW Increment 1 program.¹⁸

One major difference in basic requirements between U.S. Army (or U.S. Joint Service) and U.S. Special Operations Command requirements is that while the U.S. Army called for a single-caliber weapon system, tailored for NATO standard 5.56mm ammunition, U.S. SOCOM desired a weapon specifically capable of modification to fire multiple calibers. Due to its modular design, the XM8 is theoretically capable of being adapted to fire calibers dimensionally similar to the 5.56mm (SCAR requirements specified that capability).

Initial U.S. SOCOM requirements included two basic versions of SCAR system. The SCAR Light (SCAR-L) was designed to replace weapons of the M16 class and the

base model is chambered for the NATO standard 5.56mm cartridge. Specifications for the SCAR heavy (SCAR-H) dictate that its base model chamber the larger and more powerful 7.62mm cartridge to replace weapons of the M14/21¹⁹ and AR10²⁰ families. However, both models are required to be easily field-adaptable to other calibers. Initial caliber conversion kits considered include 7.62x39mm commonly used in the AK47 assault rifle and RPK machinegun as well as calibers not so readily available.²¹ U.S. SOCOM wrote the SCAR rifle system's specifications to provide Special Forces operators with a wide variety of weapons options. SCAR variants range from a short-barreled 5.56mm SCAR-L Close Quarters Combat variation, tailored for urban room to room combat, to a long range Sniper variant of the SCAR-H chambered for the 7.62mm cartridge. The SCAR-H specifications also require the ability to fire the 7.62x39 round of the AK47 from AK47 magazines in situations where soldiers may be incapable or unwilling based on mission constraints to receive regular ammunition resupply.

U.S. SOCOM requires both the SCAR-L and SCAR-H to be available in the Standard, Close Quarters Combat, and Sniper Variants initially. They needed to employ components designed to be interchangeable, allowing for the creation of hybrid variants. All these variants, regardless the caliber and exact configuration, provide the operator with the same basic weapons handling and control orientation, maintenance procedures, and the capability to employ any optional equipment, (such as sights, scopes, and other current and future attachments designed for the system) providing the soldier in the field with a large degree of flexibility.

In 2004, U.S. SOCOM announced that FN USA had won the initial SCAR contracts. FN USA is the U.S.-based subsidiary of Belgian arms manufacturer Fabrique-

Nationale, Herstal. This company produced prototype rifles and will also handle series production of the weapons. Starting in mid-2005, SOCOM received the first shipment of SCAR rifles. SCAR rifles carry Navy-type "mark" designations and the official designation of the SCAR-L is Rifle Mark 16 while the SCAR-H is designated the Rifle Mark 17. SOCOM intends to gradually replace most rifle systems now in service with its forces (such as M4 carbine, M16 rifles, M14 rifles and Mk. 25 sniper rifles) with Mk.16 and Mk.17 rifles.

FN designed the SCAR rifles from the ground up as an entirely new weapons system rather than modifications of any previous weapon. All variants of the FN SCAR rifle feature a short stroke piston, gas operated system which locks via a rotating bolt. The bolt system is similar to that of FN Minimi/M249 SAW machine gun currently in use by the U.S. Army. This method of operation is far less sensitive to sand, debris or other fouling inside the receiver than other systems which employ M16-type multi-lug bolts and plunger-type ejector. The receiver is composed of two sections consisting of upper and lower receivers connected by cross-pins similar to the system found on the M16. FN constructs the upper receiver of extruded aluminum while the lower part is formed of polymer. Both SCAR-L and SCAR-H rifles employ upper receivers which differ only in the size of ejection port which is larger in the case of the SCAR-H to accommodate the larger cartridges fired by the weapon. A number of components for the SCAR family of weapons are caliber specific including the bolt, barrel, and lower receiver with its integral magazine housing. By changing these assemblies, the operator can rapidly adapt the weapon to fire additional calibers as required to accomplish the mission. The trigger assembly provides for ambidextrous operation with semi and full automatic capability.

The charging handle is capable of installation on either side of the receiver which has guides machined on both sides.

FN designed the SCAR family of weapons for part and accessory compatibility and the SCAR-L and SCAR-H feature 90% commonality of parts. The upper receiver incorporates a quick-change barrel feature to allow for rapid caliber and barrel change. A pair of cross-bolts facilitates barrel retention and allows rapid changes with a minimum number of tools and without a requirement to adjust headspace.

