BRITISH 1853 PATTERN ENFIELD RIFLE CARTRIDGES

Introduction

This article traces the construction and evolution of the cartridges used for the British 1853 pattern Enfield muzzle-loading rifle musket, with reference to the types used in New Zealand.

1860s cartridge with 1865 percussion cap (Royal Laboratory), bullet with its wood plug (Royal Laboratory). ***Adrian Roads collection*****.**

The cartridge consisted of two (after 1859, three) pieces of thin paper wrapped around a thicker paper tube containing FFg gunpowder and an Enfield pattern lead bullet. The bottom of the cartridge, around the bullet, was lubricated to facilitate loading and remove fouling.

To load, the end of the cartridge was ripped off, exposing the powder, which was poured down the barrel, the cartridge then turned so the bullet was at the bottom and pushed into the muzzle. With the bullet firmly lodged, the paper holding the powder tube was ripped off and discarded. This operation is very simple and quick, as there is a natural weak point between the top of the bullet and the bottom of the powder tube, where the bullet is encased in only three layers of the thin wrapping paper. The bullet, still wrapped in its lubricated paper patch, was then rammed down to the breach, a percussion cap placed on the rifle's nipple and the trigger pulled, igniting the powder. A trained soldier could fire at least three rounds a minute.

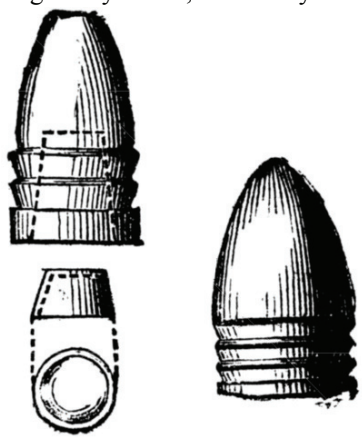
Over the period that the Enfield was the main rifle used by British forces (1855-1867), the cartridge was re-designed several times, making it less fragile, easier to open and easier to load, as detailed below.

The pure lead bullets, by the mid 1850s, were stamped out in a factory, at a rate of between 1800 and 2000 per hour, using the Anderson's bullet pressing machine. By 1865, each machine at the Royal Laboratory was able to stamp out 88,000 bullets in a 10 hour day[1]. The wood expansion plugs were formed on a machine that turned out 10,000 per day. The cartridges were assembled by men and boys in the factory.

However, as part of musketry instruction, every recruit was taught how to make a bullet with a bullet mould, and assemble a cartridge. Tin stencils and instructions were issued to the musketry instructors for this purpose.

The Bullet

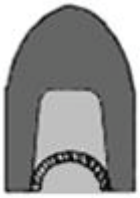
The Enfield rifle musket bullet was of the type known as the 'Minié' after Captain Claude Etienne Minié, an officer in the French Army, who in 1849, perfected the design of an expanding bullet first proposed by Greener, Norton, Delvigne and others. As designed by Minié, it was a cylindro-conoidal soft lead bullet, slightly smaller than the rifle barrel's bore, with four exterior lubricant-filled cannelures. The bullet had a hollow sectioned base containing a small iron cup, whose purpose, on ignition of the gunpowder in the breach, was to expand the soft sides, sealing the gap (known as 'windage') between the bullet and the inside of the barrel.



The bullet thus engaged the rifling in the barrel, causing it to spin and stabilise in flight. The hollow base also threw the centre of gravity of the bullet forward, stabilising it much like an arrow. Consequently because of this increased accuracy, rifles using the Minié principle were fitted with sights, scaled out to 900-1100 yards and the men given instruction in range estimation and target practice. When in flight, Minié bullets make a distinctive sound. Cadogan remarked "I know nothing so disagreeable as the singing sound of a Minié bullet; it is quite different from a round ball, which whistles softly as it passes."[2]

The first British Minié bullets were manufactured for use in the short-lived 1851 Pattern Minié rifle, which was first used in South Africa in 1851, then carried by three of the four British divisions that landed on the Crimean peninsular in September 1854. The rifle weighed 10 lbs. 8¾ oz. with bayonet, bore .702 in. The bullet was smooth-sided, .690 in. diameter, weighing 680 grains. It was used with great effect at Alma, Balaclava and Inkerman, wreaking havoc amongst the close-packed Russian formations. For example, during the battle of Balaclava on 25 October 1854, Sir Colin Campbell, trusting in the increased accuracy and penetrative power of the rifle bullet, formed the 93rd Highlanders in line, rather than in the traditional square, to face Russian cavalry, repulsing them with one or two volleys at long range. This event was famously recalled as the "Thin Red Line", epitomising the Victorian British soldiers' steadfastness in battle.

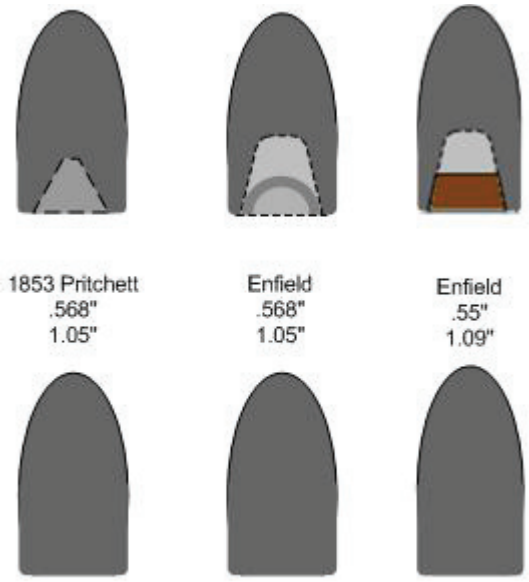
However, even before completion of trials of this rifle, it was realised that the rifle and bullets were much heavier than was optimal. In 1853, in a series of competitive trials at the School of Musketry at Hythe, the .577 in. calibre Enfield rifle was declared to be superior to the Minié and was approved to replace the latter. The first Pattern 1853 Enfields were issued to British troops in the Crimea from February 1855. When first issued, the infantrymen commented enthusiastically about the rifle. "even turned up our nose at the beautiful Minie and the Regt. is now armed with the most lovely rifle [Enfield] ... It is as long as the



Minie Patt. 1851
(type 2)
.691"

Mine but 2 lbs. lighter... The men are all delighted with the change."[3] The rifle weighed 9 lbs. 3 oz., with bayonet. A full service load of 60 cartridges weighed about 1¼ pounds less than the same number of Minié cartridges.

The bullet used in the 1853 pattern Enfield rifle musket was known variously as the 'Pritchett', 'Metford-Pritchett', or 'Enfield'. The first Enfield bullet adopted by the British Army was designed by Mr Pritchett, who won a design competition against Lovell, Wilkinson and Metford among others. The bullet was a cylindro-conoidal smooth-sided soft lead bullet with base cavity in the base, .568 in. calibre, weighing 529 grains (1.2 oz.). This bullet contained no iron cup. It was rated as accurate out to 600 yards in ideal conditions. However, in May 1855, tests found that due to anomalies caused by wear in the manufacturing dies, bullets were not all the same size, so they did not expand uniformly. This, combined with the fact that, due to manufacturing tolerances, as well as wear, the bore of the Enfield rifles could also vary by up to .003 in., caused any undersized bullets to be most irregular in flight. To obviate this problem, the iron cup was re-introduced in a redesigned .568 in. bullet with a larger base cavity. This bullet was 1.05 in. long and weighed 530 grains. Propelled by the service charge of 2 ½ drams (68 grains) of gunpowder, the bullet could penetrate 12 half-inch thick elm planks at 500 yards.[4]



On 21 February 1859, to ease loading, the calibre of the bullet was reduced to .55 in., with a conical expansion plug made of boxwood. This bullet was 1.09 in. long and weighed the same as its predecessor. The plugs were dipped into a composition of beeswax and a very small quantity of spirits, "to prevent alteration of size and shape". This bullet was adopted after extensive tests at Hythe that disproved the fears that a smaller bullet would slide out of the barrel when pointed downwards, and that it would be less accurate. Indeed, this bullet appeared to have a lower trajectory and the same range as the former.[5] From 2 February 1864, the plugs were made of baked clay, saturated with beeswax, because of the difficulty being experienced in obtaining supplies of boxwood[6].

