

# Pattern 1853 Enfield Ammunition

A history of the development of the ammunition used in the first successful general-issue military rifle

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## *Foreword*

A great deal has been written about the Pattern 1853 Enfield rifle-musket by prominent experts of far deeper understanding and knowledge than myself. These outstanding works painstakingly document the various modifications and changes to the rifle itself over its brief but colorful service life, including its extensive use in the American Civil War. I hope to add in some small measure to what has previously been written about the Enfield rifle, by providing an overview of the development and history of the ammunition used by that rifle.

I submit that the Pattern 1853 Enfield rifle-musket is the first infantry weapon of our current modern era, having more in common with the M16's and M4's of today's U.S. military than the smooth-bore muskets that came before it. The P1853 was mass-produced and issued to the entire army; for the first time, every single soldier was armed with a weapon that could accurately engage individual targets out to extraordinary ranges. Most importantly (and this separates the P1853 from other rifle-muskets of the era), it could be loaded and fired with ease, even hundreds of times, without being stopped by the accumulation of black powder fouling. The *ammunition* made this possible. The P1853 rifle itself, while undoubtedly a fine arm, was virtually identical in construction, quality, and accuracy to the rifle-muskets adopted by France, Belgium, Austria, the United States, and the other major powers. When used in the American Civil War with US-style Minié cartridges, it fouled just as quickly as any other. Only Britain, however, persevered with developing a cartridge that made a muzzleloading rifle truly practical,

and highly effective. It represented the absolute zenith of muzzleloading rifle technology, and was improved upon only by the advent of the breechloader firing metallic centerfire cartridges.

In the telling of the fascinating story of the Enfield cartridge, I hope to make a meaningful contribution to the discourse, correct many widely-held misconceptions, and lay a humble foundation perhaps for others to build upon. I have sought to answer the question “Why?” at each step of the development and history of Enfield ammunition. It is also important to note here that I have referenced only primary sources. This was done deliberately, to ensure that the work is entirely original and to avoid repeating any of the misconceptions or errors found in much of the secondary sources.<sup>1</sup> I felt it was important that the quotations and descriptions be directly from the period sources, and I have sought to provide appropriate context and elaboration where necessary for clarity and understanding. Any errors or omissions are my own entirely.

### *Early Expanding Rifle Bullets 1830-1853*

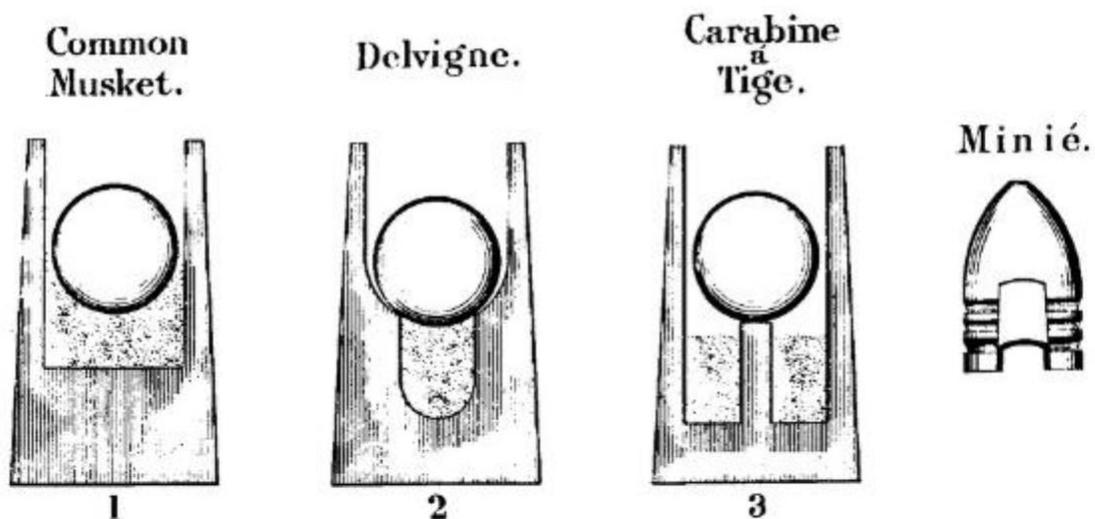
The evolution of the P1853 Enfield rifle cartridge can be traced in a series of successive improvements, each the result of extensive field testing and experimentation. This does not mean that the improvements weren't *controversial*, both then and now; for instance, black powder enthusiasts on internet message boards *still* argue over the purpose and function of the expanding plug in the Enfield rifle bullet. To fully understand the groundbreaking importance of the P1853 rifle, one must start before the adoption of the Enfield rifle in 1854 and go back a few years, to the late 1840s.

A whirlwind of scientific advancements in firearms technology began in the 1830s, and considerable international efforts were made in overcoming the problem of rapidly loading a

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<sup>1</sup> I acknowledge the need to be very careful with period sources, especially when dealing with a subject that was highly controversial and polarizing in its time (which the Enfield rifle-musket and the composition of its ammunition was). If taking period sources at face value with no other context, a hasty researcher could easily conclude that the P1853 Enfield rifle was an unmitigated disaster, and its ammunition was so worthless that the rifle-musket was no more accurate than the Brown Bess. After studying the available primary documents for years, and considering many good (and some not so good) secondary sources along with my own practical experience and trial-and-error shooting of an Enfield with historical ammunition, I think I have developed a good sense of determining which sources are consistently reliable, and which to take with healthy skepticism.

rifle, which was the principle obstacle to the widespread adoption of the rifle (instead of the smoothbore musket) by the armies of Europe. Except for minor skirmishing on the periphery of battle, the laborious process of loading a rifle with a patched bullet (the American and English practice) or an oversized bullet tapped into the barrel before ramming (the German method) precluded widespread use. The advantages of a rifle that could be loaded just as fast as the smoothbore was highly appreciated. In the late 1830s and early 1840s, two competing yet complimentary systems would be adopted by militaries of the period. Both systems used a bullet that was smaller than the bore size of the rifle, but differed in how the bullet was expanded into the rifling. Henri-Gustave Delvigne and Louis-Étienne de Thouvenin, both French Army officers, developed systems that used the force of ramming to seat the bullet on top of a chamber or on