The upper receiver features a full-length integral upper Picatinny rail for optics mounting with additional rails machined on either side and a fourth rail beneath the free-floating handguards for additional accessories. The weapon features a side-folding polymer buttstock which is adjustable for length of pull. The cheek rest is adjustable as well, allowing soldiers to configure it to their own requirements as far as cheek weld and optics selection. FN designed the 5.56mm Mk.16 SCAR-L rifle to utilize standard M16 magazines as well as an improved version constructed of steel for improved reliability. The 7.62mm Mk.17 SCAR-H employs a proprietary 20-round magazine rather than adopting an existing design. When configured to fire the 7.62x39 cartridge, the SCAR-H accepts standard AK47 magazines.

SCAR rifles feature removable, adjustable iron sights, with a folding diopter-type rear sight mounted on the receiver rail, and a folding front sight mounted on the gas block. Additional optics (such as telescopic, "red dot", night vision, or the thermal weapons sight) can be installed using MIL-STD 1913 compatible mounts on the Picatinny rail. The SCAR family of weapons does not currently possess bayonet mounts and it is unlikely that U.S. SOCOM will see a need to add this feature.²²

The Heckler and Koch HK416 is one of the more interesting alternatives currently available. Unlike the SCAR weapons family which is an entirely new design, or the XM8 which is essentially a redesigned G36, the HK416 is a product improved version of the M16 family of weapons. Other companies have designed reliable gas piston systems for the M16 including LWRC²³, POF-USA²⁴, and Bushmaster²⁵. Even Colt, manufacturer of the M4, is reportedly developing a piston driven version allegedly designated the M5.

Following the suspension of the OICW Block 1/XM8 program, Heckler & Koch entered the U.S. military and law enforcement markets with the alternative design. Based on the experience, gained during successful upgrade program of the British SA80/L85A1 program, HK, in conjunction with U.S. SOCOM's Operational Detachment Delta (commonly referred to as Delta Force), decided to cure the existing M16 rifle and M4 carbine from most of their problems, inherent to this 40-years old design. The key improvements, made by HK, are their patented short-stroke gas piston system, borrowed from HK G36. This system replaced the direct gas system of standard M16 rifle, so no powder residue will remain in the receiver even after long shooting sessions. The "new" gas system also is self-regulating and will work reliably with any barrel length. Other improvements include new buffer assembly, improved bolt, and a cold hammer forged barrel, as well as free-floating handguard with integral Picatinny-type rails. Originally developed as a "drop-in" upper receiver assembly for any standard M16/M4 lower receiver, HK416 is also available as a complete weapon, with HK-made lower receivers. Current models include carbines with 10.5" and 14.5" barrels, and 16.5" barreled carbine and a 20" barreled rifle. Delta Force operators have carried the HK416 in Iraq and Afghanistan since its completion in 2004.²⁶

The HK416 is a gas operated, selective fired weapon based on Eugene Stoner's M16 design and incorporating modular design features. The weapon employs a short-stroke gas piston which initiates rearward motion of the bolt carrier assembly unlocking the 7-lug rotating bolt from the barrel extension. Like the M4, H&K utilizes high grade aircraft quality aluminum alloy in the construction of the upper and lower receivers.

While the HK416 can be based on any lower receiver from the M16 family, the H&K lower receiver employs the standard M16 type controls but unlike the current generation of the M16 family provides for single shots and full automatic mode rather than a three round burst setting. This HK416 retains all other current M16-style features, including last round bolt hold-open device, rear-based charging handle and magazine release button on the right side of the magazine well. The HK416's upper receiver features four Picatinny rails as standard, and soldiers may be fit any type of sighting devices or optics with compliant mounts to the weapon. The HK416's rail system also accept other M4 carbine accessories to include the M4 variant of the M203 or a modified HK AG36 40mm grenade launcher, which are clamped directly to bottom rail. The HK416 employs a multi-position telescoping buttstock typical of the M4 carbine.

The HK 416 features a free-floating forearm and can be equipped with either M4 back up sights or a version of the typical HK diopter design which provide the HK416 the same sight picture as the MP5. The rear sight has four settings: 100, 200, 300 and 400 meters. These sights mount to the top rail and do not fold which eliminates some of the zeroing problems found in some folding designs. Some shooters believe that backup sights should always be in a usable position rather than foldable since if they are required, during the heat of combat, soldiers may not have time to adjust them.