The Paper

The cartridge was constructed using two weights of paper – the inner tube, which held the gunpowder, was of heavy 'cartridge' paper, and the outer papers were a very light-weight paper. In 1859[7] the paper was specified as: Cartridge paper (White Fine) – ream weighed 13 lb, each sheet was 29 inches x 19 5/8 ins. In modern terminology this is approximately 32 gsm. The 'wrapping' – ream weighed 45 lb, each sheet 25 in. x 19 in, or approximately 133 gsm. In the mid 19th century, paper was made from pulped rag and was somewhat stronger than most modern papers which are composed of wood pulp. However, I have found no great problems with using modern paper. Suitable paper available today is "Butter paper" of 40 gsm weight, or typewriter paper of 45 gsm, and artist pads of 135 gsm cartridge paper. The wrapping paper needed to be very thin, because the windage between the .577 in. calibre of the rifle and the original .568 in. Pritchett was only .009 in. (or .0045 in. each side of the bullet. This was later less crucial when the bullet was reduced in size to .55 in.

Lubrication

In an Enfield cartridge, lubrication served two purposes: 1) - to lubricate the bullet to ease loading, and 2) - as an anti-fouling agent to clean the bore of burnt powder residue as the paper patch was forced out around the projectile. This was essential as the windage was very small and any build up of fouling would quickly render the rifle unloadable.

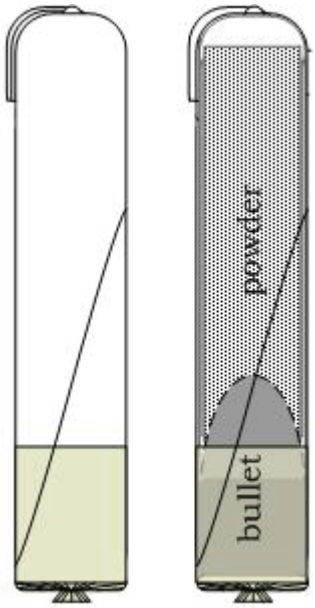
Before the adoption of the Minié rifle system, the firearm carried by line infantry was the smoothbore musket, which fired a spherical lead ball. The cartridge consisted of a simple paper tube containing a musket ball and the gunpowder. It did not require a lubricant. To load, the end containing the powder was ripped open with the teeth, a portion of powder being used to prime the pan, then the rest poured down the barrel. The paper and ball were then rammed down. The paper formed a wadding that held the ball in place and helped minimise windage on firing. Fouling did occur, but as the windage was large and the bore did not have rifling, it did not cause a major problem with loading.

During the Napoleonic wars, while the vast majority of troops were armed with smoothbore muskets, rifles were issued only to specially trained troops, such as the British 60th and 95th Rifles regiments, King's German Legion light regiments, and Prussian and Austrian Jaegers. Using light infantry tactics, these marksmen would pick off targets at long range, using the more accurate rifle.

The first rifle adopted for general service by the British Army was the Baker Rifle. In well trained hands it was accurate out to 300 yards, but slow to load and prone to fouling. On first adoption of the Baker Rifle, riflemen were issued with a small mallet to aid the ramming process, as, to eliminate windage, the original spherical bullet was almost the same size as the bore. This was later modified to using a slightly smaller ball, wrapped in a thin lubricated leather patch.

Fouling could be a major problem with the Minié type rifle. Several methods were adopted by different nations to combat the problem. In the system adopted by the French and Americans, the Minié was much like the original Minié bullet, with cannelures, or 'grease channels' around the diameter to hold the lubrication. However, it did not have an expansion plug. To obviate windage, the bullet was larger than the Pritchett-Enfield bullet, often as large as .575 in. leaving a windage of

only .001 in. on each side of the bullet in the .577 in calibre rifle. This was very similar to the bullet later used in the Snider Enfield breech loader. On loading, the bullet, located in the top of the cartridge, was removed before pouring the powder down the barrel and loaded unpatched. Upon firing, the scouring produced by the lead skirt of the bullet engaging the rifling and the lubricant in the cannelures was the only method of removing the build up of fouling. The personal experience of this author is that the rifle quickly becomes fouled to the point that the rifle cannot be loaded more than a dozen times without risk of a bullet jamming in the barrel. The rifle must be cleaned immediately after a break before attempting to fire again, say the next day.



The method used by the British was to put the bullet at the bottom of the cartridge, wrapped in a lubricated, paper patch formed by the wrapping paper. Three slits were cut in the paper in contact with the bullet to allow lubricant through and aid the paper breaking apart on leaving the muzzle. Tests carried out at Hythe in the 1850s concluded that "With sufficient lubrication, the more perfect the expansion, the less the barrel will be found to foul. When proper care has been observed, the Enfield has frequently been fired 200 times successively without any difficulty in loading."[8] Indeed, a test was conducted later, when one Enfield rifle, at a rate of twenty rounds per day, was fired a total of 16,000 times over the period from 5 August 1863 to 5 May 1866, without cleaning.[9]

The early lubrication consisted of a grease made of six parts tallow to one of bees'-wax[10]. Tallow is rendered animal fat, which was also widely used for making candles before the advent of paraffin wax candles. This mixture was used because the coating needed to be very thin and the lubricant soft enough to be pushed into the muzzle, bearing in mind that the windage between the .577 in. rifle barrel and the .568 in. bullet was only .009 in. and the paper wrapped around it brought the diameter to almost the same as the bore size, making it a tight fit in any case.

