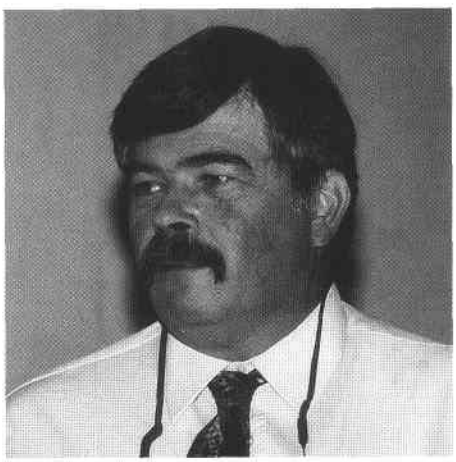
Federal Ammunition for Civil War Breechloading Carbines and Rifles

Dean S. Thomas

According to the "Statement of ordnance and ordnance stores purchased by the Ordnance Department from January 1, 1861, to June 30, 1866," the United States Army procured more than 427,000 assorted breechloading carbines and rifles during this period.[1] Additional quantities were purchased from the manufacturers by various Northern states, volunteer regiments, and individual soldiers. In all, more than twenty different brands found their way onto regimental ordnance returns, and each, with rare exception, required their own peculiar form of ammunition. Captain James G. Benton of the Ordnance Department described these weapons in his book, *Ordnance and Gunnery*:

> The term "breech-loading" applies to those arms in which the charge is inserted into the bore through an opening in the breech; and, as far as loading is concerned, the ramrod is dispensed with.
>
> The *interior* of the barrel of a breech-loading arm is divided into two distinct parts, viz., the *bore* proper, or space through which the projectile moves under the influence of the powder; and the *chamber* in which the charge is deposited. The diameter of the chamber is usually made a little larger, and that of the bore a little smaller, than that of the projectile; this arrangement facilitates the insertion of the charge, and causes the projectile to be compressed, and held firmly by the lands in its passage through the bore. This operation is called *slugging* the projectile. The bottom of the grooves and the surface of the chamber are generally continuous.
>
> The distinguishing feature of a breech-loading arm is the method of closing the breech. The systems at present used may be referred to two classes—those with *moveable* chambers, and those with *fixed* chambers.
>
> The moveable chamber is formed in a separate piece from the barrel, and the joint, or opening, is necessarily in front of the charge; the fixed chamber is formed by counterboring the bottom of the bore, and the opening is in rear of the charge. As a general rule, the mechanism of the fixed chambered pieces is stronger and simpler than that of moveable chambered pieces, and is, therefore, to be preferred, for military purposes.[2]

Henry II of France is credited as the inventor of breechloading arms in 1540.[3] At that time and into the subsequent flintlock and percussion periods, the development of a superior breechloading weapon was greatly hampered by gas leakage at the breech joint—or lack of obturation. This fault was mechanically inherent in many early breechloaders, but was not successfully overcome until there were advances in cartridge-making technology. Although the Hall breechloading flintlock rifle was adopted by the United States in 1819 (and a carbine in the 1830s), they did not have the merits of later weapons with metallic cartridge cases.



Most of the early advances in breechloading ammunition were made in France. In 1826 Cazalat made a cartridge from a single sheet of metal and contained a center-fire primer. In 1834 Robert introduced the first rimfire ignition. Houllier invented the "modern" pinfire cartridge in 1846. Nevertheless, despite this progress, by 1860 only a small number of breechloading weapons had been issued or adopted by the American or European armies. In Prussia part of the infantry was armed with the needle gun, in Norway and Sweden the breechloader was partially introduced, and in France the Cent Guards were so armed.

During the 10 years before the Civil War, the federal Ordnance Department purchased some 9,140 assorted breechloading carbines and rifles for experimentation and issue to mounted troops. Of significance were Sharps, Greene, Merrill, Maynard, Joslyn, Burnside, and Smith patented arms. Many of these weapons would see cavalry use during the war, but their introduction as infantry arms was not a foregone conclusion. One proponent in the military was Lieutenant (and later Confederate Major General) Cadmus M. Wilcox, who wrote in 1861:

> The facility of breech-loading gives great rapidity of fire, and consequently would strengthen the weak, by enabling them to

Reprinted from the American Society of Arms Collectors Bulletin 78:3-19
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deliver a greater quantity of fire upon a too powerful adversary. It cannot be denied, that in many instances breech-loading would be preferable to ordinary rifles; the cannoneers of field-artillery, if armed with breech-loaders, would be more capable of defending their batteries from the attacks of infantry and cavalry; engineer troops, in trenches and in mining, as well as their guards, would make a better defence with breech-loading arms in cases of surprise; escorts to supply trains could use them to advantage in cases of sudden attack or ambuscade, &c., &c.

It cannot be denied that the breech-loading arm inspires more confidence in the individual, and gives him a superiority over his adversary, if not similarly armed. In the defence of forts, block-houses, trenches, breaches, bridges, defiles, and in fact, *in all cases* where rapidity of fire should compensate for paucity of numbers, the breech-loader would be preferable. With the many advantages thus offered, it is perhaps strange that breech-loading arms have not been more generally introduced into service. The influence of a fire of a few regiments of infantry armed with breech-loaders, at critical periods of an action, could not fail to be decisive; and the army that has such corps with it must be more efficient. The objections to, or defects of breech-loading arms, are, that they are complicated in their mechanism, are liable to get out of order from fouling, or escape of gas at the joints, want of strength; and, as the facility of loading gives great rapidity of fire, it is asserted that in battle, under the influence of excitement, the soldier would load and fire without reflection, or without the orders of his officer, and when the decisive moment should arrive, he would have exhausted his ammunition. The facility of fire, which is the greatest advantage of the system, is thus made to appear to be its greatest inconvenience. The future will determine whether or not the breech-loading arm is to be more generally introduced into service, or to be abandoned.[4]

Of course, the system was not abandoned; however, many people would now argue, based on 20th century hindsight, that breechloaders should have been fully adopted by all branches of service in April 1861. This argument becomes moot if one considers the totality of every question or challenge that presented itself to the Chief of Ordnance and the Ordnance Department on just this one issue. With Colonel Henry K. Craig's retirement on April 23, 1861, the matter devolved upon Brigadier General James W. Ripley. For Ripley's consideration were the following:

1. How long was the war going to last?
2. How many weapons would be needed? 75,000? 300,000? 1 million?
3. Should the National Armory re-tool to make breechloaders? How long would that take?
4. What weapon or system should Springfield make?
5. Should the Ordnance Department purchase the guns? Which type? More than one type? What better idea will be offered next week?
6. Were the private armories sufficiently tooled to make large quantities of weapons? If they were not, how long before they could get the necessary machinery? How many guns can they make now?
7. Who would supply the ammunition? The federal arsenals? Private manufacturers?
8. Would some forms of ammunition require special tooling to make in quantity? How long would that take, regardless of who made it?
9. Had all of the different breechloading systems and ammunition been tested and tried in the field?
10. What was the comparative expense of muzzleloading vs. breechloading weapons and ammunition?

On December 9, 1861, Ripley put forth some of his opinions about certain breechloaders when he wrote to then Secretary of War Simon Cameron:

Ordnance Office
Washington,
December 9, 1861

Hon. Simon Cameron,
Secretary of War:

Sir: As directed from the War Department, I have examined the reports upon the Henry and Spencer guns accompanying the proposition to furnish these arms to the Government, and have also examined the arms. Both of them are magazine arms; that is to say, they have the cartridges for use carried in a magazine attached to or forming part of the arm and fed out by a spiral spring. They require a special kind of ammunition, which must be primed or have the fulminate in itself. The reports heretofore made are favorable, so far as the limited trials went, but they do not go farther than to suggest or recommend the procurement of a sufficient number to place in the hands of troops in the field for trial. Indeed, it is impossible, except when arms are defective in principle, to decide with confidence, in advance of such practical trials, on their value, or otherwise, as military weapons. I regard the weight of the arms with the loaded magazine as objectionable, and also the requirement of a special ammunition, rendering it impossible to use the arms with ordinary cartridges or with powder and ball. It remains to be shown by practical trial what will be the effect on the cartridges in the magazine of carrying them on horseback, when they will be exposed to being crushed or marred possibly to such an extent as to interfere with their free passage into the barrel, and whether they will be safe for transportation with the fulminate in the cartridge;

also, what will be the effect on the spiral spring of long use and exposure in the field. I do not discover any important advantage of these arms over several other breech-loaders, as the rapidity of fire with these latter is sufficiently great for useful purposes without the objection to increased weight from the charges in the arm itself, while the multiplication of arms and ammunition of different kinds and patterns, and working on different principles, is decidedly objectionable, and should, in my opinion, be stopped by the refusal to introduce any more unless upon the most full and complete evidence of their great superiority. In view of the foregoing, of the very high prices asked for these arms, and of the fact that the Government is already pledged on orders and contracts for nearly 73,000 breech-loading rifles and carbines, to the amount of $2,250,000, I do not consider it advisable to entertain either of the propositions for purchasing these arms.

Respectfully, your obedient servant,

Jas. W. Ripley,

Brigadier-General[5]

Knowing what we now know about the final outcome of the war, and the superiority of Henry and Spencer carbines and rifles, and their rimfire ammunition, we are free to criticize Ripley for not ordering or tooling to make huge quantities of these weapons. But, reasonable people cannot deny that he chose a wise fiscal policy. Not having any idea of the length or magnitude that the American Civil War would become, Ripley placed muzzleloaders in the hands of the infantry and ordered more made, or acquired, in the North and abroad, of what he could get quickly to arm the growing ranks. Contracts were made "for nearly 73,000 breech-loading rifles and carbines" for the cavalry, of which almost 19,000 were delivered by the end of 1861. That the Commission on Ordnance and Ordnance Stores concurred with the Chief of Ordnance was stated by Joseph Holt on May 26, 1862:

> Although the commission consider that they should not make any further recommendation as to the numbers or kinds of revolvers and small arms to be now contracted for, it is proper that they should state that their investigations have shown satisfactorily that the prices paid heretofore for such arms have been unnecessarily high, as well for securing suitable and effective arms for troops as for a fair renumeration to the manufacturer. No one pattern of patent arms has been proved the best, and, as many of them are, as far as known, equally effective, the simplest and cheapest of such arms are the best for the service. The government can establish the grade of work and price when selecting the pattern, and judge very accurately of the true cost to be incurred and the proper price to be paid for it. Excessive charges for special patents, and the erection of large factories to make experimental arms, ought to be discouraged, and the purchase of more than a moderate number, say 1,000 at most, ought not to be made until after satisfactory trial by troops in the field.
>
> The commission respectfully urge, therefore, increased restrictions upon the multiplication of patterns of arms for use in service:
>
> 1. That the sample arm shall be tried, by competent officers, in comparison with the best in use; that it shall be proved superior in essential qualities, or in probable cheapness of manufacture, to such.
> 2. That after a sample has been approved, as above, 1,000 be ordered for trial by troops, and that no larger numbers be ordered until satisfactory trial has been made by them.
> 3. That general orders be given requiring all captains of companies to report quarterly to the chief of ordnance the kind of arms in use by his company; his opinion of the suitableness of the arm and the general extent of service, and the number requiring repairs since last report. Such reports, if regularly and carefully made, would best check the purchase of unsuitable arms, and soonest show the best and strongest for service.[6]

Nevertheless, 10,000 Spencer breechloading rifles had been ordered "by direction of the Secretary of War" Simon Cameron on December 26, 1861. In a compromise, this quantity was modified by the Holt Commission to 7,500 rifles because no deliveries were made as of May 31, 1862. In fact, the first delivery on this army contract was not made until December 31, 1862; however, by June 29, 1863, a total of 7,502 were delivered. On July 13, 1863, the first contract for Spencer carbines was given out. The quantity ordered was 11,000, but none were delivered until the initial 1,000 on October 3, 1863.[7] That Spencer rifles and carbines did prove their merits on the battlefield eventually led the Ordnance Department to a standardization of a carbine caliber and the decision in May 1864 to purchase all that the Spencer factory could produce from May 24, 1864, to September 1, 1865, and all of the Spencer carbines that the Burnside Rifle Company could produce from June 27, 1864, to August 31, 1865.