Heckler and Koch utilizes a hammer forged, hard chrome lined which is extremely strong and well made. Testing by both U.S. government agencies and outside organizations confirm that the HK 416 is extremely accurate despite its use of a gas piston operating system. Despite the employment of a short-stroke gas piston operating system on the highly accurate, Soviet-era SVD Dragunov sniper rifle, some experts still contend that the direct gas impingement system provides inherently more accuracy than a firearm utilizing a gas piston system. Accuracy tests of the HK416 indicate that this assertion may be overstated. HK416 bolts differ from standard M16 versions since the bolt does not require gas rings which are on the gas piston and the bolt head has reduced drag against the carrier produced in direct gas impingement systems.

Compared to the M16 and M4s rate of failure, tests indicate that the HK416 exhibits a much lower rate of failure firing 10,000 to 15,000 rounds between stoppages as opposed to the 5,000 rounds between stoppages for the M16 family under similar circumstances. Agencies have tested the H&K416 in endurance firing to 15,000 rounds without lubrication. In contrast, government inspectors pull samples from each lot of M4s produced by Colt and perform 108-point inspections to ensure they meet Army specifications. The government routinely subjects M4s to 6,000 round endurance firing which the Army has established as the standard.²⁷

Heckler and Koch produces the HK 416 as either a complete carbine or a conversion kit which consists of an upper receiver, replacement buffer and buffer spring and is used to convert an existing M4 or M16 lower to the HK416 system of operation. Since the lower receiver typically avoids much of the wear that many of the other components suffer the Army could theoretically upgrade its existing weapons to HK416

specifications for far less than the cost of replacing them with an entirely new weapon while maintaining most of the familiarity American soldiers already have with operating the M16 family of weapons. Considering Heckler and Koch's history and its contract with Britain to update existing SA80s it is also likely that they could be contracted to refurbish and convert existing M16s and M4s themselves.

Heckler and Koch is also developing a rifle designated the HK417 chambered in 7.62mm. This rifle is apparently an beefed up variant of the HK416 design which makes it the equivalent of the Armalite AR10 combining a large caliber rifle with M16/M4 ergonomics, layout and handling and the improved reliability of HK416s short stroke gas piston system. If Heckler and Koch continues development of the HK417 and initiates production, the 5.56mm HK416 and 7.62mm HK417 family should provide an alternative to the FN SCAR system.

The HK416 provides reliability in a weapon which provides all the benefits of the M16 family without the flaws and which requires minimal retraining for soldiers who are already familiar with the M16 so why is the Army not considering upgrading its M16s and M4s to either the HK416 or another system with a gas piston as opposed to the Gas impingement system? The answer is once again cost. Adoption of a weapon employing a piston gas system mitigates long-term maintenance and system replacement costs. Tests of gas piston carbines indicate that these designs present a cost savings in replacement components and weapons over time. Gas piston weapons prevent the entrance of heat generated by expended gasses from entering the receiver which is a byproduct of the M16 family's method of operation. Heat from expended gasses rapidly dries out lubricants and

particulate matter in the gasses can act as an abrasive inflicting additional wear on moving components.

Issues which arose when the Army attempted to adopt the XM8 illustrate the political issues involved in adopting a new weapons system. The Army can not simply adopt a newer weapon or contract the adaptation of its current weapons to a gas-piston system without issuing specifications and holding a competition and trials intended to ensure that no manufacturer has an unfair advantage. While the intent of these requirements is to ensure fairness in military contracting, the result places an obsolete system in the hands of American soldiers in harms way.

The Army currently plans to retain the M4 and M16 for regular forces. Despite advances in small arms technology, the Army continues to contract for large numbers of new M4s and plans to purchase approximately 100,000 M4s during fiscal 2008 at a bulk purchase price of approximately \$800 without accessories. However, the Army will actually be paying approximately \$1,300 for M4 systems which include a forward rail system for accessory mounting, a backup iron sight, seven magazines and a sling assembly. Heckler and Koch CEO John Meyer, Jr., has stated that the package price for the HK416 “will range anywhere from \$800 to \$1,425 depending on volume and accessories.” There is no significant difference in the purchase costs of the weapons and this does not even account for the possibility of a contracted Heckler and Koch rebuild of M16 family weapons already in Army inventories.

The mechanical flaws inherent in the M16’s gas system are not the only criticism leveled against it. As the development of smokeless powder in the 1880s rendered blackpowder cartridges obsolete, advances in cartridge technology since the 1970s have

eclipsed the 5.56mm round. While the 5.56mm cartridge provided decent performance as designed, this cartridge pales in comparison to cartridges developed more recently which incorporate the lessons learned over the last forty years as well as the latest advances in propellants and other components. Unfortunately, since the United States was the driving force behind NATO adoption of the 5.56mm cartridge it may linger in the ammunition pouches of American soldiers for much longer than it would otherwise. The 6.8mm SPC and the 6.5mm Grendel provide two examples of these newer cartridges.