Most famously, the introduction of the Enfield rifle to Indian troops (sepoys) in 1857, issued with cartridges lubricated with mutton tallow, provided one of the catalysts to the Great Mutiny of 1857. The 1854 Infantry Manual specified that to load, the soldier should bite the end off the cartridge to expose the powder. The musketry books also recommended that "Whenever the grease around the bullet appears to be melted away, or otherwise removed from the cartridge, the sides of the bullet should be wetted in the mouth before putting it into the barrel; the saliva will serve the purpose of grease for the time being.[11]" Rumours started spreading that the lubrication contained pork fat, which was regarded as unclean by Muslims, or beef fat, regarded as sacred to Hindus, thus defiling both religions. Despite the Military Secretary, Colonel Richard Birch, on 27 January, ordering that all cartridges issued from depots were to be free from grease, and that sepoys could grease them themselves using whatever mixture 'they may prefer',[12] the most common being ghee (clarified butter), the damage had already been done; many of the sepoys were then convinced that the rumours must be true. Incidentally, after the Mutiny, infantry manuals changed the method of opening the cartridge to "Bring the cartridge to the forefinger and thumb of the left hand, and with the arm close to the body, carefully tear off the end without spilling the powder"[13]. The American manuals continued to specify biting the end off. In practical terms, in any case, the use of a mixture of tallow and wax was problematic. In a hot climate, grease was inadmissible as lubrication; a high temperature causing the grease to disappear from the surface of the cartridge, and some penetrating the paper to the surface of the bullet, frequently corroding the lead, rendering the cartridge unserviceable, and fouling an inevitable consequence.[14] In temperatures below 40° Fahrenheit, the mixture became too hard, making loading difficult until about three or four rounds had been fired in quick succession, heating the barrel.[15] In 1857, a committee, under General Hay, commandant of the School of Musketry, was fully satisfied that beeswax processed advantages over tallow in keeping properties of cartridges, but concluded that beeswax alone was not suitable and recommended a proportion of 1 part tallow to 5 parts beeswax. They had found that, in all but the hottest climates, beeswax alone was too hard, and in cold temperatures would flake off the cartridge when being pushed into the muzzle. Part of the problem was that, when dipped, beeswax formed a layer that was too thick for the end of the cartridge to be forced into the muzzle. In 1858, further tests proposed solving this problem by forcing the warmed finished cartridge through a .582 in. diameter gauge heated to130^{o} Fahrenheit to strip off the superfluous wax. However, the problem was finally solved, when in 1859, the size of the bullet was reduced to .55 in, thus increasing the windage, allowing pure beeswax heated to 230° F., to be used.

Use in New Zealand

Both the .568 in. and .55 in. bullets were used in the Taranaki war of 1860-61. Indeed, Private Mackenzie of the 40th Regiment, in his journal, attributes a spate of exploding rifles at Te Arei in early 1861 to the use of the Crimean era bullet. His practical experience was that the ammunition was to blame. "Our arms were beginning to get into a very rickety condition, several had burst at the muzzle, but it was a mistake to say that it was caused by faults to the rifle. The ammunition was the cause. We were supplied with two kinds, that with iron and wooden cups. Rifles from which the iron cupped ammunition was fired was damaged or leaded. Here is how the iron cup acted. After firing say 20 or 30 rounds one felt rather surprised that his ramrod did not reach the breech by the length of an extra bullet in addition to the charge he was putting in. It would take hard ramming but still the charge would not go home". "Taking his chance, the man would fire his shot and find that it 'went off' all right. Again loading he found that his ramrod wouldn't touch the breach by the additional length of another bullet and so on, the powder always reaching the nipple, until he could not get the ramrod further down the barrel than six inches. Then in a few cases the rifle barrel tore open just at that spot. Of course the armourer sergeant was sent for after a few instances when you might see ten out of twenty men hurrying to get to the rear to have their rifles examined. The upshot was that the iron cup of the bullet was always blown through the latter saving a thin shim of lead in the barrel through which the powder of the succeeding charges passed to the nipple, but which of course stopped the new bullet."[16] About the time the regiments in Taranaki were experiencing this dangerous problem,

the War Department changed the plug of the 1851 pattern Minié rifle and the converted 1842 pattern Sea-Service rifle, for precisely the same reason - "It having been found that the cup ball ammunition heretofore in use with the 1842 and 1851 pattern muskets, the iron cup was liable to be blown through the bullet, improved ammunition for these muskets has been adopted, having the diameter of the bullet reduced and a wood plug substituted for the iron cup."[17] Due to the huge number of earlier cartridges in stock, it appears that both the 1859 and the 1860s cartridges were used in 1863-64 Waikato war. An article in an Auckland newspaper in early 1864, six months after the invasion of the Waikato commenced, states that there were about 4 million cartridges in the armoury at Albert Barracks in Auckland, with another 5 million on the way. The Auckland War Memorial Museum has a collection of the cartridges with a paper band, on display, which are claimed to have been carried at Rangiriri in November 1863.

Left to Right - (1) Bullet for P. 53 Enfield with boxwood plug, (2) bullet for Altered Pattern 1842 pattern rifled musket with plug absent, (3) bullet (type 2) for P. 51 Minié with iron cup, (4) same as previous but a pulled example which had been loaded, (5) bullet (type 1) for P. 51 Minié, modern cast, note the non parallel sides of this early type which was first used. *Adrian Roads collection*.

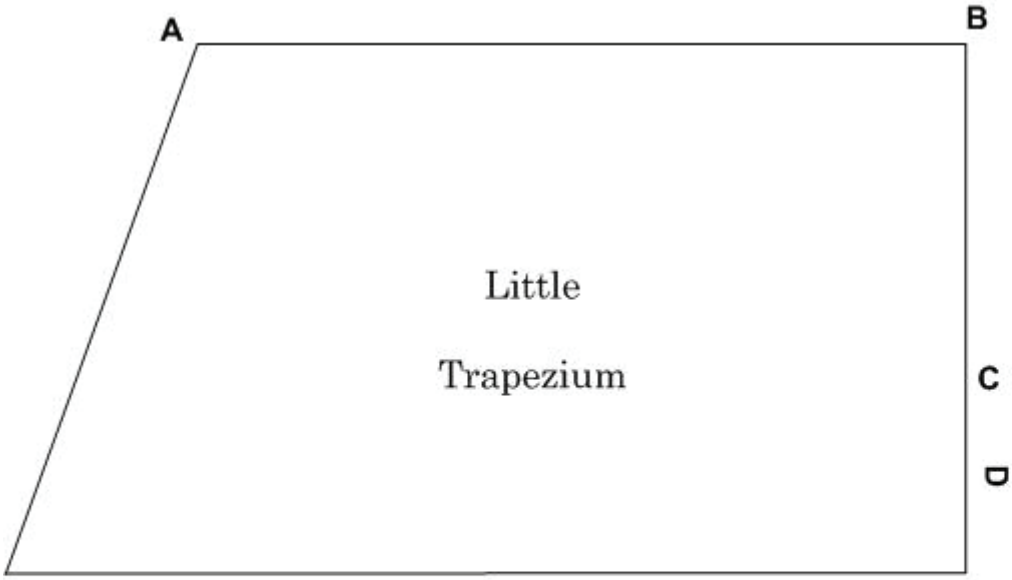
Enfield bullets - left to right - (1) Bullet with box wood plug, (2) bullet with plug absent, (3) bullet with iron cup, (4) early pattern Prichett pre-iron cup. *Adrian Roads collection*.

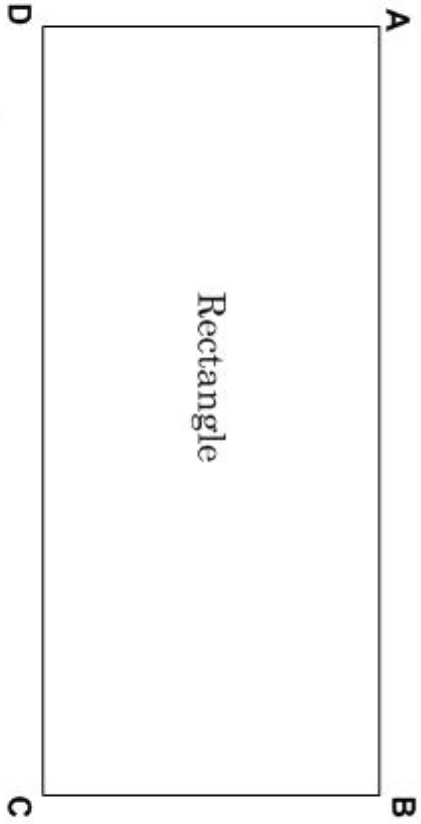
The bases of the bullets above. Note that the iron cup is missing from two of the examples and note also the four small raised Broad Arrows on the base edge of each original example - denoting manufacture by the Royal Laboratory. *Adrian Roads collection*.