Surely the public supported these decisions. *The Scientific American* editorialized on March 19, 1864:

> Breech-loading Small-Arms
>
> There is no subject of more pressing or of more lasting importance to the Government and people of this country than the arming of our infantry with breech-loading rifles. It

was the great aim of Napoleon Bonaparte to train his soldiers to very rapid loading and firing: and able military critics attribute to his success in this effort the irresistible power of his armies. Experience, however, has developed the astounding fact that, when soldiers load and fire in such haste, their aim is so careless that they do not hit a whole regiment once in 200 shots!

Now, a breech-loading rifle can be loaded and fired more than 30 times faster than a muzzle-loader, and it can be fired at least five times more frequently with all of the movements made with the utmost deliberation. It is altogether probable that a soldier with a breech-loading rifle will fire 5 times as many shots in an hour as one with a muzzle-loader, and that 10 times as many of the shots will prove effective thus increasing the offensive power of the soldier 50 fold.

The superiority of breech-loading small-arms, so manifest in theory, has been confirmed by large and varied experience. The Spencer, the Burnside, and other breech-loading rifles have been extensively used in this war, and have everywhere won the warmest approval of both officers and privates.

The nation is making very great efforts, and expending enormous sums of money to send additional hundreds of thousands of men to our armies. Every one of these soldiers, when ready for service, costs very nearly $1,000. By the expenditure of $5 or $10 additional for his gun, one-half or one-third of the number of soldiers would be equally efficient.

We should like to see sufficient judgment and decision at the head of the War Department to stop, at once, the manufacture of muzzle-loading small-arms, and to devote the whole power of our armories to the production of breech-loading rifles.[8]

Retooling the National Armory to make breechloading arms, of course, would not occur until after the Civil War. In the meantime, myriad breechloaders would be used. The 1862 edition of *Ordnance and Gunnery* taught West Point cadets the advantages and disadvantages of breechloading arms:

> The advantages of breech-loading over muzzle-loading arms are: 1st. Greater security from accidents in loading; 2d. The impossibility of getting more than one cartridge in the piece at the same time; 3d. Greater facility of loading, under all circumstances, and particularly when the soldier is mounted, or is lying upon the ground; 4th. The security with which the charge is kept in its place when the piece is carried on horseback with the muzzle down.
>
> The disadvantage of breech-loading arms is the complicated nature of the machinery, and their consequent want of strength and solidity when subjected to rough usage. It cannot be denied that, in spite of this disadvantage, breech-loading arms are steadily progressing in favor for the mounted service, and in some European services they are used, to a certain extent, by foot troops of the line.[9]

By the 1883 edition of the course book, breechloaders had more advantages and no disadvantages:

> The advantages of breechloading over muzzle-loading arms are: 1st. Greater certainty and rapidity of fire; 2d. Greater security from accidents in loading; 3d. The impossibility of getting more than one cartridge into the piece at the same time; 4th. Greater facility of loading under all circumstances, and particularly when the soldier is mounted, or lying upon the ground, or firing from behind a cover; 5th. The greater security with which the charge is kept in place when the piece is carried on horseback with the muzzle down.
>
> The results of the late wars in this country and Germany have led to the introduction of breech-loading small-arms for all branches of military service.[10]

The 1862 edition of *Ordnance and Gunnery* also gave the cadets a brief historical narrative on successful obturation in breechloaders:

> One of the most serious defects of breech-loading arms was the escape of gas through the joint; this not only incommoded the soldier and his comrades, but seriously interfered with the working of the machinery, and the accuracy and force of the fire. The great attention that has been paid to the subject of breech-loading arms, in the last few years, has led to an improvement which entirely removes this defect, and this consists in closing the joint at the moment of discharge, by the action of the gas itself. This operation, which is called "packing the joint," is now accomplished in a variety of ways, all of which may be divided into two general methods: 1st. By the use of a cartridge-case of sheet-brass, India-rubber, or other material; 2d. By the use of a thin elastic ring of metal which overlies the joint. By the first method, the case is permanently distended, and some arrangement is required to remove it from the chamber. Generally speaking, the case is not so much injured but that it can be safely used for several fires. In the second method, the ring, or *gas-check*, is a part of the arm; and its elasticity causes it to return to its original form after the discharge.[11]

Ammunition for Civil War era breechloading carbines and rifles ran the gamut from simple to complex and may be divided into two general classes: externally primed as with flint and steel or percussion primers, and internally primed that was self contained with primer, powder, ball, and case all together in one piece. Regardless of the priming or type of chamber, the one essential characteristic for breechloading ammunition to be effective was that the bullet diameter be larger than the bore diameter. Therefore, too, the chamber diameter was larger than both the bullet and the bore.

Externally Primed

This class of breechloading ammunition included a vast number of different cartridge types, many of which were patented. The most fundamental were the paper cartridges for the Hall carbines and rifles. The rounds were loaded into the moveable chamber as if it were a muzzle-loading arm. The cartridge was opened to expose the powder which was poured into the chamber. The powder charge was then topped by the round ball still wrapped in the cartridge paper, or a naked ball was inserted on the powder and wadded in place with the cartridge paper. Most of the early breechloading weapons provided this means for charging the arm, and although they were quite an improvement over muzzle loaders in regard to ease of loading, many lacked obturation.

A more successful way to speed up the loading process was to load the powder and bullet in one motion as a whole cartridge and then to ignite the charge with an external, percussion primer. Inventors and manufacturers of breechloading arms and ammunition went about this in a variety of ways, which will be detailed later. But this proprietary approach meant that few cartridges for one gun could be used in another, and it increased the number of different kinds of cartridges that the Ordnance Department had to order and inventory.

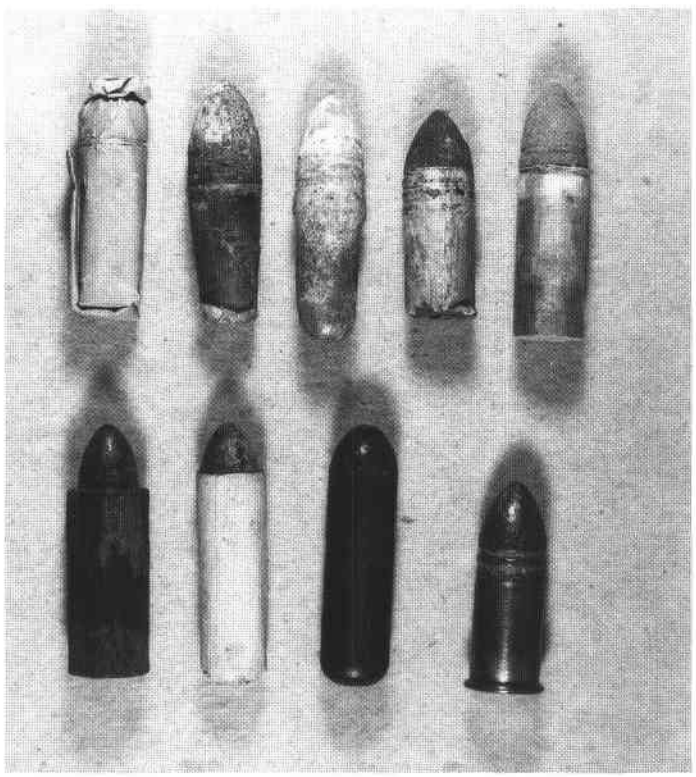

Figure 1. Top row: externally primed cartridges of various case materials. (Left to right) Paper cartridge (Hall), nitrated paper (Colt), collodion covered (Sharps), paper (Merrill), linen (Sharps). Bottom row: India rubber (Smith), metal foil and paper (Gallager), drawn brass (Gallager) and internally primed Spencer rimfire.

Externally primed cartridges had powder cases made of nitrated paper, animal skin membrane, collodion-covered or shellacked pressed powder, linen, India rubber, metal foil and paper, and drawn brass. Depending on the exact makeup, these cartridge cases were glued, tied, crimped, or held by friction to the bullets. After ignition, except for some of the truly combustible types, all or parts of the cases had to be removed from the chambers of the weapons before the next cartridges could be inserted. Not as important to a soldier on the battlefield as it was to a sportsman, but many of these cartridge cases were reusable.

Even though they provided ease of loading, none of the combustible cartridges fired in breechloaders could be successful obturators by themselves, and many of the weapons using these cartridges had poor gas checks. In addition, combustible rounds were inherently susceptible to moisture and breakage. Cartridges with cases made of rubber, foil and paper, and drawn brass were designed to expand upon ignition and help to seal the breech. While all of this class provided ease of loading and most were substantially stronger than combustible cartridges, some of them were better than others at preventing gas leakage, and in some weapons the fired case was difficult to remove from the chamber.

Internally Primed

At the time of the Civil War, several forms of internally primed cartridges had been invented. Many of these self-contained cartridges have been called "patent ignition" and were used in several different kinds of weapons; however, the only form of internally primed ammunition purchased during the war by the federal government for breechloading carbines and rifles was the rimfire.