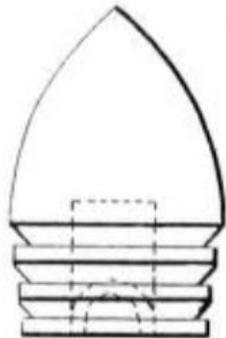


A clean depiction of the various methods used in very early military rifle-muskets, with a depiction of the common musket (far left) for comparison. Both systems of Delvigne and Thouvenin (the “tige rifle”) required the soldier to ram precisely and, for lack of a better term, “smoosh” the lead into the rifling grooves at the breech. The Minié system required no more finesse in ramming than the old musket ball, and expanded itself. From Colonel Lane-Fox’s *On the Improvement of the Rifle Musket*.

top of a stem (tige) and expand the ball into the rifling. It worked, but not well or consistently, and had many inherent disadvantages. The other method relied upon a self-expanding bullet, forced into the rifling grooves by the explosion of the powder charge. Perhaps far too much historical credit has been given to Claude-Étienne Minié, inventor of the Minié ball and often (incorrectly) cited for inventing the type of bullet used in US muskets during the Civil War. Nearly identical bullets had been invented earlier William Greener and John Norton, both Englishmen, but they were not adopted by the British Army, which instead adopted the notorious Brunswick

rifle with mechanical rifling and infamous belted ball. It was fundamentally a step backward in rifle development, using mechanical rifling instead of an expanding ball, and it was found to be an “inconvenient” weapon owing to the difficulty of loading a fouled rifle.<sup>2</sup> Rifle development stagnated in England after the British Army declined to adopt the Greener or Norton concepts, but it flourished in the 1840s in France. In the *Spectateur Militaire* of August 1843, Delvigne

**Fig. 80c.**



Minié bullet, with iron cup in base, as depicted by Major Mordecai's Report

described a new bullet he had patented in 1841, declaring: "I made an important discovery which was that the gas produced by the ignition of the powder rushing into the vacuum formed at the base of the bullet expanded it and forced it into the grooves."<sup>3</sup> In 1847, Minié proposed adding a small iron cup in the hollow base of Delvigne's bullet, to ensure controlled expansion upon ignition of the powder charge. This was the sole contribution of Captain Minié, who would become a household word in America following the Civil War and forever have a badly butchered Americanization of his name attached to any rifle-musket bullet. To the immense chagrin of English inventors like William Greener, the British Army ignored

the developments while Minié succeeded in getting his weapon system adopted on a small scale by the French Army in 1849. Its advantages were obvious at once, and Minié became a household name on both sides of the Channel. While Minié's entire contribution had been adding the iron cup to the base of the bullet, he was successful in getting the French Army to adopt his rifle, and his ammunition.

This prompted something akin to a panic in Britain, as the Minié rifle in French service was vastly superior to the Brunswick rifle. Tensions between France and Britain were high at this time, and there was fear of a French invasion which could pit French troops armed with Minié rifles against British troops with smoothbores.

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<sup>2</sup> *Text Book on the Theory of the Motion of Projectiles, the History, Manufacture, and Explosive Force of Gunpowder, the History of Small Arms, the Method of Conducting Experiments; and on Ranges: For the Use of Officers Sent to the Schools of Musketry* (London: HM Publishing Office, 1863), 144

<sup>3</sup> William Greener, *Gunnery in 1858, Being a Treatise on Rifles, Cannon, and Sporting Arms; Explaining the Principles of the Science of Gunnery, and Describing the Newest Improvements in Fire-arms* (London: Smith, Elder & Co, 1858), 350. Greener would insist he discovered this expansive principle in the 1830s, and claimed that Delvigne, et al, stole his invention.

A quick aside about expanding muzzleloader bullets. In the mid-19<sup>th</sup> century, nobody knew with any certainty what caused the bullet to expand into the grooves of the rifling. There were two prevailing theories (although it should be noted that sometimes a combination of the two theories were given by period sources as an explanation for expansion). The first was the “upsetting” theory, in which a bullet lighter at the base was heavier at the nose so that when it fired, the heavier front portion of the bullet was slowed down by its own inertia, resistance of air in the tube, and friction with the barrel. The lighter back of the bullet moved forward under the immediate pressure of the charge at a greater speed than the heavier front of the bullet, and this squashed the lead into the rifling grooves, having nowhere else to go. This principle was somewhat effective and was used by the Austrians (the Lorenz rifle, imported in large numbers for the American Civil War, used this type of solid bullet with no cavity or hollow base) and several German states. The second theory, probably more familiar to shooters today, utilizes a bullet with a hollow cavity in the base, and the “skirt” of this hollow-base bullet is expanded by the pressure of the charge into the rifling (the Minié ball is one such bullet). Each theory had its true believers, who defended their doctrines with a near-religious fervor and accused the other side of believing “delusions.” A background of these theories, and the raging controversy between them, will be useful later.

The debates over the various proposed weapons for the British Army were bitter, and filled columns of fine print in the periodicals of the day with arguments for or against various methods of rifling, bullet designs, etc. As a column in *Mechanic’s Magazine* put it, “the Duke of Wellington expressed such apprehension of a French invasion shortly before his death when our smooth barrels and spherical balls would, in addition to the numerical inferiority of our army, have exposed us to a degree of danger that threatened most serious results.”<sup>4</sup> Some controversy exists over the role of the very elderly Duke of Wellington, who (it has been alleged) put little faith in the new rifle technology and insisted on maintaining the old smoothbore musket of .75 caliber. This is not entirely true, as the Brunswick rifle was developed and entered service during the tenure of Wellington as Commander in Chief of the British Army. He was, however, skeptical of reducing the caliber of any proposed rifle bullet to any size much less than the massive nominally .710 caliber musket balls that had been used in the old Brown Bess for hundreds of

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<sup>4</sup> *Mechanics Magazine* 69 (October 30, 1858): 422

years.<sup>5</sup> Therefore the development of the P1851 “New Regulation Rifle Musket,” the first mass-produced modern rifle intended as general issue for regular soldiers in the British Army, remained under the shadow of the revered Duke of Wellington’s insistence on a large bore, in spite of mounting evidence of the superiority of the smaller-bore rifle musket.