The bases of the bullets above. Note the Broad Arrows on the first 3 examples and the "4" inside the second bullet. *Adrian Roads collection*.

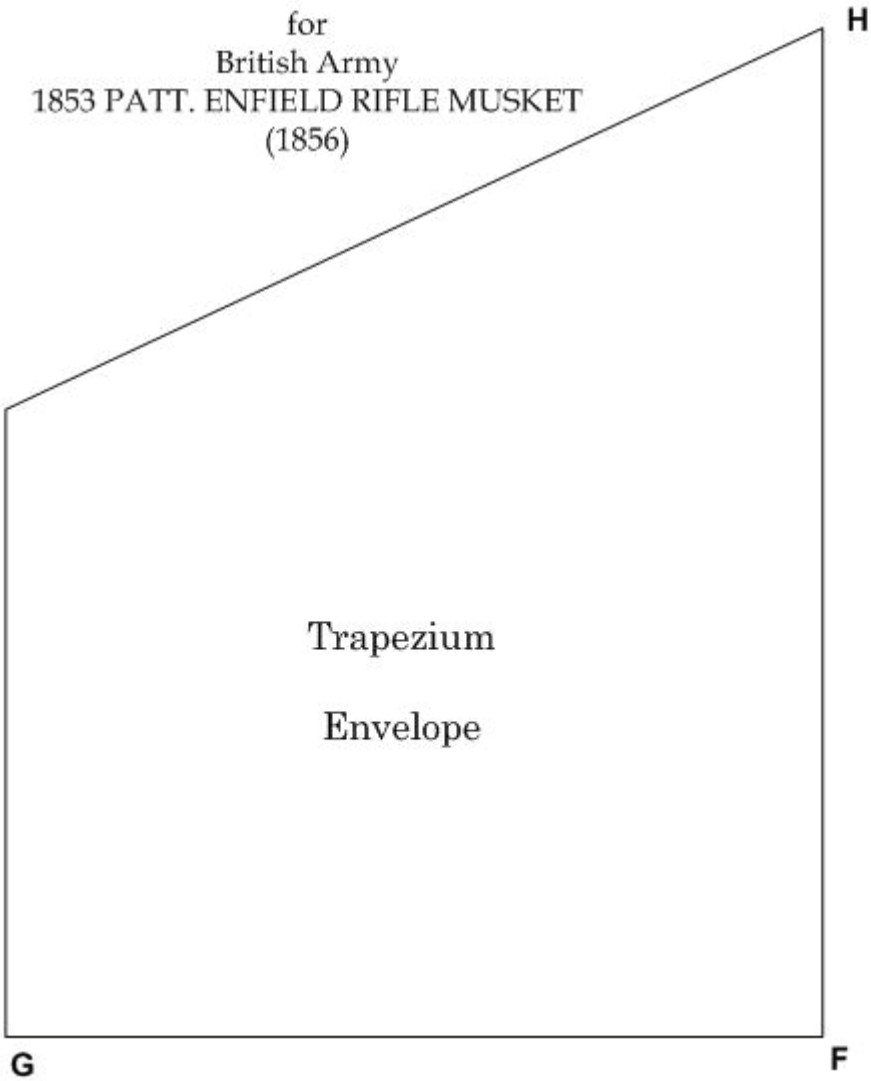
1856 Pattern

Scale – full size





CARTRIDGE CUTTING STENCILS
for
British Army
1853 PATT. ENFIELD RIFLE MUSKET
(1856)



ENFIELD BULLET
.568" Diameter
1.05" Length
Iron cup

The following instructions detail how to make a cartridge using the .568 in. Enfield bullet used in the Crimean War.

To construct the Cartridge – Cut the paper according to the patterns, place the rectangle on the little trapezium, the sides A B C of the rectangle coinciding with the sides A B C of the little trapezium, lay the mandrel on the rectangle, parallel to the side B C, the base of the mandrel even with the side C D of the rectangle; roll the whole tightly on the mandrel (fig. 1); place it vertically, and fold the remainder of the trapezium paper into the hollow in the base of the mandrel; commencing with the acute angle of the trapezium, make use of the point of the former to close the folds; examine the bottom of the inner case thus formed, to see that there remains no hole for the escape of the powder when charged; introduce the point of the bullet into the aperture at the base of the mandrel; take the trapezium envelope, place the mandrel and bullet parallel to the side F G , the base of the bullet at half an inch from the base F H, of the envelope; press up the point of the bullet into the cavity; roll the envelope tightly on the bullet and on the mandrel (fig. 2); fold the remainder of the envelope on the base of the bullet, commencing with the acute angle; place the base of the cartridge on the table; withdraw the mandrel, squeezing the case of the cartridge with the left hand, and raising up the mandrel with the right hand.

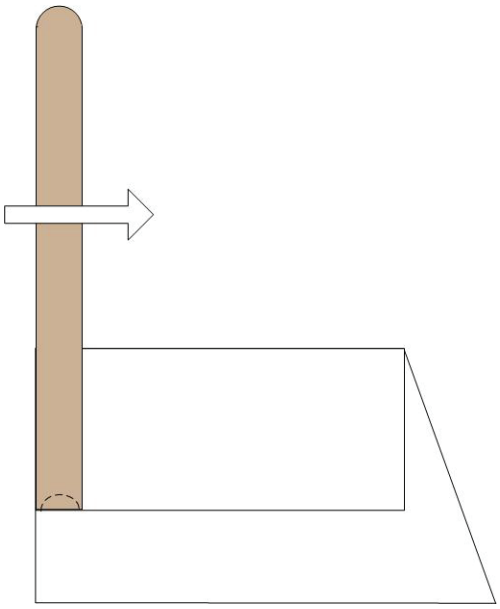


Fig. 1

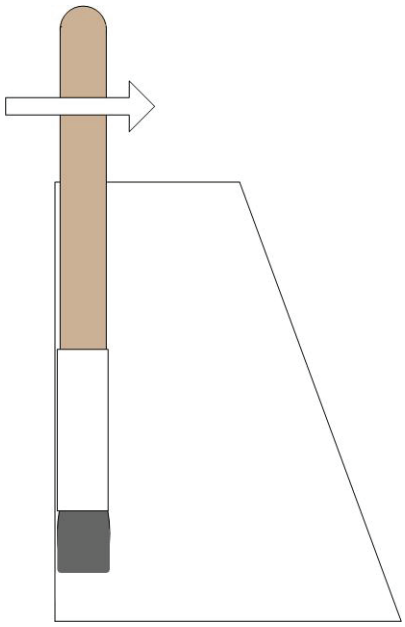


Fig. 2

To charge the cartridge, introduce the point of the copper funnel into the bottom of the case of the cartridge; pour into it 2½ drams of fine grain powder from the powder-flask; withdraw the funnel; taking care that none of the powder escapes between the case and the envelope (fig. 3); squeeze the top of the cartridge, and twist it round.

When completed, the base of the cartridge must be dipped up to the shoulder of the bullet in a pot of grease, consisting of six parts tallow to one of bees'-wax (fig. 4).