After a lengthy process that lasted a little more than a year, Horace Smith and Daniel B. Wesson of Springfield, Massachusetts, were granted Letters Patent No. 27,933 for an "Improvement in Filling Metallic Cartridges" dated April 17, 1860. This improvement was the essence of the modern rimfire cartridge that contained the primer, powder, ball, and case together in one compact unit. The cases were formed from a single disk of sheet copper in a series of drawing presses. Fulminate was spun into the outer recesses of the annulus or rim at the base of the case. The appropriate powder charge was inserted and the bullet crimped to the open end of the case, making a waterproof seal. In operation, the hammer or a firing pin struck the rim of the cartridge, which inflamed the fulminate and in turn the powder charge. Most of the weapons employing rimfire ammunition were excellent at providing facility of loading and obturation. These arms are found both single shot and repeating. In the

former the cartridge was inserted by hand and in some designs the empty case was extracted mechanically. The repeaters were equipped with mechanisms to load the round and eject the spent case. The empty cases for the most part could not be reused.

One aspect of Civil War era breechloading ammunition that caused some minor confusion, then and now, was the nonstandard method of marking the cartridge packages. Although most manufacturers stated the caliber and make of weapon for which the rounds were intended, others named only the gun and not the caliber. And then, there were those who identified the weapon without caliber, but gave the bullet's diameter. Perhaps the most trying description was that of the "No. 56" Spencer cartridge. This cartridge was to be used in the .52 cal. Spencer rifle and carbine, and other weapons. Nominally, the bullet was .540" in diameter. The "No. 56" nomenclature is explained by the fact that the outside diameter of the case has a nominal measurement of .560".

During the war, the federal government made in its arsenals approximately 56,781,000 cartridges for breechloading carbines and rifles.[12] In addition, the Ordnance Department ordered from private manufacturers more than 166,841,000.[13] This 223,622,000 total number does not include those cartridges produced or purchased by various Northern states,[14] but we cannot argue that it was an impressive amount of work.

Examples of federal ammunition for Civil War breechloading carbines and rifles will be presented alphabetically by method of priming, beginning with externally primed:

BURNSIDE: The Burnside carbine with moveable chamber was patented in 1856. The original cartridge, of which no specimens are known, had a straight tapered case without the Foster-patented "swell." Foster's improvement consisted "*in making* the cartridge-case with a recess or grease-chamber within its projecting bead, which serves to close the joint of the breech of the gun."[15] Cartridges with the Foster improvement were initially 2.55" in overall length; however, in 1859 the case length was shortened to accommodate a reduction of 10 grains in the powder charge. Both the Watervliet and Frankford Arsenals were ordered to produce 50,000 each of this third form of Burnside cartridge. Its appearance was to be unmistakable, and Col. H. K. Craig wrote about it to Bvt. Major P. V. Hagner at the Frankford Arsenal on February 10, 1860:

> . . . The old Cartridge case being longer than necessary to contain a maximum charge of powder, it was reduced in length, this involved the necessity of a corresponding change in length of chamber, or receiver of this carbine, and to avoid confusion in the use of ammunition, so nearly similar in appearance, but so essentially different in form, the tinning was adopted for the cases of the new Gun. This method for distinguishing the Cartridges is a good and cheap one, I think should be adhered to while we have Carbines of the old Model in the field and probably no longer. . . .[16]

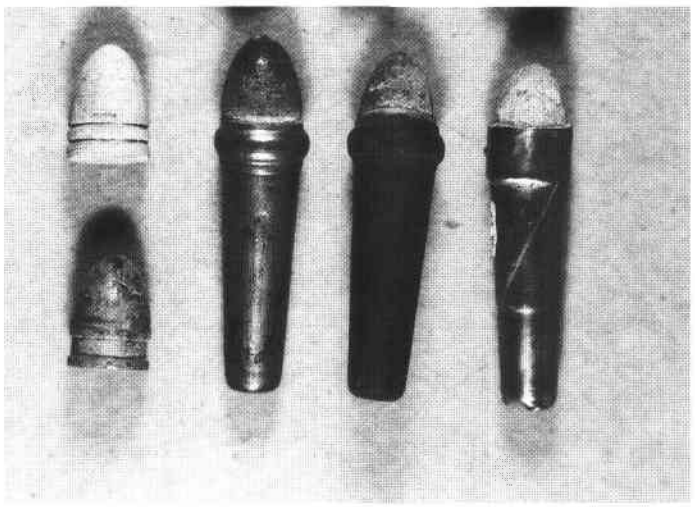

Figure 2. Burnside: standard bullet and modified ball of 1864, "tinned" case cartridge, common cartridge, and "Poultney's Metallic" cartridge.

The tinning, which added $1.00/m to the cost of the cases, was dispensed with when the Ordnance Department began ordering cartridges from the Burnside Rifle Company in October 1861. In all, the Company supplied more than 20 million cartridges during the war.[17]

In April 1864, to increase the supply of Burnside cartridges, lower the cost (then at $24.00/m), and discourage the current monopoly with the Burnside Rifle Company,

Figure 3. Burnside packaging: early "green" label (top left), common by Burnside Rifle Co. (top right), "Poultney's Metallic" (bottom left), and plain unlabeled probably by Watervliet Arsenal.

General George D. Ramsay ordered the Watervliet Arsenal to produce 1 million cartridges.[18] However, the Ordnance Department quickly learned why Burnside cartridges were not delivered as fast as they would like and were so expensive—there was only one manufacturer in the country producing cases. The firm of Wallace & Son of Ansonia, Connecticut, was working to their full capacity, and the Burnside Rifle Co. was taking all the cases they could make.[19] In a compromise, it was agreed that Wallace would ship Burnside the first 30,000 cases of daily production and the balance to Watervliet.[20] This did allow the arsenal to fabricate 322,000 cartridges during the remainder of the year.[21]

Not desiring to lose their cartridge business, the Burnside Rifle Co. conceived of an idea "to cheapen and improve" their cartridge.[22] Initially, the thought was to modify the ball to use less lead, and to eliminate the Foster swell from the case.[23] Ordnance Department tests proved inconclusive, but Ramsay agreed to accept 300,000 cartridges with modified balls only.[24]

Another type of Burnside cartridge was tested and ordered by the Ordnance Department in 1864; however, none of the 2 million purchased was delivered by the middle of April 1865.[25] These cartridges were the so-called Poultney's Metallic or Poultney's Wrapped Soft Metal and were produced under one of Silas Crispin's patents dated December 15, 1863, and assigned to Thomas Poultney of Baltimore, Maryland. The Poultney cartridge was ostensibly intended to save the government money by replacing the drawn brass case with one made by wrapping a sheet of brass on a mandrel. The cartridge contained the same charge and ball as the regulation cartridge, but the case was without the swell. The brass foil case expanded by the explosion to "pack the joint" and take the shape of the chamber, so much so that a fired case looked like an unfired standard case.[26]

All forms of Burnside cartridges were ignited through a small hole or orifice in the base or bottom of the case.

COLT: During the Civil War, the federal Ordnance Department made or purchased cartridges for three different calibers of Colt Revolving Rifles, viz.: .44, .50, and .56. Those rounds supplied by the Colt Patent Firearms Manufacturing Co. were all produced in the same fashion and consisted merely of nitrated paper cases glued to the balls and then charged with powder. Five or six cartridges were packed in a paper label-covered, drilled wooden block.

In addition to Colt, the Army bought patented compressed .56 cal. rifle cartridges from the Hazard Powder Co., and as yet unidentified .56 cal. rifle cartridges from the New York firm of Johnston & Dow.[27] It is possible that the J & D cartridges looked just like their patented rifle musket cartridges; however, no packaging is known.

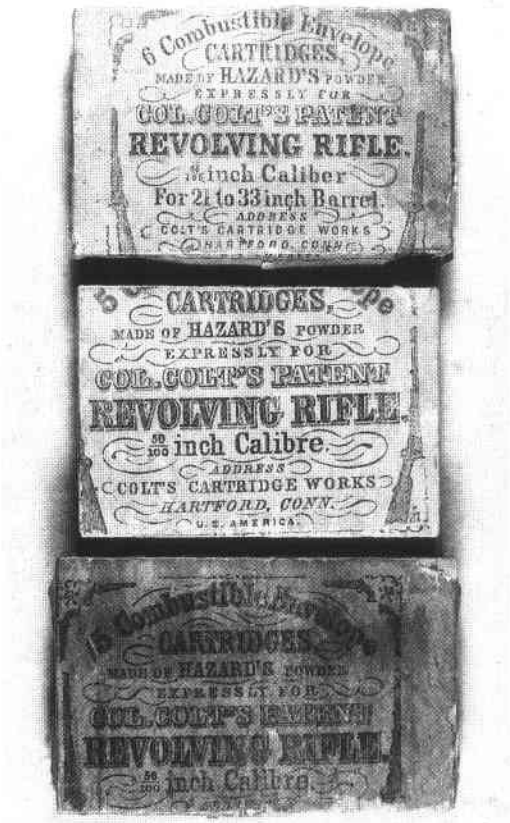

Figure 4. Colt's Cartridge Works packaging for revolving rifles: .44 cal. (top), .50 cal. (middle), and .56 cal. (bottom).

Only two federal arsenals fabricated Colt Revolving Rifle cartridges.[28] In 1861, the Allegheny Arsenal produced 200,000 .44 cal., and from 1862 through 1864 the St. Louis Arsenal produced more than 2 million .56 cal. Unfortunately, neither of these two arsenal-made rounds has been identified.

COSMOPOLITAN: The .52 cal. Cosmopolitan fixed chamber carbine was patented in 1860. Initially, it probably employed a combustible paper-cased cartridge not unlike the Colt, but the solid base bullet was without grooves. The more than 5 million cartridges supplied during the war by Gwyn & Campbell, owners of the Cosmopolitan Arms Co., have not been identified by a labeled package. To add strength to the cartridge, it appears that some were wrapped with linen. A third variety had a simple wrapped linen case closed with a piece of thin paper. The 1,204,000 cartridges produced by the St. Louis Arsenal in 1864 were of this latter type.[29]

GALLAGER: The .50 cal. Gallager percussion carbine was also patented in 1860. Its construction was such as to produce a joint between the barrel and breech, nearly midway of the length of the cartridge and chamber. The original cartridge to be used with the gun was "composed of an ordinary paper case, having a ring of sheet tin wrapped

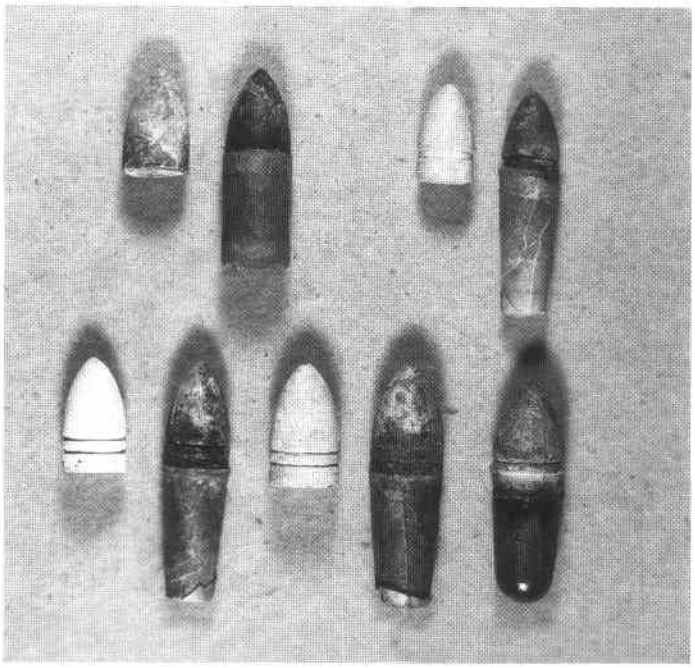

Figure 5. Top row: Cosmopolitan ball and cartridge, .44 cal. Colt revolving rifle ball and cartridge. Bottom row: .50 cal. and .56 cal. Colt revolving rifle balls and cartridges, and .56 cal. cartridge by Hazard Powder Co. (far right).