### *The P1851 Minié Rifle*

The history and development of the rifle ammunition for the P1853 Enfield is merely a continuation of the earlier cartridge, developed for the P1851. It might even be successfully argued that the P53 Enfield cartridge is little more than a refinement of the P51 Minié cartridge. Tests were conducted at Woolwich in 1851 with various foreign rifle-muskets including an old Delvigne-style tige rifle along with French and Belgian Minié rifles that had just been adopted by the services of those countries. They were shot at a 6-foot square target at 400 yards, and the Minié system was found to be superior. The “peculiar advantages” of the Minié rifle, particularly the quick loading and the self-expansion of the bullet into the rifling without any extra effort from the soldier (unlike the tige-style rifle), were proclaimed following the tests at Woolwich. As a result of the tests, the School of Musketry and the Royal Arsenal at Woolwich became firm adherents of Minié system and also the Minié theory of bullet expansion by the action of the pressure of the charge in the bullet cavity. This was despite a storm of constant criticism from a small but extremely vocal group of prominent experts in the field of rifle shooting, including such as John Boucher and Colonel A. Henry Lane-Fox. I appreciate these critics because they provide, often at length, specific explanations of how the cartridges were made, used, and performed (usually to criticize their flaws), which is invaluable for the historian! During the late 1840s and early 1850s the cartridges in use by the Belgian and French armies for their Minié rifles were of the type that had to be “reversed” for loading, i.e. soldier poured the powder, then flipped the cartridge and inserted the still paper wrapped bullet into the muzzle, discarding the excess paper. While naked bullets (without paper patching) seemed to perform slightly better than those with a patch, their use led to rapid fouling.

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<sup>5</sup> General Sir Howard Douglas, *A Treatise on Naval Gunnery* (London: John Murray), 1855

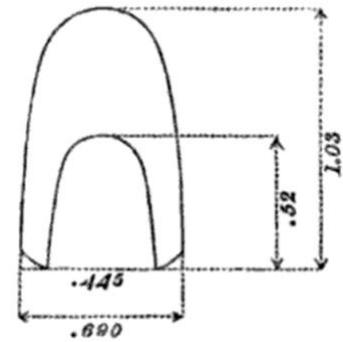
A near-identical copy of the French Minié rifle was adopted as the Pattern 1851, with a bore of .702-caliber (to satisfy Wellington). My sources differ on how many rifles were ordered; some say 28,000 (Busk) while others give different figures of 23,000 (Mordecai).

Ultimately neither amount would be delivered, owing to trouble with

contract makers. It initially entered British service with a “conoidal bullet” that had a very deep cavity in the base.<sup>6</sup> According to the School of Musketry’s text-book, the conoidal bullet was flawed and it was very quickly replaced by a copy of the Minié bullet, cylindrical and with an iron cup. The bullet was .690-inch in diameter, 1.03 inches long, and weighed 680 grains. The descriptions, and illustrations in every period text that depicts them, present a smooth-sided bullet, very similar in basic appearance to the future smooth-sided “Pritchett” bullet that would



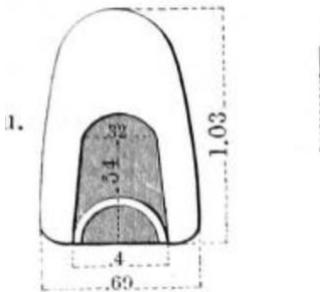
Fig. 61.



Minié bullet as originally adopted for the P1851 with .690-inch diameter, from *A Treatise on Naval Gunnery*

be used in the P1853 Enfield. This deviated from the Minié bullet then in use in France and Belgium, which had grooves (Tamisier grooves) which were found to improve accuracy and stabilize the flight of the bullet, especially a *cast* bullet with imperfections. Period sources compare the grooves in a Minié bullet to the effect of feather fletching on an arrow. Yet when the bullet was being adopted for the P1851, “the British Committee on Small Arms justly considered that, owing to the careful way that bullets are made in England, by compression, these grooves might be dispensed with.”<sup>7</sup> By and large, they were right.

Fig. 83 English.



P1851 bullet showing the iron cup, from Major Mordecai’s *Report*

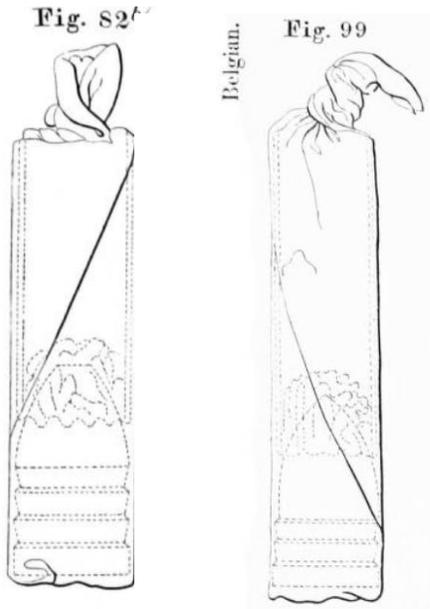
The choice of using Minié’s bullet was controversial for many reasons, not least of which that the Minié was a “foreign invention” that had been rushed into adoption

<sup>6</sup> Text Book, 117

<sup>7</sup> Captain Jervis-White Jervis, *The Rifle-Musket: A Practical Treatise on the Enfield-Pritchett Rifle, Recently Adopted in the British Service* (London: Chapman and Hall, 1854), 61

by fear and irrational haste by the military authorities.<sup>8</sup> Perhaps the greatest controversy was the role and purpose of the iron cup, which Captain Minié firmly believed was essential to causing the forced, instantaneous expansion of his bullet upon discharge. Whether or not the iron cup actually worked as an agent of expansion, it often was blown through the bullet leaving a nasty lead ring in the barrel, or fell out during the bullet's flight and becoming an erratic projectile itself that could endanger troops beneath overhead fire. As a "compound" bullet, the Minié also lacked the simplicity of solid bullets and the iron cup represented an additional expense.

These bullets were made into cartridges that would be familiar in their appearance and function to anyone acquainted with the later Enfield-Pritchett cartridge used in the P1853. These cartridges were made in the Continental fashion, and were described as "Belgian" style when



The French Minié cartridge (left) and the Belgian cartridge, circa 1847. Note the "reversed" position of the bullet, and use of a powder cylinder. From Major Mordecai's Report.