Fig. 3

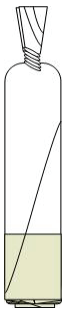


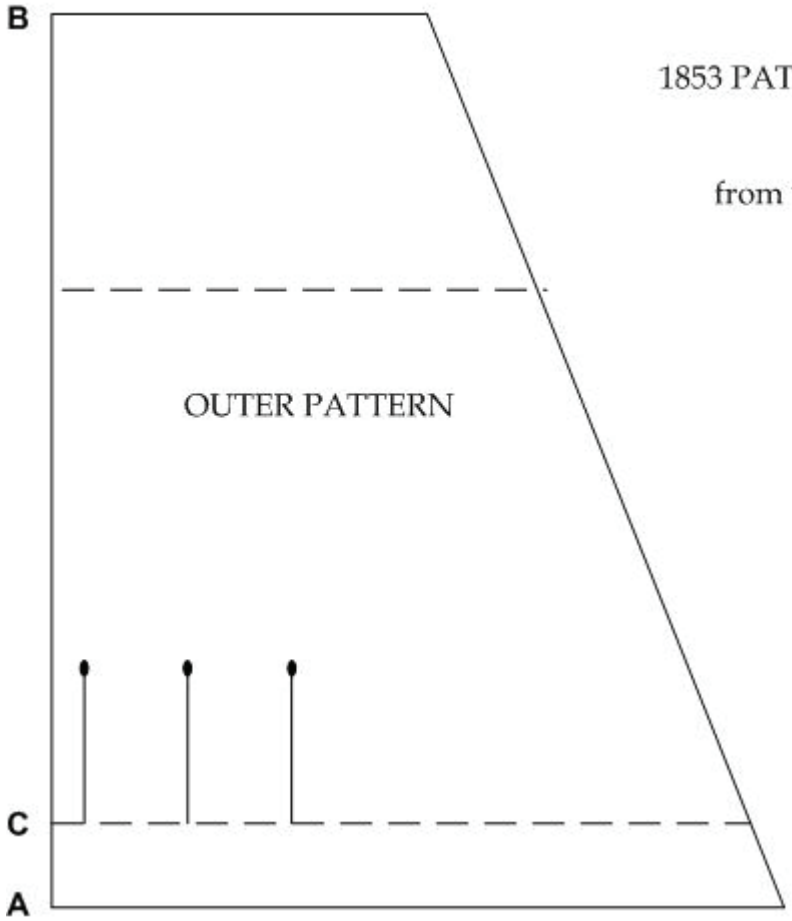
Fig. 4

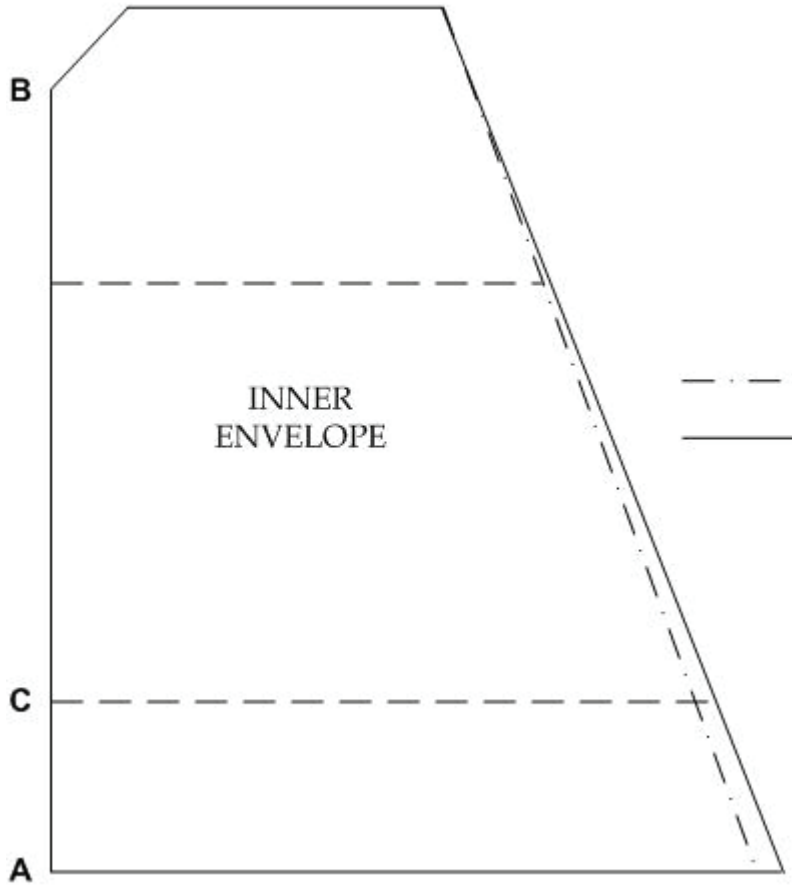
1859 Pattern

Scale – full size

CARTRIDGE CUTTING STENCILS
for
British Army
1853 PATT. ENFIELD RIFLE MUSKET
(1859)

from "Rifle Ammunition" 1859





— · — · — For .55 in. bullet

——— For .568 in. bullet

ENFIELD BULLET
.55" Diameter
1.09" Length

Wood Plug

The following instructions show how to make the cartridge used in the late 1850s. Note that in 1859 the bullet was changed from .568 in. to .55 in. and the inner envelope paper was slightly smaller for the latter bullet.

Having cut the paper according to the size and patterns shown, for cartridges for the rifle-musket or carbine,-

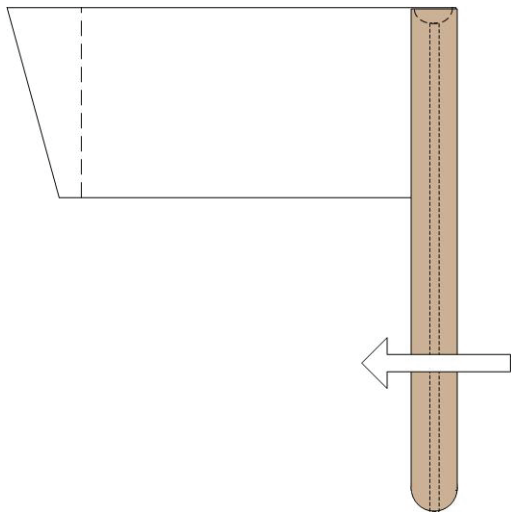


Fig. 1

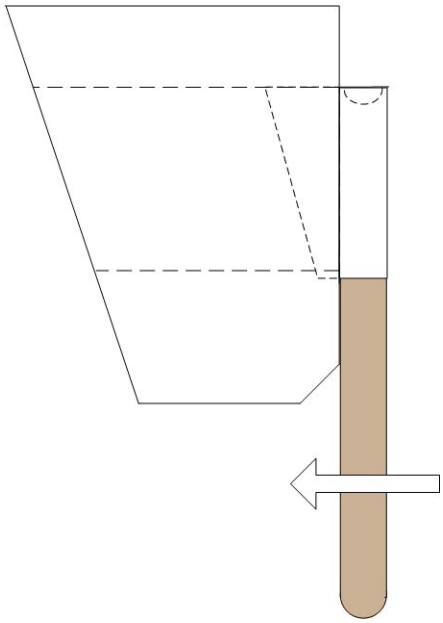


Fig. 2

Form the powder case. Roll the "stiff paper" pattern, tightly about 2½ times round the "mandrel," which is to be laid on the side opposite the acute angle, or AB, with its base coincident with the broader side, or AD; (fig. 1) then place the "inner envelope" paper pattern No.2, on the top of the stiff paper with the side opposite the acute angle, or AB, of the former about ¾ of an inch from the acute angle, of CD of the latter, and roll said envelope tightly on the stiff paper and mandrel (fig. 2); after which slightly twist the end that overlaps about 7/8 of an inch, or AC, and fold it into the hollow at the base of the mandrel, making use of the point of the "former," to close the folds and adapt the paper to the cavity, which is to receive the point of the bullet, being careful to secure the bottom of powder-case, so that no powder can escape therefrom.