Figure 6. Gallager packaging: Poultney's (top), Jackson's (bottom).

around it with its edges overlapping."[30] The cartridge proved a complete failure because of the escape of gas at the joint and the difficulty of removing the metal ring from the barrel.

Richardson & Overman, the Philadelphia-based manufacturers of the carbine, then devised what they called the "solid brass tube" cartridge. This cartridge is essentially made like the Burnside except for the shape. The drawn brass case had an ignition orifice in its base and it was merely a container for the powder and ball. More than 4 million of these cartridges were ordered by the Ordnance Department from Richardson & Overman,[31] who in turn contracted with two men by the names of Lewis Lewis and Samuel Jackson to actually fabricate the rounds.[32] Although the brass tube cartridge did prevent the escape of gas at the joint, the fired case was found to be extremely difficult to extract, even with the use of a special appendage. In addition, these Gallager cartridges were comparatively expensive at $25.00/m.

The Ordnance Department faced a dilemma by early 1864, with more than 17,000 carbines having been delivered. So, after a series of trials, two other forms of Gallager cartridges were approved and purchased. One was the Poultney's Metallic wrapped paper and sheet brass-cased cartridge and the other was Jackson's wrapped paper and sheet tin-cased cartridge. The differences are admittedly subtle and were contested at the Patent Office, but both forms received protection.

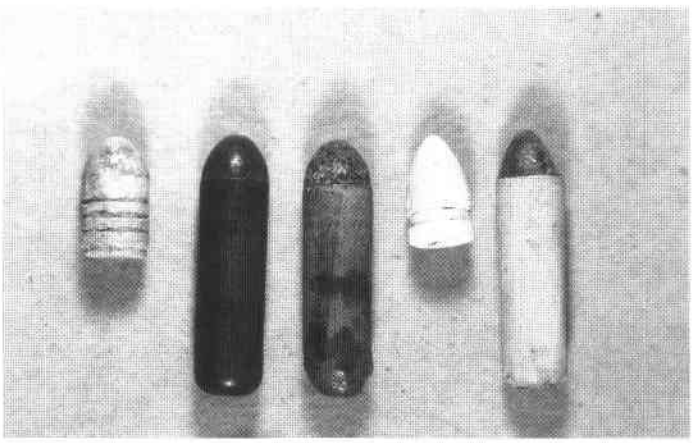

Figure 7. Gallager brass case ball and cartridge, Jackson's patent cartridge, and Poultney's ball and cartridge.

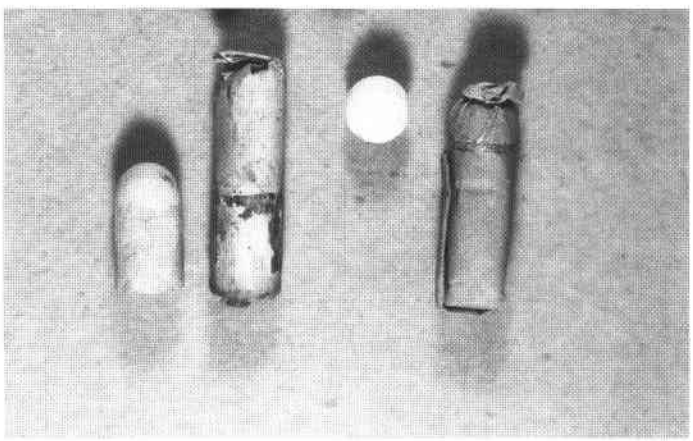

Figure 8. Greene ball and cartridge and Hall round shot and cartridge.

GIBBS: When the Gibbs carbine was tested at the Washington Arsenal in 1855, it fired a simple round ball, but according to Major William H. Bell, "This arm is considered the best breechloading arm I have yet seen."[33]

Only 1,052 weapons had been delivered on an order for 10,000 carbines when the factory was burned in July 1863 during the New York City draft riots. The federal government did not make or purchase any ammunition specifically for the Gibbs carbine, because it was determined, according to Chief of Ordnance Ripley, that "these carbines . . . use the same ammunition as Sharps."[34] At this time, the standard Sharps cartridge had a wrapped linen case glued to the ball and closed with a thin piece of paper.

GREENE: Nine hundred Greene breechloading, bolt action rifles were ordered and delivered to the Ordnance Department in early 1863. The weapon used an unusual charging system and cartridge patented in 1857. The paper, Enfield-like cartridge consisted of a felt wad, a "reversed" solid base ball, the powder charge, and was lubricated on the outside of the paper case around the ball end. The initial firing of the rifle could be done in one of two ways: a cartridge was loaded powder end first and a "blank" was discharged leaving the "joint packing" or obturating bullet and wad in the chamber. The bolt was withdrawn and another cartridge was inserted, again powder end first, behind the ball in the chamber. When the bolt was closed, the ball from the first fire was forced foremost followed by the new cartridge containing powder and ball, in that order. The gun was now ready for a "live" fire. The second method of loading required merely that the patched ball and wad be separated from the cartridge, disposing of the powder, and inserted in the chamber before a whole round.

A small quantity of 11,760 cartridges was delivered by representatives of the rifle company in April 1863, as well as 162,000 cartridges from Johnston & Dow.[35] The Washington Arsenal was directed to fabricate 150,000 Greene cartridges,[36] but may have produced as few as 62,000.[37]

Not all Greene cartridges have the felt wad and, unfortunately, none of the surviving specimens have been identified from labeled packages.

HALL: In an interesting series of arrangements, the U.S. Ordnance Department, through General John Fremont, repurchased in September 1861, some 5,000 Hall carbines sold as obsolete only the month before.

As mentioned earlier, the Hall used a .52 cal. round ball and paper cartridge similar to, and made like, standard muzzleloading musket ammunition. In addition, the moveable chamber was loaded in the same fashion as a muzzleloader with loose powder from the opened cartridge and then the wrapped ball or wadded bare ball to keep it in place.

An 1864 document in the National Archives' Records of the Chief of Ordnance states that 60,000 Hall carbine cartridges were purchased in 1861, however, the supplier was not identified.[38] All other Hall cartridges needed during the war were made at the Allegheny Arsenal (200,000) and the St. Louis Arsenal (1,482,000).[39]

LINDNER: The 1859 patented Lindner carbine with its moveable chamber was not unlike the Hall, but a special .58 cal. cartridge was designed to be used with it. The cartridge, affectionately called the "stopper" cartridge, was patented in 1861 and reissued in 1863. A paper case was first glued and wrapped around the bullet to receive the powder charge. Before closing the open end, a plug or stopper of cotton yarn was inserted to meet the powder, and the end of the paper case was twisted to keep it in place. In charging the carbine, the plug was removed from the cartridge with the teeth to expose the powder to ensure ignition and the remaining materials were inserted whole in the chamber. This cartridge was adaptable to other weapons, and according to Lindner, some of its merits were that, "The powder cannot become wet from the mouth or wasted except by carelessness; neither does the powder get into the mouth to add to the excessive thirst usual with soldiers in battle."[40]

Only a total of 140,000 carbine cartridges was purchased from Edward Lindner in 1861 and 1863[41] for use in the 892 weapons delivered to the army.

MAYNARD: The form of the most common Maynard carbine cartridge case is contained in Dr. Edward Maynard's patent of January 1859. The case consisted of a drawn brass

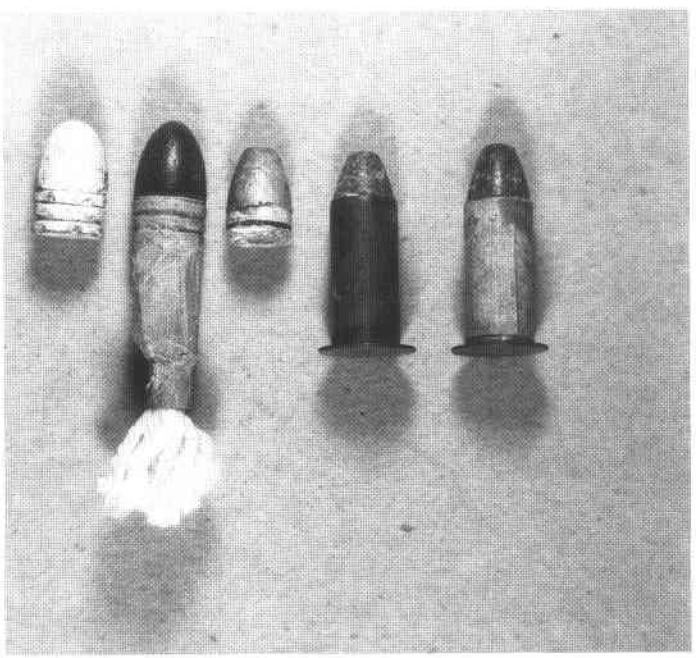

Figure 9. Lindner carbine ball and rifle musket cartridge, Maynard brass case ball and cartridge, and Poultney's cartridge for Maynard.

cup with a flat bottom to which was soldered a larger diameter circular brass disk, however, it should be noted that the patent specifications specifically mentioned a steel disk. After the two pieces were united, a small hole was drilled through the center of the disk and bottom of the cup. As in other externally primed metallic cartridges, this vent allowed the percussion cap flame to ignite the powder charge. The disk on the case served two purposes: (1) it filled the slight space between the fixed chamber and the breech block to prevent gas leakage and secure a tight joint; and (2) it provided a means to extract the fired case.

A handful of the 400 Maynard carbines purchased by the Ordnance Department in 1857 remained in federal service at the start of the war. To supply these arms with ammunition, and any other .50 cal. Maynards in the hands of state troops, the production of Maynard cartridges begun in 1860 at the Frankford Arsenal was continued. Nearly 5 million cartridges were assembled at Frankford during the war, mostly in 1864 and 1865.[42] The cases were supplied to the arsenal by four different New England firms. This late-war production was intended to fill the ammunition requirements for the 20,000 Maynard carbines ordered in June 1863, but did not start arriving until June 1864.