Major Alfred Mordecai explained them in his comprehensive report for the U.S. Ordnance Department in 1855.<sup>9</sup> Utilized for Minié rifles in France and Belgium, these cartridges were just one way (and the principle European way) of approaching the necessity for a tight-fitting rifle-musket bullet to be "greased," as the period sources often call the tallow primarily used for lubrication. The generously undersized musket balls used in smoothbore muskets did not need any lubrication, and therefore the old musket cartridge was extremely simple and could be fashioned from a single piece of paper. New cartridges for rifle-muskets had to keep the lubricant away from the powder, lest they comeingle and the grease contaminate the powder, causing it to clump and cling to the lubricant. This resulted in the use of a "powder cylinder" which was featured in one form or another in all

<sup>8</sup> *Mechanics Magazine* 69 (October 30, 1858): 422  
<sup>9</sup> Major Alfred Mordecai, *Military Commission to Europe, in 1855 and 1856. Report of Major Alfred Mordecai of the Ordnance Department* (Washington: George W. Bowman, 1860)

the paper cartridges of the rifle-musket era. By lubricating the exterior of a paper cartridge where it wrapped around the bullet inside, far more lubricant could be carried down the bore on the large surface area of the paper patch.

These cartridges were “reversed” when loading and they were probably near-direct copies of the French and Belgian cartridges. By “reversed” the period sources refer to the flipping of the cartridge, after the powder had been poured, and then inserting the bullet end (base of the bullet first) into the muzzle, up to the shoulder of the bullet where the lubricant came up to. Then the excess paper of the powder cylinder was torn away, and the bullet rammed. This was another controversy, and most criticism of the cartridge for the P1851 (and later the P1853) was that the loading process was different from the traditional blank cartridge used in training. There was concern that soldiers, trained with blanks, would forget the additional step of reversing the cartridge and tearing-off the powder cylinder with live ammunition in the excitement of combat. Hans Busk dismissed this as a “puerile objection” in his *Hand-Book for Hythe*.<sup>10</sup>

The cartridge for the P1851 would have appeared very similar (except for the grooved bullet) to cartridges in use in France and Belgium. On the bullet end of the cartridge, the paper was not “choked and tied” as it later would be for P1853 cartridges, but instead it was simply twisted together and stuffed into the cavity of the Minié bullet. This would later cause problems, not so much in the P1851 Minié rifle, but unexpectedly in the P1853 Enfield cartridge. The .690-caliber bullet had only 0.012-inches of windage in the .702-caliber bore, and when wrapped in the paper of the cartridge, it was a very tight fit. This early in the era of the Minié system, the obvious goal was for the expanding bullet to eliminate all windage, and therefore the cartridges were made to be only just slightly smaller (as much as one thousandth of an inch smaller) than the actual bore. Sources for the later P1853 cartridge describe the exact thickness of the paper used, but I have found no such information on the thickness of paper used for the P1851. There seems to have been no Regulation standard, and thicknesses seem to have varied. In Sir Howard Douglas’s *Treatise on Naval Gunnery*, he mentions an instance with P1851 cartridges where, “On examination, the paper was found to have been reduced both in thickness and quantity

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<sup>10</sup> Hans Busk, *Hand-Book for Hythe: Comprising a Familiar Explanation of the Laws of Projectiles, and An Introduction to the System of Musketry, Now Adopted by all Military Powers* (London: Routledge, Warne, and Routledge, 1860), 169

compared with that with which the former cartridges were made.”<sup>11</sup> Assuming, however, a uniform thickness of about 0.0025-inches for the paper used and a “quantity” of two wraps around the bullet like the later P1853 cartridge, this would increase the exterior diameter of the P1851 Minié cartridge by 0.011-inches, for a total size of .701-inches, which was *one thousandth* smaller than the P1851 bore. This meant that the bullet needed only to expand slightly to fill the rifling grooves, but it made the rifle very susceptible to fouling, especially in dirty field conditions. Modern muzzleloader shooters, with the advantage of 160 years of hindsight and development, often scoff when I tell them about this and they say “Well, no wonder it fouled, with a thousandth of an inch to spare!” We know this now; they knew it not then. The rule of thumb for modern muzzleloading expanding bullets is to be about 5 thousandths smaller than the bore.

The official School of Musketry text-book casually mentions the “many complaints having been made of the difficulty of loading the Minié rifle with its regulation bullet.”<sup>12</sup> This official history quickly and conveniently glosses over the great troubles with the P1851 Minié rifle, caused by the tight-fitting cartridge. It was actually a disaster that undermined the limited progress that had been made in Britain towards a modern infantry rifle. Critics of the P1851 rifle’s performance would continue criticizing the P1853 throughout its service life, even long after the accuracy and reliability of the P1853 had been demonstrated in British and especially American hands.

Sir Howard Douglas gives attention to the fouling problem of the P1851 in his excellent *Treatise on Naval Gunnery*. The “chief objection to the new Minié rifle-musket consists in its great liability to get fouled... so as to render it sometimes impossible to force the shot down the barrel,” Douglas explained. Per Douglas, who was not particularly fond of the P1851 or the scheme of lubricating the exterior of a paper cartridge, soldiers in combat found bullets jamming in the fouled barrels of their Minié rifles, compelling them to “force it down by striking the ramrod with heavy stones.” This happens, Douglas claims, after only ten or fifteen rounds. Such P1851 Minié cartridges sent to India arrived “totally unserviceable.” The necessity that every cartridge be lubricated was a “great inconvenience” and Douglas (citing a paper by Lt. Colonel Alexander

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<sup>11</sup> Douglas, 520

<sup>12</sup> Text Book, 117

Hamilton Gordon) argued that these tallow-lubricated cartridges would spoil in heat, moisture, and even “the attacks of vermin.”<sup>13</sup>

Not all of this was exaggeration and hyperbole. There *were* problems with the tallow lubricant used for “grease” on the cartridge exterior. It worked great in England, but turned runny in hot colonial weather or in the sweltering holds of transport ships, and would soak into the rest of the cartridge paper and into paper wrappers of the cartridge packs. Problems would be encountered later with the tallow soaking through the cartridge paper, contacting the bullet, and undergoing a chemical reaction with the lead that caused a white crust to form, making the cartridge hard to load. But, by and large, these problems were not as dire as Douglas described them. “Should the grease melt away,” at least one period source advises soldiers to “moisten the cartridge in the mouth in the act of loading.”<sup>14</sup> Even this slight moisture would help reduce the fouling with each shot. (This was not a problem for European soldiers, but would be highly objectionable to Hindu or Muslim soldiers in India.) The P1851 Minié rifle was carried by British troops in the Crimean War, and it served well at Alma and Inkerman, where it easily outclassed the smoothbores still in service in the Russian Army. It was an undisputed step in the right direction. More importantly, the experience of the P1851 cartridge would produce many lessons that would be remembered, and successful changes would be made accordingly, for the P1853 Enfield cartridge.