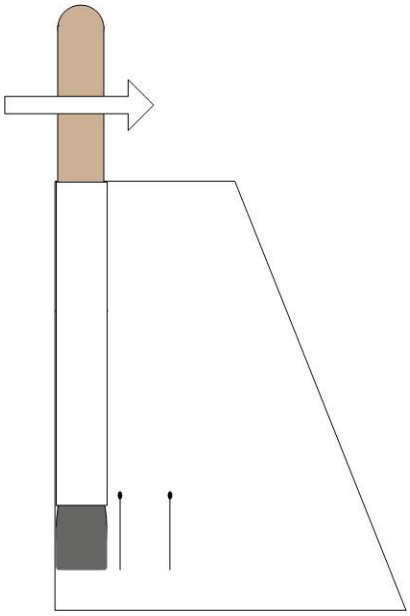


Fig. 3

Fig. 4

Fig. 5

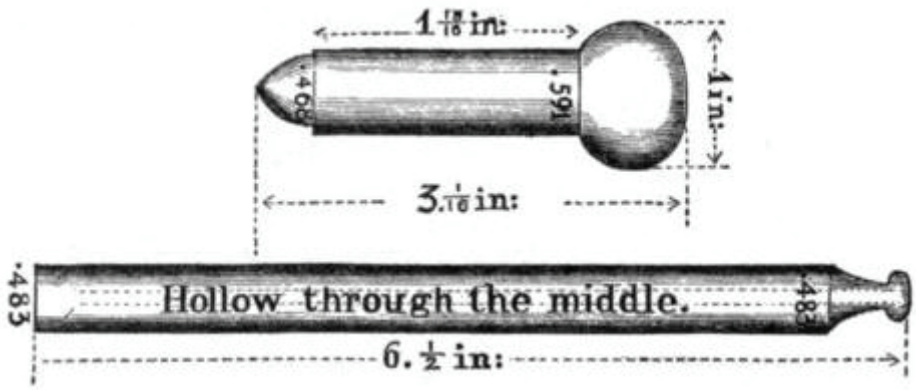
Unite the bullet with the powder-case. Put the point of the bullet well into the cavity of the powder-case, and place both so fixed on the side of the "outer envelope" paper opposite the acute angle, AB, and about ½ an inch from the broader, or AC; (fig. 3) roll the "outer envelope" tightly round the bullet and powder-case, with the mandrel still in it, then twist or fold the paper that overlaps, and tie it as close as possible to the base of the bullet; after which place the base of the cartridge on the table, and withdraw the mandrel with care, by pressing the powder-case with one hand while raising the mandrel with the other, so as not to separate the powder-case from the bullet, both of which must be kept as close as possible to prevent any play at the juncture, which would soon render the cartridge unserviceable.

Charge the powder-case. Place a funnel into the mouth of the powder-case and pour 2½ drams of powder or a less quantity, according to the arm used [2 drams for carbines], into it (fig. 4); remove the funnel, being careful that none of the powder escapes between the inner and outer envelopes; and secure the charge by squeezing the tops of the two envelopes close to the stiff paper of

powder-case, and giving them a slight twist with a pressure inwards, laying the ends on the side of the cartridge. The slits in the outer envelope are made to facilitate its detachment when fired.

Lubricate the cartridge. The cartridge being complete, dip the base up to the shoulder of the bullet (fig. 5), in a mixture composed of 5 parts of bees-wax and 1 part of tallow at 220° F. From 21 February 1859, this was changed to pure beeswax at 230° F.

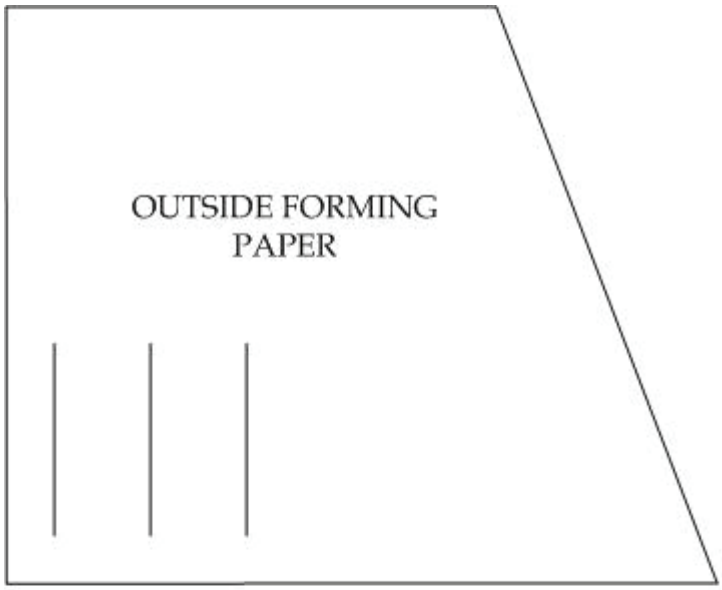
Cartridge Forming Tools



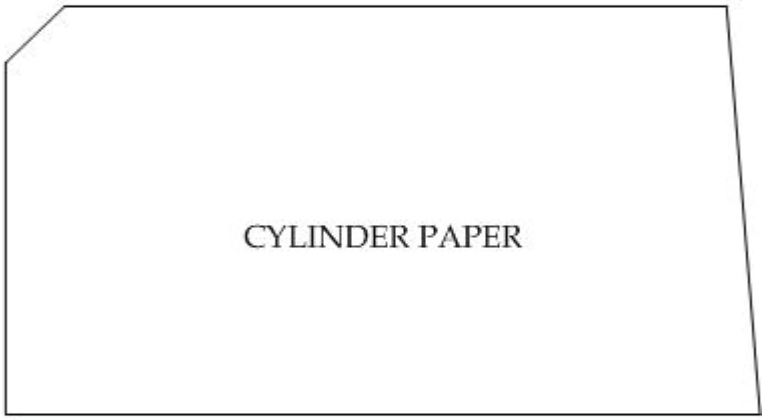
Top - Former,
Bottom - Mandrel

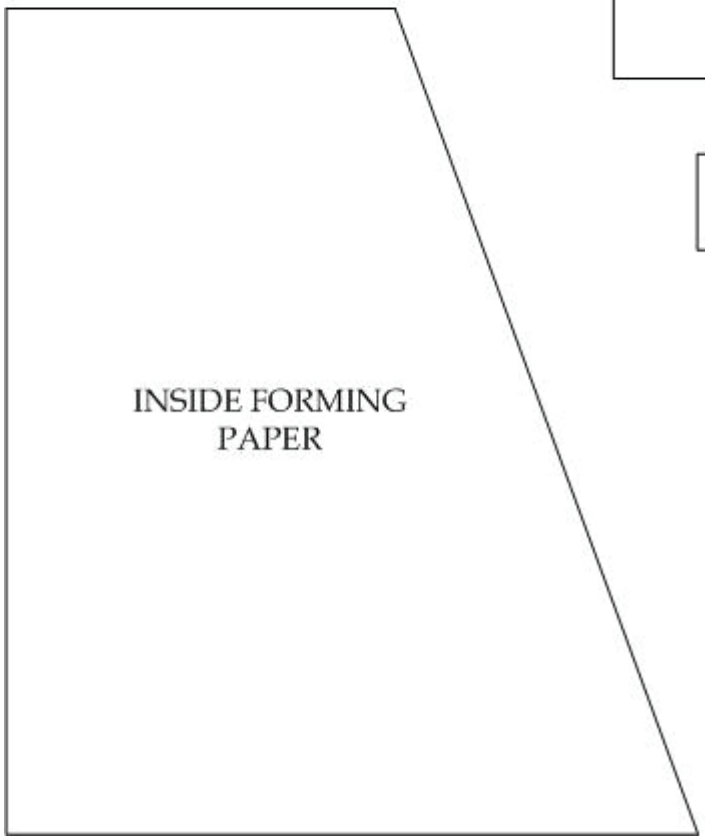
The final Pattern

Scale – full size



CARTRIDGE CUTTING STENCILS
for
British Army
1853 PATT. ENFIELD RIFLE MUSKET
(1860s)