A Poultney's Metallic cartridge was also designed for the Maynard. Two million of these cartridges were ordered in early December 1864, however, none were delivered before May 1865.[43]

Figure 10. Maynard packaging: Poultney's (top), Frankford Arsenal (middle), and Massachusetts Arms Co. (bottom).

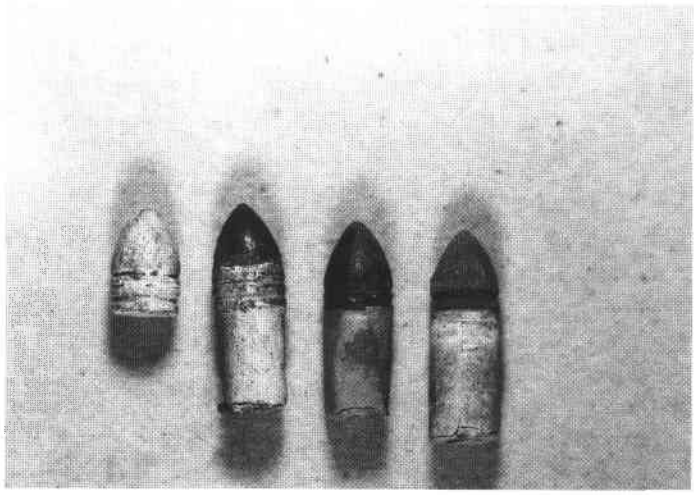

Figure 11. Merrill ball and Patent Fire Arms Mfg. Co. cartridge, "pink" paper cartridge attributed to St. Louis Arsenal, and Washington Arsenal cartridge.

MERRILL: The original Merrill carbine was patented in 1856; however, the design with which more collectors are familiar was improved in 1861. The cartridge for the Merrill was very basic. It consisted of a solid base .54 cal. ball with three grooves to which was pasted a paper cartridge case. After the case was charged with powder, the bottom of the case was folded closed. The percussion cap flame was able to ignite the powder through the side of the case. Both the carbine and a similar breechloading rifle used the same ammunition loaded into the fixed chamber by means of a sliding plunger.

More than 5 million Merrill cartridges were purchased from Merrill, Thomas & Co. and Johnston & Dow during the war.[44] In addition, the St. Louis Arsenal produced nearly 2.5

Figure 12. Merrill packaging: Washington Arsenal (top left), plain unlabeled probably by St. Louis Arsenal (bottom left), and by Merrill Patent Fire Arm Mfg. Co. (top & bottom right).

million and the Washington Arsenal just over 500,000 cartridges.[45]

SHARPS: Christian Sharps' invention enjoyed success in the prewar army, and during the Civil War the Sharps carbines and rifles were second only to the Spencer in the numbers of weapons purchased.[46] The Sharps was popular on both sides of the Mason-Dixon Line.

In 1860, with the adoption of a new model, cartridges for the Sharps were drastically changed. On April 4, 1860, Col. Henry Craig wrote to Capt. F. D. Callender, then at the Benicia Arsenal:

> Sir:
>
> Referring to my letter of Nov. 22nd 1859 I would add, that the Sharps Carbines which are now being received by the Department from the Manufacturers, a portion of them having been sent to the Pacific Coast, are of improved Model, and can be readily distinguished from the old Model by the Swivel under the Butt, and by the square cut off of the Barrel at the Breech, as well as by the Superior workmanship of the Arm. It will however require a different form of Cartridge from that used in the old Model. The two samples accompanied my letter of the above date were made for the new Gun, to be loaded without being sheared, although the Slide is provided with a cutter, that is capable of any portion of the Cartridge which by accident may protrude. The Chamber of the new Gun is shorter than that of the old one, consequently the other cartridge Cylinder must be of greater diameter than that for the latter.
>
> If you do not succeed in making linen or cotton cylinders, they can be made of paper.[47]

The belted bullet for the old-style cartridge is now commonly called the "ringtail" or the "tie ring," the latter being more accurate because a paper powder cylinder was actually tied with thread to attach it to the lower part of the ball. After the cylinder or case was filled with powder, the open end was folded closed with a tail, like standard musket ammunition. In operation, the whole cartridge was inserted into the chamber; however, because of its length, the rear portion of the case including the tail was left protruding from the breech of the barrel. The breech block was equipped with a shear, and when it was raised into firing position, it cut off the end of the cartridge to expose the powder. As mentioned, this method of cartridge fabrication was ordered to be abandoned at the federal arsenals in 1860, but it would be used in parts of the Confederacy during the Civil War. It is also possible that Sharps cartridges produced by the Indiana State Arsenal used the tie-ring balls.

The Sharps New Model of 1859 cartridges were initially made with cases of two fashions, but both used the same .52 cal. ball without the lower ring of lead. Experience with the old style paper cartridges on the frontier had shown the Sharps Rifle Manufacturing Company that their paper cases were "not strong enough to resist the wear and tear of active service."[48] Therefore, from this time forward, all cartridges supplied by the Sharps Company for M1859 and later carbines and rifles were made with linen cases. These cartridges were simply produced. A strip of linen was rolled on a former of the same diameter as the ball, glued, and allowed to dry. In the second step, a small piece of pasted paper was inserted through the linen cylinder from one end to the other to form a flat base. The case was then charged with powder and the open end glued and choked to the ball.

Colonel Craig's discretionary instructions to his arsenals in April 1860, which allowed for cases to be made of linen or paper, followed a natural course. The arsenals had no linen, so they made the Sharps cases of paper until General George Ramsay specifically directed them to stop in January 1864.[49] This action apparently only affected Watervliet and St. Louis, because when Allegheny, Frankford, and Washington were ordered to fabricate Sharps cartridges during the war, they were given linen Sharps Company samples to follow.

Two styles of closure are found on New Model paper cased Sharps cartridges. One method was exactly as described above except that a strip of paper was used instead of linen, and in the second, cartridge paper was pasted around the ball, powder loaded in the cylinder, and the case folded closed with a tail.

Nearly 40 million Sharps cartridges of all types were produced at the federal arsenals during the war.[50] Of this number, more than 25 million were made at Watervliet and almost 10 million at St. Louis. In addition, the Sharps Rifle Manufacturing Company supplied more than 8 million .52 cal. cartridges, and, 6,800,000 more patented and linen cartridges came from D. C. Sage, the Hazard Powder Company, and Johnston & Dow.[51]

While the vast majority of the Sharps carbines and rifles used during the war were .52 cal., the Army Ordnance Department did procure at least 200,000 cartridges for some .56 cal. "Navy" rifles and 10,000 rounds for a small lot of .44 cal. Sharps sporting rifles.[52]

SMITH: Gilbert Smith of Buttermilk Falls, New York, received patent protection for his carbine in 1855, 1856, and 1857. Also, in 1857, he secured a patent for an "Improvement in Cartridges" for his weapon. The cartridge patent was reissued the following year and described

> . . . Making the cartridge-case, or at least the cylindrical portion thereof, of some impermeable and elastic substance, such as India-rubber or gutta-percha, substantially as above

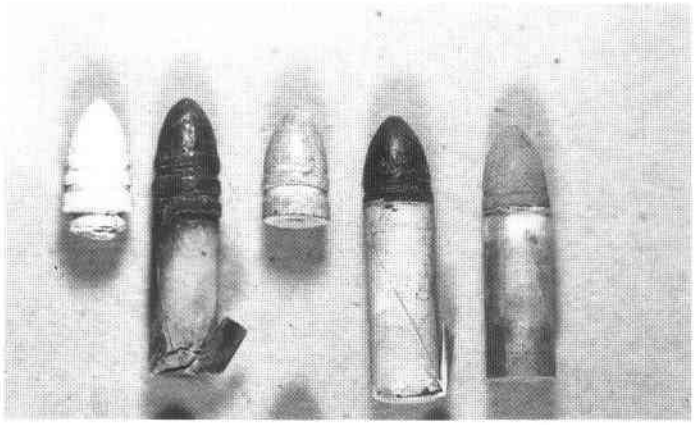

Figure 13. Sharps old style "tie ring" ball and cartridge probably of Confederate manufacture, Sharps new model ball, paper case cartridge, and linen case cartridge.

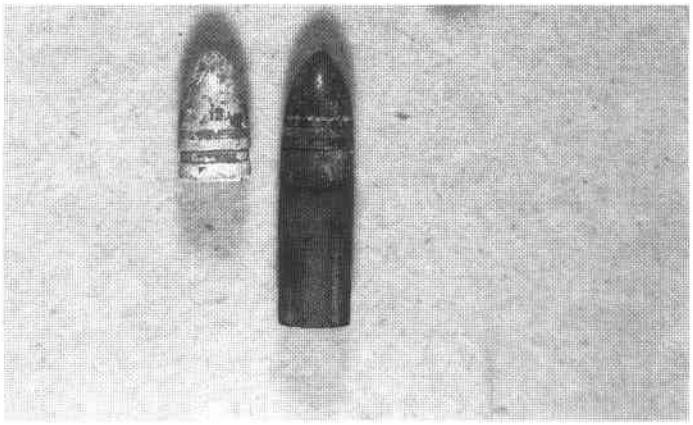

Figure 14. .56 cal. Sharps ball and linen case cartridge.

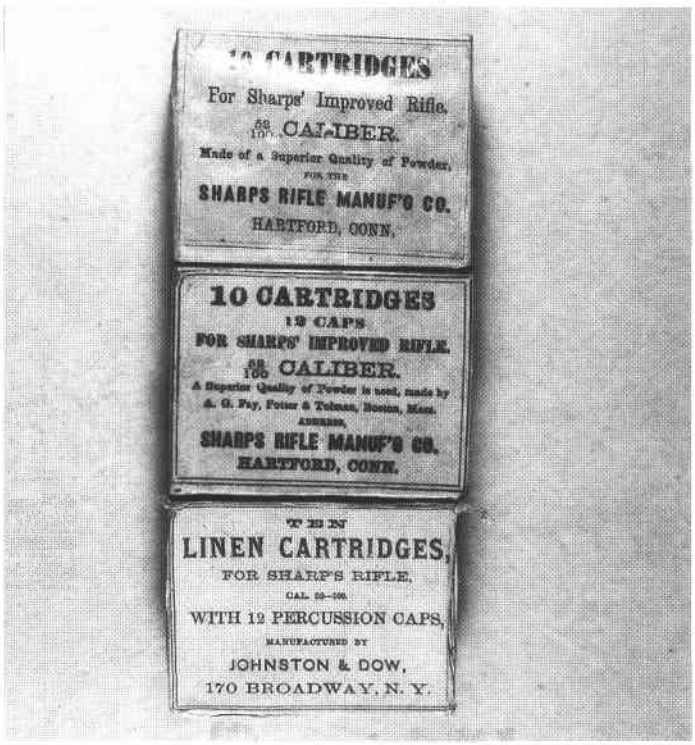

Figure 15. Sharps packaging: commercial (top), military—"with caps" (middle), and by Johnston & Dow (bottom).