By 1854, the School of Musketry at Hythe had been opened for training the officers and NCOs of the British Army on the use of the new P1851 rifle. Lt. Col. Charles Crawford Hay, the superintendent at Hythe (and whose name we will see repeatedly during the development of the Enfield cartridge), was in the ideal place to observe the P1851 rifle and propose improvements. To solve the fouling problem, LTC Hay “proposes to diminish the diameter of the shot by 0.005 inch,” or in other words, Hay reduced the size of the bullet from a .690-caliber to a .685-caliber.<sup>15</sup> Thus the paper-patched bullet loaded by the cartridge for the P1851 rifle went from having virtually no windage at all to a few thousandths of an inch of windage. This was against the conventional wisdom of the time, and the universal consensus was that expanding rifle-musket cartridges had to fit the bore very closely. Windage was the enemy that had to be

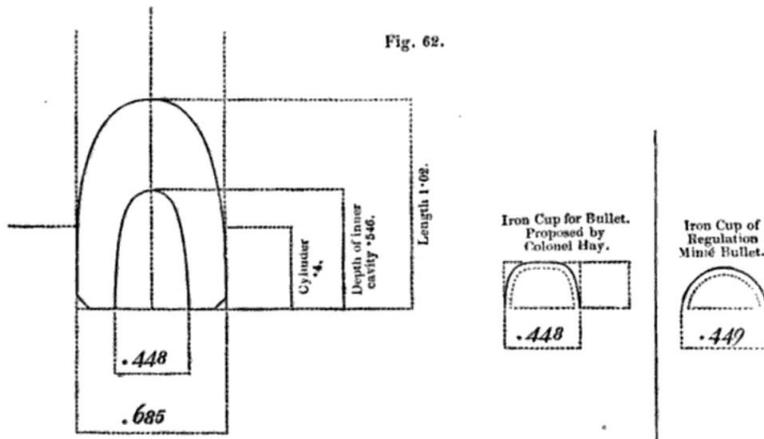
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<sup>13</sup> Douglas, 521

<sup>14</sup> John Scoffern, *Projectile Weapons of War and Explosive Compounds* (London: Longman, Brown, Green, Longmans, 1858), 245

<sup>15</sup> Douglas, 519

overcome, and deliberately increasing the windage of a rifle cartridge was audacious (and, if it failed, certainly would have been the ruin of LTC Hay's career). But it worked; the .685-caliber bullet still expanded into the rifle grooves even though it had to expand 5 thousandths more than the .690-caliber ball. The impact of this decision was profound, not just on the P1851 but



The new .685-caliber bullet for the P1851 rifle as proposed by Lt Colonel Hay, including the new shape of the iron cup from hemispherical to cylindrical-conoidal. From *Naval Gunnery*.

later with the P1853. With the reduction of the bullet size, the P1851 went from an inadequate military weapon that fouled rapidly, to a decisive battlefield combat multiplier. LTC Hay also modified the shape of the iron cup used in the new .685-caliber bullet, from a half-sphere shape to more of a thimble-shape. "These alternations were made," the *Text Book* explains, "as it was found the

loading of the rifle was thereby rendered more easy, while, at the same time, the accuracy of its shooting was not in any way impaired."

These changes were made in March of 1854, the same month that Great Britain declared war on Russia and entered the Crimean War.

#### *Lord Hardinge's Small Arms Committee tests at Enfield, 1852*

The Duke of Wellington died in September 1852. In the months before his death, the Iron Duke was completely deaf and in declining health. His successors, therefore, began quietly experimenting with promising new rifle-musket technology with "small-bore" rifles. It was understood that any new rifle-musket would not be formally adopted until Wellington was dead, out of respect for the Iron Duke. His successor was Lord Henry Hardinge, 1<sup>st</sup> Viscount Hardinge, fifteen years younger than Wellington and a junior officer at the beginning of the Napoleonic Wars. Hardinge went on to serve in Britain's colonial wars and rebellions before succeeding

Wellington as Commander in Chief of the British Army, and this experience had given Hardinge an appreciation for the rifle. He “zealously advocated” for the adoption of a single pattern of rifle-musket for the entire infantry.<sup>16</sup>

Several months before Wellington’s death, when Hardinge was still Master-General of Ordnance, the “principle gunmakers of England” were invited to pattern rifle-muskets for extensive testing at Enfield.<sup>17</sup> Lord Hardinge hoped to use the tests “for obtaining a lighter and more efficient arm with a smaller bore” for the British infantry, since the .702-caliber P1851 ammunition was absurdly heavy and prevented a soldier from carrying a full load of 60 rounds.<sup>18</sup> This commission would eventually result in the rifle that became the Pattern 1853 Enfield. Lord Hardinge also requested the leading gunmakers to present before the Small Arms Committee assembled at Enfield “such suggestions as they might consider would be effectually an improvement on the Minié cup.”<sup>19</sup> Even in spring of 1852, the faults associating the Minié and its expensive, dubious iron cup were appreciated sufficiently that Lord Hardinge would specifically be seeking a replacement. The best description of these tests is in Major Mordecai’s *Report* which endeavors to state facts as directly and plainly as possible with none of the hidden agendas or promotion of one system over the others that is found in the British sources. Major Mordecai summarizes the objective of the tests:

“As before observed the chief object of these trials was to determine on an arm with caliber which would enable the soldier to carry the customary sixty rounds of without fatigue. This could not be done with the Minié arm of large caliber heretofore in use. It was also to present the advantage of greater strength with less weight of metal It was, in addition, the province of the commission to ascertain the influence of the number of grooves, to obviate the use of the culot [iron cup], and to modify the objectionable shape of the ball which was too conical and finally to construct a breech sight less faulty than the one in use on the Minié rifle.”<sup>20</sup>