ENFIELD BULLET
.55" Diameter
1.09" Length

Wood Plug
(Clay Plug -
Authorised 15 Dec
1863)

This style of cartridge was introduced at the end of the 1850s. Although Hawes describes the construction of the earlier pattern of cartridge in his 1859 book[18], he also includes the following statement "A cartridge also slightly modified from that described in a former part of this book, has been introduced; the object being to facilitate the "tearing of," by reducing the number of folds of paper in the upper portion of the powder-cylinder. This is attained by shortening the "forming," or outside paper; and to secure it at the junction to the second or inside paper, a small strip of gummed paper is fastened round the cartridge at this place."[19] The new cartridge started production in April 1859.[20] It should be noted, however, that the 1862 edition of the *Artillerist's Manual* illustrates the earlier cartridge, as described by Hawes. This is possibly because the three-piece cartridge requires no gluing, so would be simpler to be made by troops in the field.

This type was also supplied to the Confederates during the American Civil War by British private contracts.

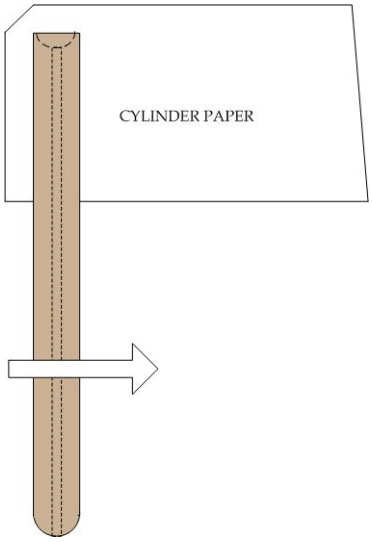


Fig. 1

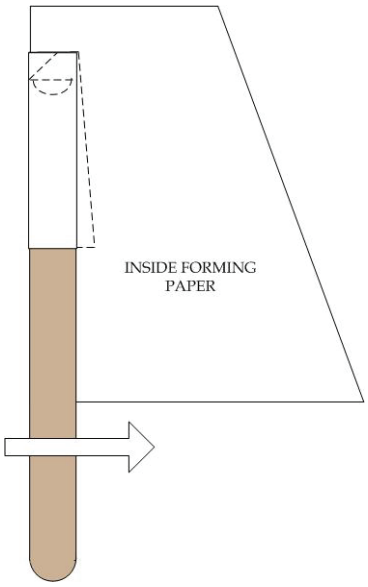


Fig. 2

STEP 1

Place the cupped end of the wood former flush with the small cut-out in the cylinder paper, leaving about ¼" sticking out the top. Roll tightly round former. (fig. 1)

STEP 2

Leave the end of the cylinder paper unrolled and place the inside forming paper inside, leaving ½" above the cupped end of the former and roll tightly. (fig. 2)

Turn the paper that extends beyond the former into the cup and press the forming plug into it to set it in the proper shape.

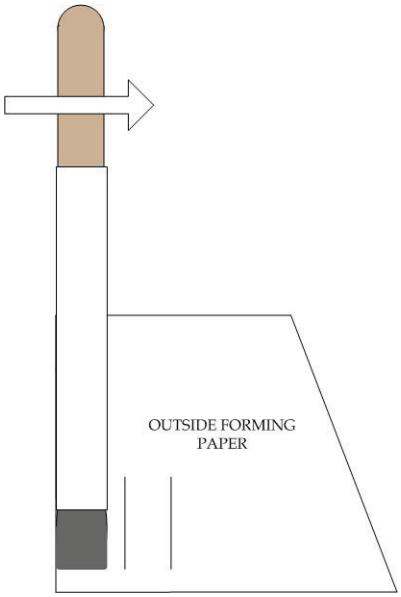


Fig. 3

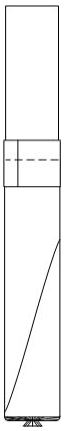


Fig. 4

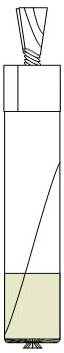


Fig. 5

STEP 3

Place the bullet nose first into the recess of the rolled cylinders formed by the cup of the former.

Roll the outside forming paper onto the bullet and previously rolled cylinders. (fig. 3)

STEP 4

The paper extending beyond the base of the bullet should be choked and tied with two half hitches, using natural-coloured flax thread ('3-ply' thread).

Glue the paper band at the junction of the outside and inside forming papers.

Fill the cylinder with 2½ drams (68 grains) of FFg powder. (fig. 4)

Fold the portion of the inside forming cylinder sticking above the powder cylinder onto the charge. Note that the cylinder paper must stay stiff.

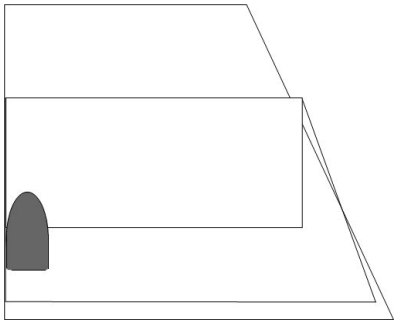
Twist the remaining paper in a simple clockwise twist, leaving the top ½ in. or so untwisted.

Dip the bullet portion (up to .8 in.) in melted beeswax at 230° F. (fig. 5).