Remington developed the 6.8mm Special Purpose Cartridge (SPC) with the help of members of the U.S. Army 5th Special Forces Group as an answer for the requirements of urban warfare and Close Quarters Battle (CQB). The 6.8mm SPC provides better performance than the than the 5.56mm round with its 62-grain bullet. The 6.8mm SPC also functions as a more effective short and intermediate distance sniping round than the Mk262 5.56mm round with its 77-grain bullet developed for the Special Purpose Rifle (SPR) issued to U.S. SOCOM soldiers.

The 6.8mm SPC features an intermediate length rifle cartridge based on the 30 Remington cartridge case. After selecting the .30 Remington as the parent case which required only slight modification to the M16's bolt face, Remington shortened the case, formed a new shoulder, and increased the diameter to maximum case capacity for a new high-performance propellant. Remington designed the 6.8mm SPC to function in the M16/M4 family of weapons specifically to provide increased reliability, terminal ballistics, and accuracy not only for close quarters combat, but at ranges out to 500 meters.

Remington tested a variety of bullet diameters including 5.56mm, 6mm, 6.5mm, 7mm, and 7.62mm, before selecting a bullet of 6.8mm. The 6.8mm SPC features a .270-caliber, 115-grain projectile with a muzzle velocity of 2750 to 2850 fps which offers optimum lethality and range. The 6.8mm SPC provides one “Minute of Angle”²⁸ accuracy out to more than 600 meters. The 6.8mm SPC’s trajectory is nearly identical to that of the .308 Winchester while producing lower chamber pressures than the 5.56mm. The round fits the M16 magazine envelope although the magazine requires minor modifications and loses two rounds in capacity. Testing revealed that the 6.8mm SPC provides terminal ballistics as good as or better than the 7.62mm. Conversion of any M16 style weapon to 6.8 SPC only requires exchanging the 5.56mm upper receiver for a 6.8mm SPC unit or replacing the barrel and bolt on the existing upper receiver. Barrett Firearms manufactured 6.8mm SPC upper receivers for U.S. SOCOM. The 6.8mm SPC provides roughly the same trajectory as 7.62mm NATO to a range of 600 yards.²⁹

Another caliber option available is the 6.5mm Grendel from Alexander Arms. The 6.5mm Grendel cartridge provides extended range capability for tactical applications beyond those previously achievable in an assault rifle. The 6.5 Grendel is suitable for bullets weighing between 130 and 140 grains making it ideal for long range, tactical shooting. At the Blackwater Training facility in NC in May 2003, the 6.5mm Grendel out-shot the 7.62 NATO at range with half the recoil. The bullet was still supersonic at 1200 yards and demonstrated superior external ballistics when compared to the 7.62mm cartridge.³⁰

The 6.5 Grendel is capable of propelling a 123-grain bullet to a muzzle velocity of 2600 feet per second and provides superior accuracy out to 1200 yards. Shooters can

engage targets the size of a tennis ball at 600 yards. Alexander Arms claims that the 6.5mm Grendel is unbeatable in terms of extreme accuracy, formidable terminal ballistics and range. The 6.5 Grendel launches a bullet with approximately twice the mass of the 62-grain projectile of the current 5.56mm round with superior accuracy at more than twice the range from the same weapons platform.³¹

The modern urban combat American soldiers currently face in the cities of Iraq places a high demand on the individual weapon. Engagement ranges vary from across a room to hundreds of yards. Soldiers must be capable of responding to deadly threats when entering, exiting, and riding in vehicles or buildings. However, when units request weapons with either greater accuracy over longer ranges, or increased lethality against the opponents they currently face, the Army responds by producing studies or deploying individuals to inform them that the 5.56mm round is still the answer. Requests for M14s firing the 7.62 round resulted in a document which purported to show that the short barreled M4 firing the 5.56mm round was far more accurate than the M14. Competition shooters find this statement laughable and it tends to erode the credibility of those making these assertions.³²