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<sup>16</sup> Busk, 170

<sup>17</sup> Text-Book, 118

<sup>18</sup> Douglas, 515

<sup>19</sup> Jervis, 61

<sup>20</sup> Mordecai, 121

Six gunmakers sent in muskets for tests at Enfield: Purday (or Purdy), Richards, Lancaster, Wilkinson, Greener, and Lovell. They were all small-bore rifles (between .577 and .530 inches) and represented a wide spectrum of what was then cutting-edge firearm technology. They varied in the number of rifling grooves (Lancaster's was an oval-bore rifle without grooves), the rate of twist, and the progressive depth (or lack thereof) of the rifling. The exact specifications of these rifles are beyond the scope of this work on Enfield ammunition, but it is worth mentioning that Mr. Lovell was the inspector of small arms at Enfield, where he prepared his submitted rifle at the Enfield small arms factory. It was .577-caliber, and had standard rifling of constant depth from the breech to the muzzle, instead of progressive depth rifling.<sup>21</sup>

Although eliminating the compound Minié bullet with its iron plug and developing a new superior bullet was one of the objectives of the tests at Enfield, all but one of the submitted rifles for testing utilized compound bullets. They relied on "either a separate plug, or an iron or a copper cup, to produce the required expansion."<sup>22</sup> One type of bullet (Mr. Westley Richards's bullet) even used an expanding plug made from horn.<sup>23</sup> The lone exception was Mr. Wilkinson's solid bullet that had no cavity or hollow of any kind, but grooves in the base of the bullet that made the base lighter (less mass) than the nose. Much like Austrian bullets, it relied on "upsetting" to fill the rifling and Wilkinson designed it to be loaded naked, without any paper patch. Unfortunately, it could not be adapted to work in a paper cartridge, as upon firing the grooves in the bullet "closed up by the force of the powder and nipped the paper round it, and held pieces of it during its flight."<sup>24</sup> With the exception of Mr. Wilkinson, "every one of the makers changed either his musquet or projectile during the course of the trials," complained then-Lt. Colonel Alexander H. Gordon, "thereby causing them to be protracted."<sup>25</sup> Major Mordecai reports that all of these bullets were for the most part "entirely unsuited for field service."<sup>26</sup> In between delays caused by the gunmakers modifying their rifles or bullets, valuable

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<sup>21</sup> Douglas, 516. This page also lists convenient table of the rifles tested

<sup>22</sup> Jervis, 61

<sup>23</sup> Colonel Sir Alexander Hamilton Gordon, *Remarks on National Defence, Volunteers and Rifles: With a Report on Experiments with Small Arms, Carried on at the Royal Manufactory at Enfield in 1852, Volume 11, 7*

<sup>24</sup> Jervis, 61

<sup>25</sup> Gordon, 5

<sup>26</sup> Mordecai, 212

experimentation was conducted to the best types of bullets, ideal cartridge construction, and other factors. The tests dragged on throughout the summer of 1852.

A month before Wellington's death, two rifles were produced at Enfield in August 1852 that would be the prototypes of the most successful rifle-musket of this turbulent and ever-changing period in firearm development. They "embodied the improvements and alterations suggested by the experience obtained during trials."<sup>27</sup> The rifle-muskets themselves are handled very well and thoroughly by C.H. Roads in his landmark *The British Soldier's Firearm 1850-1864* and many others. For our purposes, it is sufficient to understand that slight modifications of these prototype rifles would eventually be adopted as the Pattern 1853 in .577-inch caliber, and constant-depth rifling. Because it was produced at the Enfield small arms factory, the new rifle was known as the "Enfield rifle" and so-called almost immediately, to differentiate it from the P1851 Minié rifle. All the new Enfield rifle needed was a bullet that met the requirements of Lord Hardinge and was, above all, highly accurate.

### *Robert Taylor Pritchett*

The name "Pritchett" is still closely associated with the P1853 Enfield rifle, although much like Captain Minié before him, most bullets that are described as being Pritchett bullets really aren't Pritchett's at all. Especially in the modern era (and among muzzleloader shooters today) a "Pritchett bullet" usually refers to any smooth-sided conical bullet with a cavity.



**R. T. PRITCHETT.**  
*(From a Photograph by H.  
Bibo, Warwick.)*

The actual "Mr. Pritchett" was a fascinating figure, who is among the few individuals in history to be incredibly successful in several completely different pursuits. Robert Taylor Pritchett is best known today as an artist and an author. He wrote a commercially successful tourist's guide for Norway and a less successful book on yachting. As a landscape and portrait painter, he achieved considerable renown during his life and secured the patronage of none less a figure than Queen Victoria, when in 1868 she purchased the first of over eighty of

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<sup>27</sup> Douglas, 521

his paintings ultimately commissioned for the royal family and displayed at Balmoral. A favorite of the Queen, he accompanied her closely during the events of her Diamond Jubilee. His access to the royal family (and primary source of income) ended with the Queen's death in 1901 and he faded back into obscurity in the final years of his life.<sup>28</sup> His obituary in the *Times* in 1907 described him as "a man of strangely varied talents who had in some measure outlived his fame."<sup>29</sup>

In August of 1852, when the Royal Small Arms Factory at Enfield built the prototype Enfield rifle-muskets, Pritchett was a 23-year old gunmaker working for his father's firm, which primarily made arms for the East India Company. In 1852, Pritchett was acquainted with 27-year old William Ellis Metford, whose name is closely associated with the developing the rifling for Lee-Metford .303-caliber magazine rifle. The two shared an interest in firearms and Pritchett was at this time (mid-1852) experimenting with a smooth-sided bullet with a base cavity, but no cup or plug. According to Metford's biographical sketch, it was Metford who "late in 1852 or early in 1853 suggested a hollow-based bullet for the Enfield rifle, expanding without a plug."<sup>30</sup> Most period sources omit any mention of Metford in the development of the Enfield bullet, although there are surviving "Pritchett (Metford)" bullet molds. If it was largely Metford's creation, he must have been a gracious and humble man who allowed Pritchett to receive the fame (and even a £1000 award from the House of Commons) for the Enfield bullet.