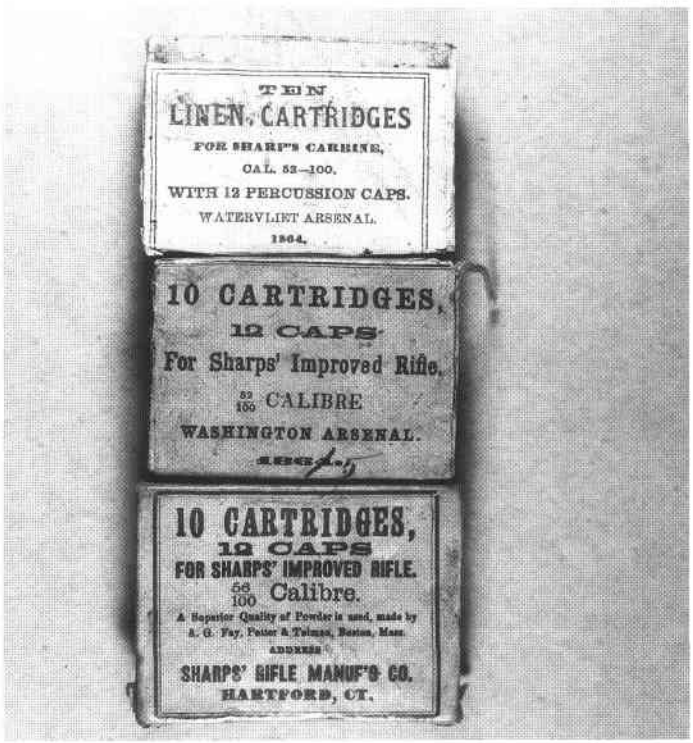

Figure 16. Sharps packaging: Watervliet Arsenal (top), Washington Arsenal (middle), and .56 cal. (bottom).

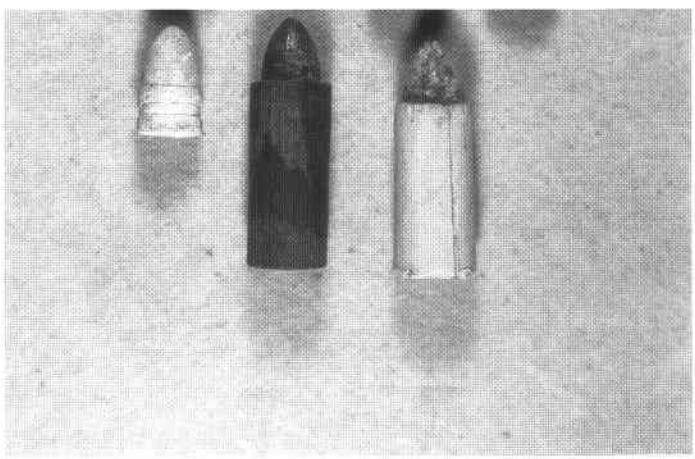

Figure 17. Smith ball and rubber case cartridge, and Poultney's cartridge.

described, so that it may be expanded laterally by the force of the explosion of the charge, and will contract itself after the explosion by its own inherent property.[53]

A thin sheet of India-rubber cloth was rolled on a former and glued, and a thicker perforated wad of the same or similar material was then glued into one end of the case. Or, Smith suggested, the wad could be inserted when the case was rolled. Nevertheless, after the cylinder was charged with powder, the .50 cal. bullet was held in by friction.

The cartridge performed its intended purpose well in sealing the breech, and more than 5.5 million cartridges were purchased during the war from three vendors.[54] Other than its high cost (about $30.00/m), the only complaint against the Smith rubber case cartridge was lodged in September 1862. Lieutenant F. J. Shunk wrote from near Sharpsburg, Maryland:

> . . . the Smith's Carbine Cartridge is a failure. The powder, in riding, spills out of the hole in the rear end of the india rubber cartridge, so that a number of cartridges will be found in every cartridge box with little or no powder in them. The arm, I believe to be a good one, but a change is absolutely necessary in the cartridge.[55]

No additional correspondence was located on this subject, but by late 1863 a change in ammunition was initiated. In order to save about $10.00/m on the cost of Smith cartridges, the Poultney's "soft metal" cartridge was approved and more than 8 million were ordered from Schuyler, Hartley & Graham and Poultney & Trimble through the end of the war.[56]

STARR: The first delivery of the 1858 patented Starr percussion carbines was not made until the end of July 1863; however, by August 1864, more than 20,000 were delivered.[57] The linen-cased cartridge for the Starr was very similar to the Sharps except for the distinctive bullet with its projecting flange or band at the base. The two cartridges were so alike that the Sharps could be used in the Starr arm[58]; however, more than 6.5 Starr linen cartridges were produced

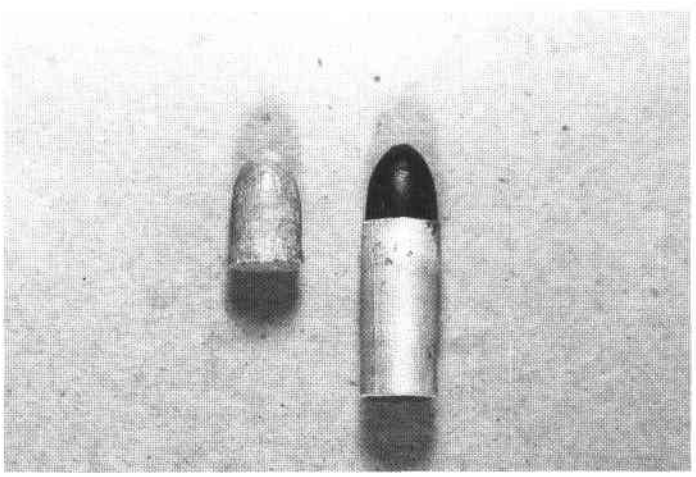

Figure 18. Starr ball and cartridge.

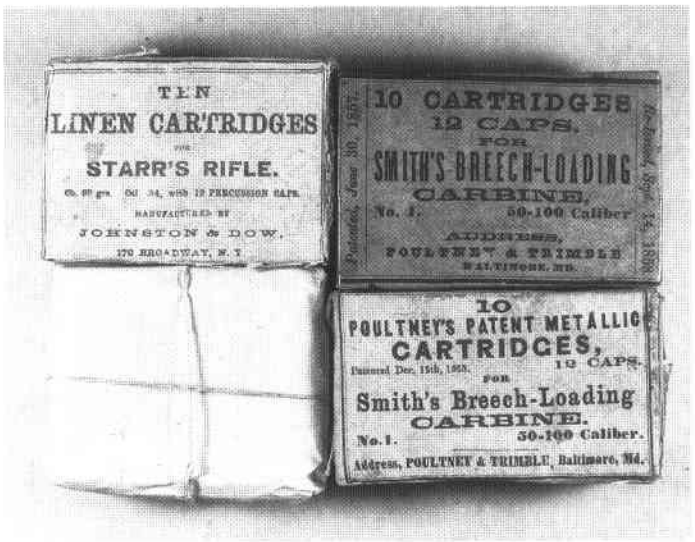

Figure 19. Packaging for Starr and Smith cartridges: Johnston & Dow (top left), plain unlabeled attributed to St. Louis Arsenal (bottom left), Smith rubber (top right), and Poultney's Smith (bottom right).

for the Ordnance Department by Johnston & Dow and D. C. Sage.[59] In addition, four federal arsenals fabricated more than 3.25 million Starr linen cartridges in 1864 and 1865.[60]

According to an August 1863 letter written by H. H. Wolcott, president of the Starr Arms Company, to General J. W. Ripley, Johnston & Dow had manufactured some of their "waterproof" cartridges for the Starr carbine before being asked to switch to linen.[61] As many as 100,000 of these cartridges were supplied to the Ordnance Department in 1863.[62]

A dozen or so models of breechloading carbines and rifles purchased by the U.S. Ordnance Department during the Civil War used internally primed ammunition. The cartridges for these weapons were all rimfires and were predominantly fabricated by five companies: (1) Crittenden & Tibballs Manufacturing Company, South Coventry, Connecticut; (2) C. D. Leet (& Company), Springfield, Massachusetts; (3) New Haven Arms Company, New Haven, Connecticut; (4) D. C. Sage (& Company)/Sage Ammunition Works, Middletown, Connecticut; and (5) Sharps & Hankins, Philadelphia, Pennsylvania.

Two other companies made their first deliveries in 1865: Fitch, Van Vechten & Co. and Joseph Goldmark, both of New York, New York.

The manufacture of rimfire cartridges was an intricate and multi-step process,[63] and precaution was necessary to prevent explosions of work in progress. Very briefly, it involved (1) punching a circular disc or "blank" from a sheet of copper; (2) forming the blank into a cup; (3) annealing the cup to restore its ductility (sometimes more than once); (4)

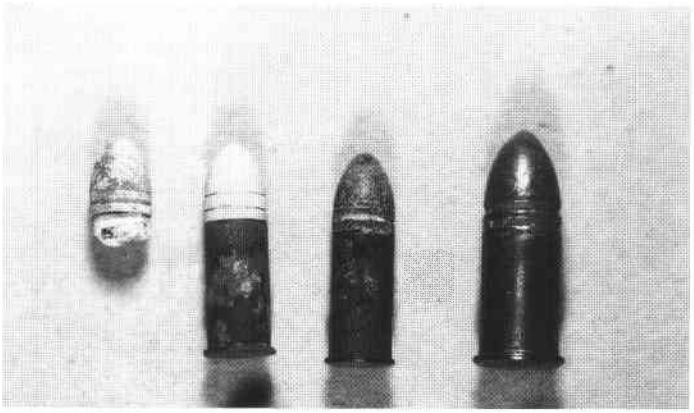

Figure 20. .44 cal. Ballard ball with excavated and non-excavated rimfire cartridges; No. 56 rimfire cartridge for Ballard, Joslyn and Spencer weapons (far right).

the first drawing in a press to elongate the cup; (5) the second drawing to extend its length; (6) trimming the case to remove the ragged edge; (7) heading the case to form the annular rim; (8) mixing the fulminate; (9) priming the case; (10) scrolling the case to force the fulminate into the rim; (11) casting the bullet; (12) loading the case with powder; (13) inserting the bullet; (14) crimping the bullet into the case to prevent their separation and secure a water-tight joint; (15) lubricating the cartridge; and, finally, (16) packing the cartridges in pasteboard boxes and wooden shipping crates.