In the 1980s and 90s the Army redesigned the 5.56mm round to counter the threat posed by the issue of body armor to Soviet troops. However, the 62-grain bullet of the improved round tends to over penetrate on soft targets producing a narrow wound channel which allows the target to continue to pose a threat. Reports from the battle of Mogadishu brought this fact to light when soldiers reported shooting Somali gunmen numerous times before taking them out of the fight. Requests for weapons with greater stopping power than the 5.56mm round or issue of the 5.56mm Mk262 round with its 77-

grain bullet led the Army establishment to send teams into theater to inform soldiers and leaders that if they merely ignored their training to shoot center of mass to increase the likelihood of hits and focused instead on making shots to the narrow hourglass formed by the head, neck, and upper chest the 5.56mm round is sufficiently lethal.³³ This is reminiscent of a similar situation faced by American soldiers during the Philippine Insurrection. The Ordnance Department had retired the .45-caliber Colt Single Action Army revolver in favor of a new double action revolver firing a .38-caliber cartridge. When facing Moro warriors, soldiers armed with the .38 found Moro warriors continued to pose a threat after taking several hits from the .38. These reports forced the Ordnance Department to re-issue the .45-caliber Colts until the adoption of the Colt model 1911 which fired a .45-caliber rimless cartridge (referred to as the .45 ACP).

In the late 19th century, the Ordnance Department continued to expend resources on improvements to the Trapdoor Springfield line despite obvious evidence of its obsolescence. Today, small arms acquisition personnel are following the same path in regards to the M16 family of weapons. The Army publishes reports stating that the majority of soldiers prefer the M4 but neglect to mention what they prefer it to. While the majority of the systems and caliber options mentioned in this chapter are currently available, the Army continues to fund additional purchases of the M4 carbine.

¹David F. Butler, *United States Firearms: The First Century 1776-1875*, 189.

²Matthew Cox, “Out of Reach: Why You Won’t Get Your Hands on the Army’s Best Carbine”, *Army Times*, 26 February 2007

³Ibid.

⁴Ibid.

⁵Ibid.

⁶Ibid.

⁷Ibid.

⁸Ibid.

⁹Ibid.

¹⁰Ibid.

¹¹Ibid.

¹²Ibid.

¹³Ibid.

¹⁴Ibid.

¹⁵John G. Roos, “1 killer weapon: 8 things you’ll love about the XM8”, *Army Times*, 1 March 2004.

¹⁶Ibid.

¹⁷ Matthew Cox, “Too late, XM8: Doomed Carbine the Victim of Army Infighting”, *Army Times*, 4 June 2007.

¹⁸Kevin Dockery, *Future Weapons*, 96-97, 122-123.

¹⁹The M21 is the sniper variant of the Vietnam era M14 rifle which was the last issue rifle produced by the Ordnance Corps. The rifle chambers for the 7.62mm NATO round.

²⁰Armalite currently produces the AR10 which is a semi-automatic rifle chambered for the 7.62mm NATO cartridge. Eugene Stoner designed the original AR10 and the current Armalite rifle is a modernized version of his original design.

²¹The 6.8mm Remington SPC cartridge, especially developed for U.S. Special Forces or the 6.2 Grendel which are dimensionally similar to the 5.56mm round but provide vastly improved ballistic and terminal performance are both possible options and are covered in greater detail at the end of the chapter.

²²Ibid., 97-98, 123-124.

²³LWRC Homepage, <http://www.lwrifles.com/>, 15 May 2007.

²⁴POF-USA Homepage, <http://www.pof-usa.com/>, 15 May 2007.

²⁵Bushmaster Gas Piston Carbine Page,
<http://www.bushmaster.com/shopping/weapons/bcwa3f16m4-gp.asp>, 15 May 2007.

²⁶Matthew Cox, “Out of Reach: Why You Won’t Get Your Hands on the Army’s Best Carbine”, *Army Times*, 26 February 2007.

²⁷Ibid.

²⁸One Minute Of Angle equates to one inch at 100 yards.

²⁹David Crane, *6.8x43mm SPC Cartridge for Urban Warfare CQB and Short-to-Medium-Range Sniping*, Defense Review.com,
<http://www.defensereview.com/modules.php?name=News&file=article&sid=383>, 12 April 2007.

³⁰6.5 Grendel Fan Site, <http://www.65grendel.com/>, 12 April 2007.

³¹Alexander Arms Web Site, <http://www.alexanderarms.com/grendel.htm>, 12 April 2007.

³²Information received by the author in an unclassified briefing while assigned to Coalition Forces, Land Component Command (CFLCC), C4 (Logistics), Ammunition Cell, Kuwait, 2005-2006.

³³Ibid.