Following the experiments at Enfield, Lord Hardinge wanted to "get rid of the iron cup" from the Minié bullet, as its flaws had become very evident. According to Major Mordecai's report, Pritchett was one of the local London gunmakers who had submitted a bullet proposal to the Small Arms Committee. His bullet was initially passed over, and "at first a ball was used as constructed on the principles of Minié; but at the close of experiments it was referred to Pritchett, the gunmaker, to furnish a ball without culot, such as he had submitted at former experiments and which had given satisfactory results."<sup>31</sup> Sir Howard Douglas makes no mention of an initial adoption of a Minié-style, and relates that Pritchett "was requested to adapt for the

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<sup>28</sup> Sir Sidney Lee, ed. *Dictionary of National Biography, 1912 Supplement, Volume 2* (London: Smith, Elder & Co, 1912), 138

<sup>29</sup> *The Times*, 20 July 1907

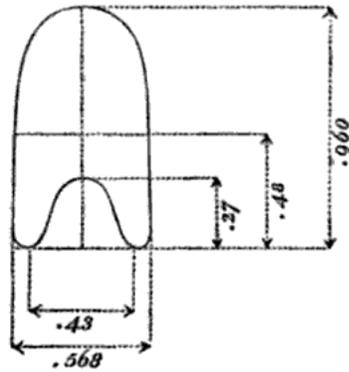
<sup>30</sup> Sir Sidney Lee, ed. *Dictionary of National Biography, Supplement Volume III* (London: Smith, Elder & Co, 1901), 165

<sup>31</sup> Mordecai, 213-214

bore of this musket a projectile without cup or plug, of a pattern which he had recently been trying with great success.”<sup>32</sup> Thus Pritchett’s bullet, developed by two men in their twenties, was first fired from the Enfield rifle, and found to have “yielded excellent practice.”<sup>33</sup>



Fig. 63.



The Pritchett bullet, as designed by R. T. Pritchett in 1853. Note the small cavity, and the smooth, rounded edges of the base of the bullet. From *Naval Gunnery*.

In December of 1852 the rifles submitted by the English gunmakers, alongside rifles produced by the government factory at Enfield, were extensively tested out to a range of 800 yards, with Pritchett’s bullet. The delay, as previously mentioned, was the result of the gunmakers making adjustments to their rifles and projectiles. In a fair competition,

the Enfield rifle outperformed all others. Colonel Gordon’s *Remarks on National Defence* describes the shooting of the Pritchett bullet in the new .577-caliber Enfield rifle:

“The shooting of these musquets with this bullet at distances up to 800 yards was found to be superior to any that had yet been tried when loaded according to the usual Minié style with greased cartridges, reversing the bullet. They were also tried with the same bullet as before, made up into cartridges, loading without reversing like the old spherical ball. The shooting was tolerably good but the barrels fouled immediately above the powder for about two inches, probably from the ungreased paper between the powder and the greased bullet being charred on the explosion of the gunpowder and leaving a slight deposit adhering to that part of the barrel. In the Minié system the greased paper around the bullet lies close above the powder and lubricates the entire barrel at every shot.”<sup>34</sup>

<sup>32</sup> Gordon, 45

<sup>33</sup> Busk, 141

<sup>34</sup> Gordon, 46

Colonel Gordon called the Pritchett superior to anything; the *Text-Book* from Hythe was a little more cautious, calling the Pritchett “equal in accuracy” to any of the rifles previously tested. Major Mordecai’s report states “the efficiency and accuracy of this rifle exceeded all others of the grooved arms up to 800 yards, especially when loaded with the greased envelope.”<sup>35</sup> At the tests conducted in December 1852, young Mr Pritchett “fired every shot” himself from the Enfield rifles utilizing his bullet.<sup>36</sup> Thus, to Mr Pritchett’s other talents, can be added the remarkable achievement of outshooting the most prominent gunmakers in England in a competition among the cutting-edge of rifle technology. That he defeated them in fair competition with a bullet of his own design is even more remarkable.

Mr Pritchett’s bullet handily met the requirements and expectations of Lord Hardinge and the Small Arms Committee. It was solid with a shallow cavity in the base, with none of the cups or plugs used by the other rifles submitted. The bullet weighed 520 grains, just under an inch long at .960 and with a diameter of .568-inch. During the tests the charge used with this bullet was 2¼ drams, or about 61.5 grains of “F. G.” powder, according to both Jervis and Colonel Gordon.<sup>37</sup> At some point before the official adoption of the Pattern 1853 rifle, the charge was increased to 2½ drams, or 68.4 grains. The bullets were made up into cartridges the same way as the P1851 Minié cartridges, with the remainder of the paper at the base end of the bullet twisted and stuffed “into the hollow of the bullet.”<sup>38</sup>

The bullet *worked*, but there was disagreement over *how* it worked. According to Boucher and others, the mechanism of expanding Mr Pritchett’s bullet was the same theory behind the Wilkinson solid bullet, by which the lighter base (so lightened by the hollow in the base) is driven forward faster than the heavier bulk of the bullet. As described by Jervis in his treatise *The Rifle-Musket*:

The expansion of this bullet is obtained by its being made of such a length in proportion to its diameter that the force of the powder when ignited acting suddenly against the base drives it up

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<sup>35</sup> Mordecai, 213

<sup>36</sup> M. H. Speilmann, *The History of Punch* (New York: Cassell, 1896), 520

<sup>37</sup> Jervis, 62 and Gordon, 48

<sup>38</sup> S. Bertram Browne, *A Companion to the New Rifle Musket, Comprising, Practical Information on the Cleaning and Management of Arms, and on the Making of Cartridges* (London: John Parker & Son, 1855), 55

slightly before the inertia of the point of the bullet is overcome thus causing it to expand throughout its cylindrical part and more especially at the shoulder the most important part being directly over the centre of gravity. The hollow at the base is used more with the view of lightening the bullet and throwing its centre of gravity forward than to obtain expansion by its means.<sup>39</sup>