BALLARD: Purchases of .44 cal. Ballard cartridges totaled almost 4 million rounds and were supplied by Crittenden & Tibballs and C. D. Leet.[64] The .54 cal. Old Model carbine, of which a number were purchased by the state of Kentucky, used standard Spencer cartridges.[65]

HENRY: Only 1,731 .44 cal. Henry rifles were purchased by the Ordnance Department, but a policy was established whereby the federal government would supply cartridges for the Henry rifles in the hands of state troops and those privately purchased by soldiers.[66] Nearly 4 million Henry cartridges were supplied by the New Haven Arms Company, many of which were stamped on the head of the case with a raised "H," and another 1.5 million rounds by Crittenden & Tibballs and C. D. Leet.[67] Both flat-nosed and rounded-nosed bullets are encountered.

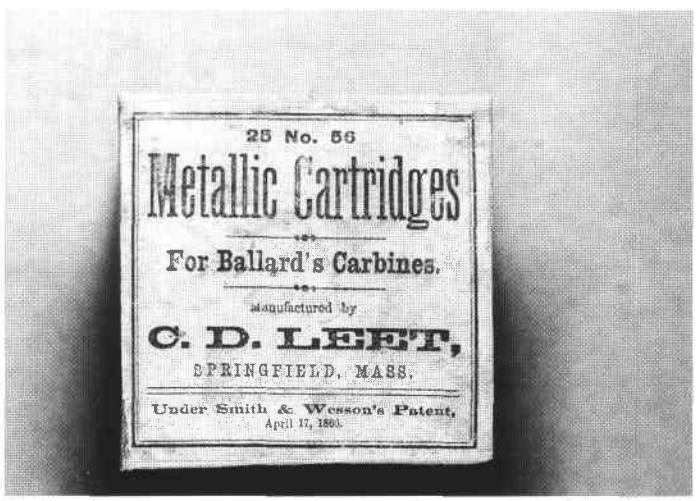

Figure 21. C. D. Leet packaging for No. 56 "Ballard" cartridges.

JOSLYN: The 1855 patented Joslyn percussion carbine, of which about 1,000 were in federal service, used an unidentified paper cartridge. The later models used rimfire ammunition and more than 10,000 weapons were purchased. On May 8, 1864, the Springfield, Massachusetts, cartridge manufacturer C. D. Leet wrote to General Ramsay to clear up any confusion about the ammunition for these guns: "The cartridges for Spencers and Joslyns arms are the same and all the difference we make is in the marking of the boxes."[68] Only 565,000 cartridges were purchased during the war in boxes marked specifically for Joslyns.[69]

E. G. LAMSON & CO.: The Ball and the Palmer carbines manufactured by this Vermont firm were not delivered until May and June 1865. The Palmer used the same rimfire cartridge as the .44 cal. Ballard and the Ball made use of the new .50 cal. Spencer rimfire cartridges.

REMINGTON: E. Remington & Sons received two wartime contracts for their 1864 patented "split-breech" carbines; however, no deliveries on either order were made before May 1865. Five thousand of these weapons were .44 cal. and used a long, .46"-diameter rimfire cartridge. More than 5 million rounds were ordered from four manufacturers for these guns, but none were delivered before June 1865.[70] The fifteen thousand .50 cal. carbines used standard model 1865 Spencer ammunition.

SHARPS & HANKINS: One million six hundred thirteen thousand Sharps & Hankins cartridges were supplied to the federal Ordnance Department exclusively by the Philadelphia company of the same name.[71] The "Old Model" carbine cartridge used a solid-based bullet with one wide, flat groove. The bullet in the "New Model" cartridge had a projection in the center of its base around which was placed a linen wad.

SPENCER: As the Civil War progressed and the demand for rimfire cartridges, particularly for Spencer carbines and

Figure 22. Crittenden & Tibbals packaging for No. 56 "Joslyn" cartridges.

Figure 23. Packaging for Henry rifle (top), Remington carbine (middle), and Sharps & Hankins "short rifle" (bottom).

Figure 25. No. 56 Spencer packaging: for Spencer Rifle Co. (top), Crittenden & Tibbals (middle), and C. D. Leet (bottom).

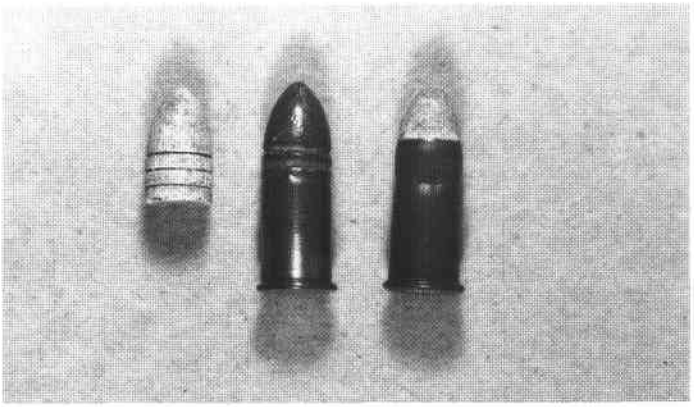

Figure 24. .52 cal. Spencer No. 56 ball and cartridge and .50 cal. model 1865 Spencer cartridge.

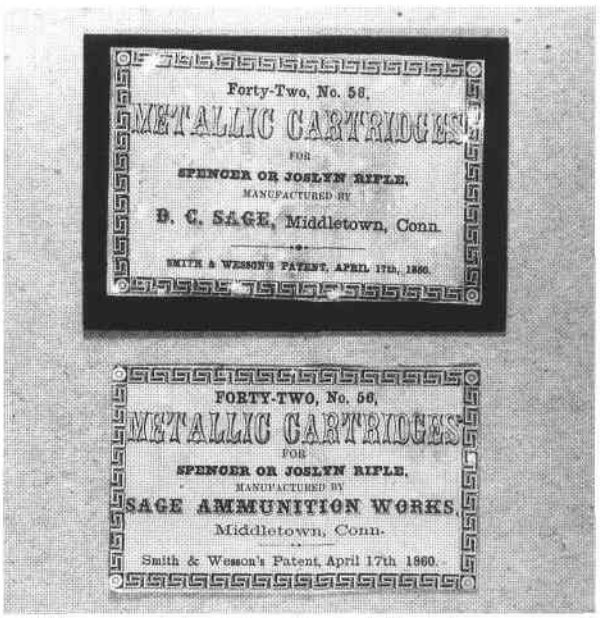

Figure 26. No. 56 Spencer packaging by Sage—two "orange" label variations.

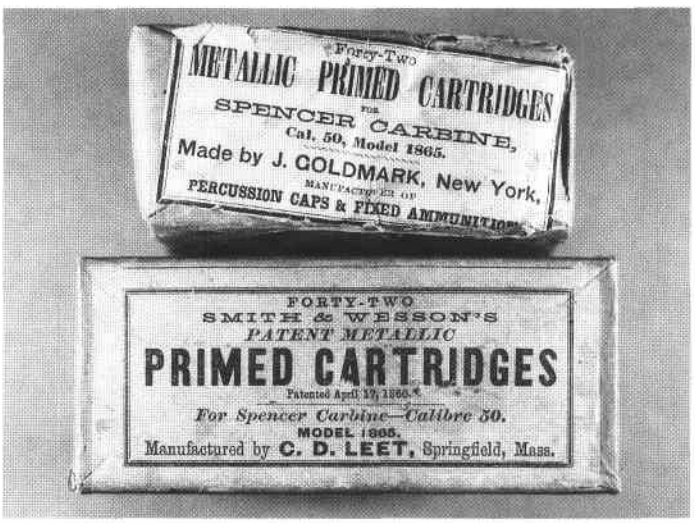

Figure 27. .50 cal. Spencer packaging: J. Goldmark (top) and C. D. Leet (bottom).

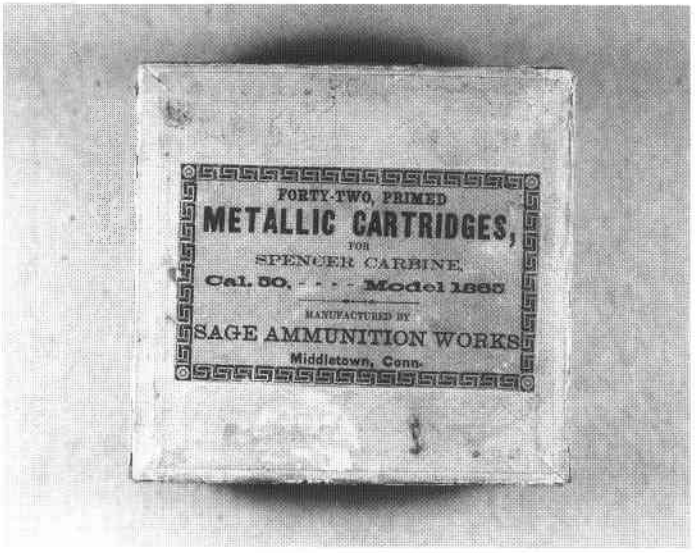

Figure 28. .50 cal. Spencer packaging by Sage Ammunition Works—"green" label.

rifles, rose, the Ordnance Department determined that it would be wise to make some of this ammunition in their own shops.[72] Frankford Arsenal was chosen as the site, but on account of numerous delays, no rimfire cartridges were produced there before the end of the war.

The .52 cal. No. 56 Spencer cartridges were purchased in huge quantities. More than 29 million were supplied by Crittenden & Tibballs, C. D. Leet, D. C. Sage, Sharps & Hankins, and Fitch, Van Vechten.[73] As previously mentioned, this ammunition was also used in Ballard and Joslyn carbines.

With the adoption of the .50 cal. Spencer carbine model of 1865, a slightly altered cartridge was needed. Before the end of the war, this new cartridge was ordered in even larger quantities: nearly 34 million cartridges were supplied by Joseph Goldmark and the five companies named above,[74] but none were delivered before April 1865. Many of these cartridges are found with distinctive head-stamps on the bases of the cases.

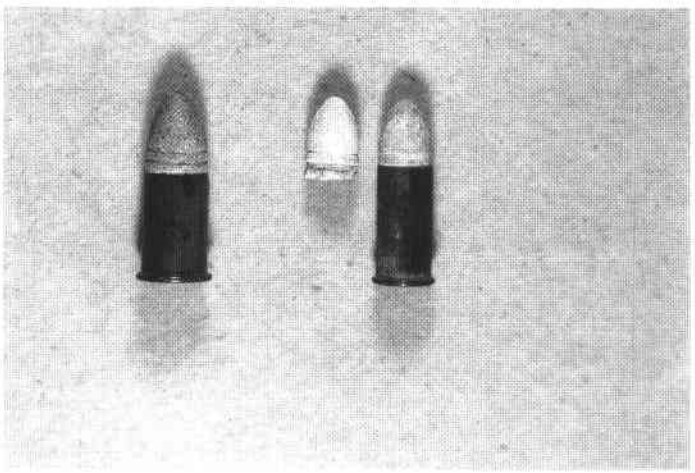

Figure 29. .50 cal. Warner cartridge (left), and .41 cal. Wesson ball and cartridge (right).