CHAPTER 6

CONCLUSION

A careful study of the actions of the Ordnance Department between the end of the Civil War in 1865 and the dawn of the 20th Century reveals an organization which welcomed technological innovation and sought to equip its soldiers with the best arms of the times. Despite allegations of Ordnance Department mismanagement or backwardness, it was economic, political, and technical considerations that drove U.S. Army rifle and carbine adoption during the period. During this relatively short 35 year period, the U.S. Army adopted a string of technological advances which eclipsed those of the preceding 500 years. In an era of miniscule budgets, the Ordnance Department replaced the muzzle loading rifles with an effective and reliable breech-loader firing self-contained metallic-cased ammunition. Then they replaced that rifle with a reliable bolt action repeater utilizing cartridges firing smokeless powder.

While the Army may have shifted responsibility for the development and acquisition of small arms away from Ordnance in the 1960s, the conservative tendency to stick with the currently issued weapon and ammo despite indicators that it is time for a change are still apparent. As long as this attitude persists, American soldiers will continue to face a hostile world with yesterday's weapons when better alternatives are available. Whether the factors which force acquisition authorities to maintain the status quo are due to financial restraints, politics, or that sense of innate conservatism that many have leveled against the Ordnance Department of the 19th and first half of the 20th Centuries, it continues to place America's fighting men and women unnecessarily in harms way.

While numerous parties continue to make allegations about the failure of the Trapdoor Springfield at the Battle of Little Big Horn, battlefield archeology suggests that the majority of these accusations are at best misguided. Major Reno and those that followed suggested that the Springfield was prone to jamming and this may have contributed to Custer's defeat. Others state that Custer and the 7th Cavalry may have stood a better chance had they carried repeaters. The evidence, however, suggests that the troopers of the 7th had either expended or nearly expended the quantity of ammunition carried into the fight before being over-run. Short of the unlikely prospect of Custer ordering his troops to carry a greater quantity of ammunition, repeaters would have been useless once they exhausted their supply of ammunition. The issue of weapons jams during the period revolved largely around the use of copper for cartridge cases and the substitution of brass for copper largely resolved the issue. Had Custer's troops still been issued copper cased ammunition it is likely that the jamming problem would have occurred regardless of the weapon carried by his troopers.

Likewise, the animosity shown the 1892 Board and its decision to adopt the Krag is largely misplaced. By most accounts, soldiers found the Krag to be more than satisfactory. The Krag possessed one feature the Board felt offered a distinct advantage, but this was not the magazine cut-off which was a requirement for all rifles submitted for consideration. Due to its unique magazine arrangement, soldiers could reload the Krag while the bolt remained closed and a round chambered. If any measure can show that the Board demonstrated bias in any fashion, it was the requirement instituted by the subsequent board on American weapons that any weapon submitted also possess this capability. While the designers involved managed to meet the requirements established

by the Board, they declared all 14 designs unsuitable due to mechanical defects cited the chapter four endnotes.

The various rifle boards which followed the 1872 Board for Selecting a Breech-System employed the same extensive testing protocols established by the Terry Board of 1872. These exhaustive protocols do not seem to favor, through either organization or employment, any weapon with the exception of one which is significantly more reliable, robust, accurate, and capable of rapid fire than any other weapon submitted. Based on the reports of board testing and subsequent field trials it would appear that the various boards did their best to ensure that the Army had the best rifles and carbines available within the economic and political constraints imposed on it. Despite the removal of the Army Ordnance Corps from small arms development, production, and acquisition in the 1960s, these factors continue to plague efforts to ensure that American soldiers have the best weapons available.

Matthew Cox has written several recent articles regarding small arms acquisition and the roadblocks faced by those who would replace the M16 family of weapons. In the 7 May, and 28 May 2007 issues of *Army Times*,¹ Cox wrote a pair of articles reflecting U.S. Senator Tom Coburn's (R, Oklahoma) calls for a replacement for the M4. Coburn questioned the Army's decision to adopt the M4 as the standard Army rifle and the continued purchase of this system. The Senator stated that, "There is nothing more important to a soldier than [his] rifle, and there is simply no excuse for not providing our soldiers the best weapon – not just a weapon that is 'good enough.'"² It is hard to contradict this statement with the positions held by the Ordnance Department of the 19th century or similar arguments employed today's small arms acquisition officials.

¹Matthew Cox, “Skirmishes over the M4,” *Army Times*, 28 May 2007; and “Senator wants gun makers to compete to replace M4”, *Army Times*, 7 May 2007.

²Matthew Cox, “Senator wants gun makers to compete to replace M4”, *Army Times*, 7 May 2007.

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