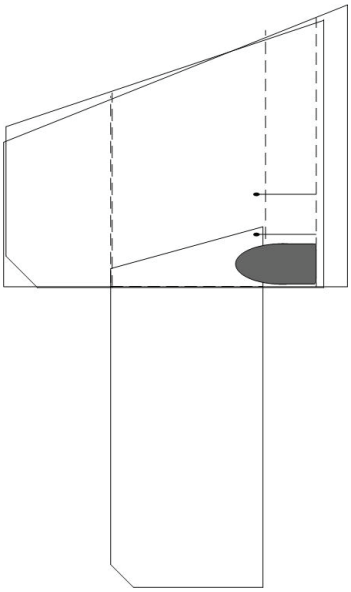
Comparison

How they all fit together

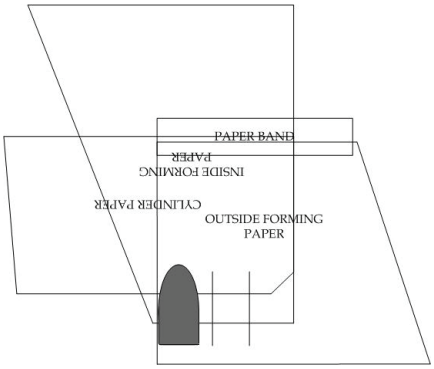
1856



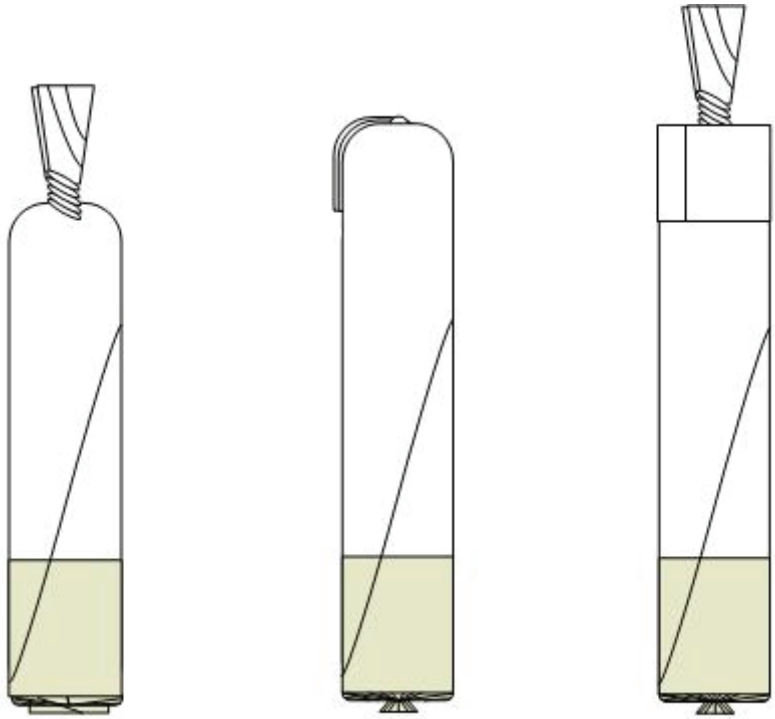
1859



1860s



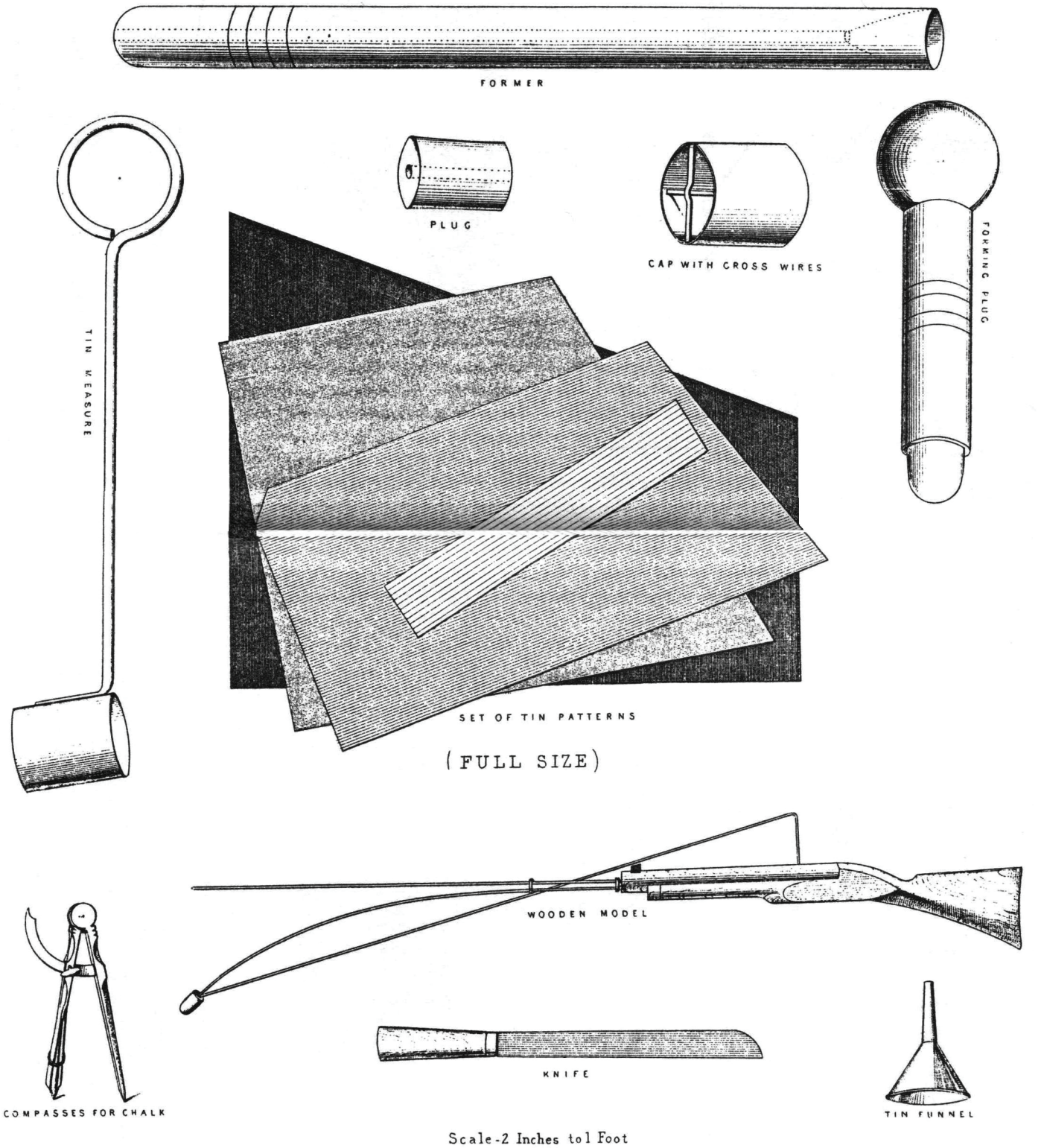
Comparison of the Cartridges



1856 Cartridge 1859 Cartridge 1860s Cartridge

PLATE XXII

ARTICLES FOR MUSKETRY INSTRUCTION.



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Army Equipment - Part V - Infantry - Plate XXII

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FOOTNOTES

1 *The British Soldiers Firearm 1850 -1864*, Dr. C.H. Roads. p. 145
2 *Cadogan's Crimea*, Sir George Cadogan, 1879. p. 34.
3 Diary entry of 23 February 1855 - *Well Done the 68th, The Durhams in the Crimea and New Zealand*, 1854 - 1866. John Bilcliffe, Picton Publishing, 1995. p. 36
4 *Handbook for Hythe*, Hans Busk, 1859. p. 21.
5 *Rifle Ammunition*, Arthur B Hawes, 1859. p. 60.
6 List of Changes 859, 15 December 1863, and Roads. *op cit.* p. 143.
7 Hawes, *op cit*. p. 34.
8 Busk, *op cit.* p. 142.
9 Roads, *op cit.* p. 69.
10 *Instruction of Musketry*, 1856. p. 34.
11 *ibid*. p. 22.
12 *The Indian Mutiny : 1857*, David, Saul (2003), London: Penguin Books, p. 528
13 *Field Exercises and Evolutions of Infantry*, 1861.
14 Hawes, *op cit.* p. 56
15 *ibid*. p. 58
16 Mackenzie, Private Duncan Henry, *40th Regiment Journal*, Alexander Turnbull Library, reference MSY-4571. p 145
17 L.o.C. 245 - Improved Ammunition for 1842 and 1851 Pattern Muskets - 23 Feb 1861.
18 Hawes, *op cit.*
19 *ibid*. p. 61.
20 Roads, *op cit.* p. 147.