Figure 30. Packaging for Wesson and Ballard cartridges.

WARNER: Four thousand .50 cal., single-shot Warner carbines were delivered from March 31, 1864, through March 15, 1865.[75] The weapons of the initial contract used a rimfire cartridge similar in all outward appearances to the .52 cal. Spencer; however, all of its dimensions were reduced in size and the bullet only had a diameter of .515″. Two small lots of cartridges totaling 19,000 rounds were delivered by James Warner in 1864, but these cartridges may have been made by C. D. Leet, who supplied more than 1 million to the Ordnance Department.[76]

The second contract for 2,500 Warner carbines stated that the guns were to be manufactured to allow them to chamber the .52 cal. Spencer cartridges[77]; however, reports from the 3rd Massachusetts Cavalry in Pleasant Valley, Maryland, advised General Dyer that they did not function properly.[78]

WESSON: Only 150 .41 cal. Wesson carbines were purchased by the federal government in 1863 through agent Ben Kittridge of Cincinnati, plus one gun from Schuyler, Hartley & Graham. Additionally, Kittridge did sell perhaps as many as 4,000 Wessons to the states of Indiana, Kentucky, Kansas, and Missouri.[79] A proprietary cartridge was produced for the Wesson and 200,000 were purchased from Crittenden & Tibballs.[80] In February 1863, Ripley agreed that the Ordnance Department would supply ammunition for Wessons in service that had been privately or state purchased.[81] The fact that the .44 cal. Ballard cartridge will chamber in the Wesson explains why so few Wesson cartridges were procured.

Notes

1. Berkeley R. Lewis, *Small Arms and Ammunition in the United States Service*, 1776-1865 (Baltimore, 1956), 280.

2. Captain James G. Benton, *A Course of Instruction in Ordnance and Gunnery* (New York, 1862), 301-302.

3. Cadmus M. Wilcox, *Rifles and Rifle Practice* (New York, 1861), 216.

4. Wilcox, 215-216.

5. U. S. War Department, *Official Records of the War of the Rebellion* (Washington, 1880-1901), Series III, Volume I, 733-734. Hereafter cited as *OR*. This letter may also be found in Joseph Holt and Robert Dale Owen,

Report of the Commission on Ordnance and Ordnance Stores, 1862, 425-426.

6. Stuart C. Mowbray and Jennifer Heroux, eds., *Civil War Arms Makers and their Contracts*, A facsimile reprint of the *Report by the Commission on Ordnance and Ordnance Stores, 1862* (Lincoln, RI, 1998), 425-426. Hereafter cited as *Holt Commission.*

7. *Holt Commission*, 418-430; John D. McAulay, *Civil War Breechloading Rifles* (Lincoln, RI, 1987), 108; and John D. McAulay, *Carbines of the Civil War* (Union City, TN, 1981), 8, 11.

8. *The Scientific American*, Vol. X, No. 12, New Series, March 19, 1864.

9. Benton, 307.

10. Benton, 1883 Edition, 307.

11. Benton, 302-303.

12. "Statements of Fabrications from April 15, 1861 to June 30th, 1867" (National Archives and Records Administration, Record Group 156, *Records of the Office of the Chief of Ordnance*, hereafter cited as NARA, RG 156).

13. "Statements of Purchases of Ordnance" (NARA, RG 156).

14. The Indiana State Arsenal produced unknown quantities of Sharps carbine and Colt revolving rifle cartridges, and, the state of Kentucky purchased Ballard carbines and ammunition.

15. Letters Patent No. 27,791, April 10, 1860.

16. H. K. Craig to P. V. Hagner—Frankford, Feb. 10, 1860, "Letters Sent to Ordnance Officers" (NARA, RG 156).

17. "Statements of Purchases" (NARA, RG 156).

18. G. D. Ramsay to P. V. Hagner—Watervliet, April 16, 1864, "Letters Sent to Ordnance Officers" (NARA, RG 156).

19. P. V. Hagner to G. D. Ramsay, April 28, 1864, "Letters Sent—Watervliet Arsenal" (NARA, RG 156).

20. P. V. Hagner to A. B. Dyer, July 6, 1864, "Letters Sent—Watervliet Arsenal" (NARA, RG 156).

21. "Statements of Fabrications" (NARA, RG 156).

22. Isaac Hartshorn to P. V. Hagner—Watervliet, April 29, 1864, forwarded to Ordnance Office and received May 5, 1864, "Letters Received by the Chief of Ordnance" (NARA, RG 156).

23. J. G. Benton to G. D. Ramsay, May 18, 1864, "Experiments with Ammunition, Class 8" (NARA, RG 156).

24. G. D. Ramsay to W. A. Thornton, May 30, 1864, "Letters Sent to Ordnance Officers" (NARA, RG 156).

25. "Statements of Purchases," and A. B. Dyer to Poultney & Trimble, April 18, 1865, "Misc. Letters Sent by the Chief of Ordnance" (NARA, RG 156).

26. W. Prince to J. G. Benton, May 10, 1864, "Experiments with Ammunition, Class 8" (NARA, RG 156).

27. "Statements of Purchases" (NARA, RG 156).

28. "Statements of Fabrications" (NARA, RG 156).

29. "Summary of the Weekly Statements of Stores Manufactured at the Principal Arsenals," and F. D. Callendar—St. Louis to G. D. Ramsay, Aug. 3, 1864, "Letters Received by the Chief of Ordnance" (NARA, RG 156).

30. Case History File of S. Jackson Patent No. 45,830 (NARA, RG 241, Records of the Patent and Trademark Office, Patented Case Files).

31. "Statements of Purchases" (NARA, RG 156).

32. Samuel Jackson to G. D. Ramsay, Feb. 1, 1864, "Experiments with Ammunition, Class 8" (NARA, RG 156).

33. W. H. Bell to H. K. Craig, Oct. 25, 1855, "Correspondence and Reports Relating to Experiments, Class 6" (NARA, RG 156).

34. J. W. Ripley to Capt. H. M. Williams, 10th Mo. Cav., June 4, 1863, "Misc. Letters Sent by the Chief of Ordnance" (NARA, RG 156).

35. "Statements of Purchases" (NARA, RG 156).

36. J. W. Ripley to G. D. Ramsay—Washington Arsenal, April 13, 1863, "Letters Sent to Ordnance Officers" (NARA, RG 156).

37. "Statements of Fabrications" (NARA, RG 156).

38. G. D. Ramsay, probably June 9, 1864, Carbine Cartridges purchased from 1861 to June 9, 1864 by the Ordnance Office, "Letters Received by the Construction Division" (NARA, RG 156).

39. "Statements of Fabrications" (NARA, RG 156).

40. Letters Patent No. 32,949, reissue No. 1,411, Feb. 17, 1863.

41. op. cit. same as #38 above.

42. "Statements of Fabrications" (NARA, RG 156).

43. "Statements of Purchases" (NARA, RG 156).

44. Ibid.

45. "Statements of Fabrications" (NARA, RG 156).

46. See McAulay, *Carbines* and *Rifles*.

47. H. K. Craig to F. D. Callender—Benicia, April 4, 1860, "Letters Sent to Ordnance Officers" (NARA, RG 156).

48. T. J. Wood to H. K. Craig, Aug. 4, 1859, "Correspondence and Reports Relating to Experiments, Class 6" (NARA, RG 156).

49. G. D. Ramsay to P. V. Hagner—Watervliet and F. D. Callender—St. Louis, Jan. 16, 1864, "Letters Sent to Ordnance Officers" (NARA, RG 156).

50. "Statements of Fabrications" (NARA, RG 156).

51. "Statements of Purchases" (NARA, RG 156).

52. "Statements of Purchases" and G. D. Ramsay to S. Crispin, March 25, 1864, "Letters, Telegrams and Endorsements Sent Relating to the Manufacture, Procurement and Repair of Ordnance Supplies and Equipment" (NARA, RG 156).

53. Letters Patent No. 17,702, reissue No. 598, Sept. 11, 1858.

54. "Statements of Purchases" (NARA, RG 156).

55. F. J. Shunk to J. W. Ripley, Sept. 23, 1863, "Correspondence and Reports Relating to Experiments, Class 6" (NARA, RG 156).

56. "Statements of Purchases" (NARA, RG 156).

57. McAulay, *Carbines*, 47, 50.

58. P. V. Hagner to J. W. Ripley, June 23, 1863, "Letters Received by the Chief of Ordnance," and J. G. Benton to A. R. Buffington, July 3, 1863, "Letters Sent to Ordnance Officers" (NARA, RG 156).

59. "Statements of Purchases" (NARA, RG 156).

60. "Statements of Fabrications" (NARA, RG 156).

61. H. H. Wolcott to J. W. Ripley, Aug. 24, 1863, "Letters Received by the Chief of Ordnance" (NARA, RG 156).

62. "Statements of Purchases" (NARA, RG 156).

63. J. A. Winebrener to G. D. Ramsay, May 21, 1864, "Experiments with Ammunition, Class 8" (NARA, RG 156). This is an excellent step-by-step report on the manufacture of Spencer cartridges at C. D. Leet and Crittenden & Tibbals.

64. "Statements of Purchases" (NARA, RG 156).

65. G. D. Ramsay to L. S. Babbitt—Louisville Depot, March 8, 1864, "Letters Sent to Ordnance Officers" (NARA, RG 156).

66. J. W. Ripley to A. E. Burnside, June 18, 1863, and G. D. Ramsay to J. Wesley Lee, May 10, 1864, "Misc. Letters Sent by the Chief of Ordnance" (NARA, RG 156).

67. "Statements of Purchases" (NARA, RG 156).

68. C. D. Leet to G. D. Ramsay, May 8, 1864, "Letters Received by the Chief of Ordnance" (NARA, RG 156).

69. "Statements of Purchases" (NARA, RG 156).

70. Ibid.

71. Ibid.

72. G. D. Ramsay to E. M. Stanton, Aug. 9, 1864, *OR*, Series III, Vol. IV, 592-595.

73. "Statements of Purchases" (NARA, RG 156).

74. Ibid.

75. McAulay, *Carbines*, 90.

76. "Statements of Purchases" (NARA, RG 156).

77. McAulay, *Carbines*, 87.

78. January 1865, "Experiments with Small Arms, Class 6" (NARA, RG 156).

79. McAulay, *Carbines*, 119-121.

80. "Statements of Purchases" (NARA, RG 156).

81. J. W. Ripley to W. O. Collins, 6th Ohio Cav., Feb. 18, 1863, "Misc. Letters Sent by the Chief of Ordnance" (NARA, RG 156).