Boucher calls Jervis's explanation "true science" in his *Treatise on Rifle Projectiles* after excoriating the adherents of the Minié school. Colonel Lane-Fox agreed with him in his essay *On the Improvement of the Rifle*. "Thus after all the ingenuity which had been expended in devising a method of self expansion after trials in which cups of various shapes, plugs of iron, lead, wood, horn, and other materials had been successively attempted, it was found that a plain leaden bullet was that which most perfectly fulfilled the necessary conditions, at the same time combining them with the utmost simplicity of form and construction."<sup>40</sup> On the other hand, most of the staff at the newly-established School of Musketry at Hythe attributed the expansion of the Pritchett bullet to the force of gas expanding the hollow base. Colonel John Clark Kennedy, chief instructor at Hythe, in his *Theory of Musketry*, describes "the expansion [...] is obtained by the direct action of the gunpowder upon the hollow at the base of the bullet [...] the lead yields to the force of the charge, and the same result, or nearly so, is obtained as when the iron cup is used."<sup>41</sup> Sir Vivian Dering Majendie, assistant superintendent at Woolwich from 1861-1871, believed both forces were at work: "In the Pritchett bullet for example which for some short time was used with the Enfield rifle there is only a shallow hollow and the expansion is due partly to the action of the gas within this hollow and partly to the upsetting of the bullet which is due to its inertia."<sup>42</sup>

This marked the end of Robert Taylor Pritchett's contribution to the bullet that carries his name, and its marriage to the Enfield rifle (very early, the new rifle was sometimes called the "Enfield-Pritchett Rifle").<sup>43</sup> I have encountered no period source that gives the inventor's opinion of the

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<sup>39</sup> Jervis 62

<sup>40</sup> Colonel Augustus Henry Lane-Fox, *On the Improvement of the Rifle as a Weapon for General Use* (London: W. Clowes & Sons, 1858), 27

<sup>41</sup> Major J. Clark Kennedy, *The Theory of Musketry, Adapted for the Use of the Troops* (London: Parker, Furnivall, and Parker, 1855), 3

<sup>42</sup> Major Sir Vivian Dering Majendie, *Arms and Ammunition of the British Service* (London: Cassell, Petter, & Galpin, 1872), 11

<sup>43</sup> Jervis's treatise, frequently cited, is one such example

mechanism of his bullet's expansion; he certainly did not leap into the debate. He continued as a gunmaker, producing P1853 rifles on contract for the British government that were stamped "RT Pritchett, London" on the lockplates.

### *The Enfield-Pritchett Cartridge, 1853-1855*

The only sources I have found (so far) that provide patterns and dimensions for the papers used in making the earliest Enfield cartridges are from manuals of instruction. These manuals were provided to British Army units so that the troops could make their own ammunition in an emergency situation where factory-produced cartridges could not reach them. For this reason, the manuals also include instructions on how to make gunpowder. It is *very important* to acknowledge the differences between cartridges made by soldiers in an emergency, and cartridges produced by the Royal Arsenal and contractors. This must be said now, before further cartridge patterns are introduced and before any confusion can be made between factory ammunition and soldier-made ammunition.

However, the patterns provided in these manuals of instruction for British troops are very early (1855) and are made in the manner described (and illustrated) the same way as the P1851 Minié cartridge. They are probably close to the official regulation ammunition being made at the Royal Arsenal; I just do not know for sure.

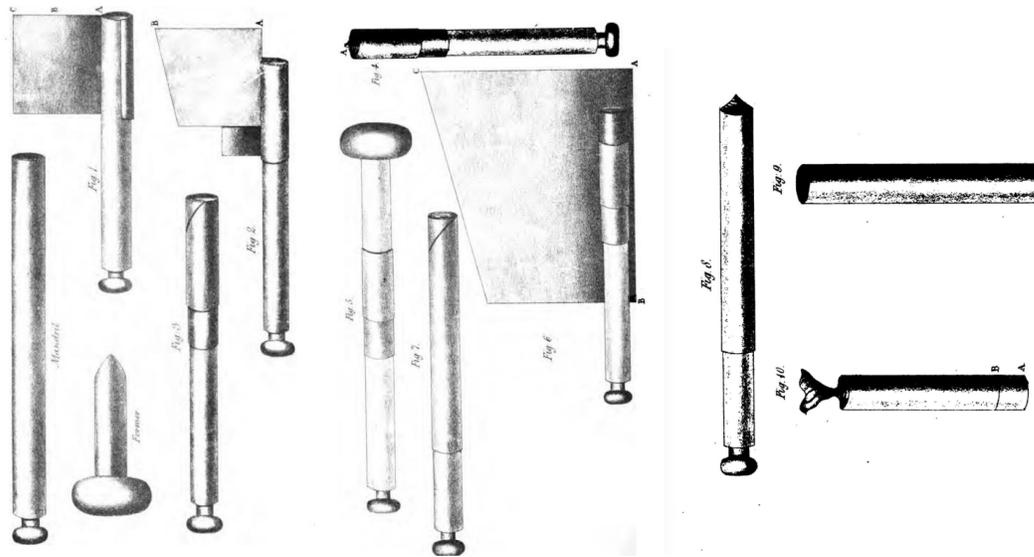
In February of 1854 (before the official adoption of the Pattern 1853 rifle), Lord Hardinge directed the War Office to print a manual titled *Instruction of Musketry*, establishing a "uniform system" for training soldiers how to correctly use rifled muskets.<sup>44</sup> This was the first time that soldiers of the regular infantry were each being issued a rifle, which previously had been considered a delicate, expensive weapon too complicated for the ordinary private to successfully use. Among the different areas of instruction (from "judging distance drill" to surprisingly in depth lessons on the theory of a bullet's flight) was the manufacture of cartridges. "In each

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<sup>44</sup> The *Instruction of Musketry* from 1854 would be revised twice, with 1856 and 1857 editions. Instead of yet another revision, the *Instruction of Musketry* was entirely replaced by the *Regulations for Conducting the Musketry Instruction of the Army* in 1859. To obviate any confusion, the dates of each are always given in parenthesis.

company,” states the *Instruction of Musketry* (1854), “from ten to a dozen men will be instructed in the manufacture of cartridges.” Then follows a list of necessary tools, step by step instructions for assembling the cartridges, and patterns for the three separate pieces of paper used for the early cartridge. One piece was made from stiffer “cartridge paper” that was used for the cylinder of the powder chamber, while the other two pieces were made from “white fine” paper. Like the earlier P1851 cartridge, and the French and Belgian cartridges from the 1840s, the cartridge was not “choked and tied” with string. *Instruction of Musketry* from 1854 instructs soldiers to “fold” the paper over the base of the bullet; other manuals directed them to “twist” it into the hollow of the Pritchett bullet. (See appendix for the cartridge patterns, year to year).

*Instruction of Musketry* (1854) makes no mention of the actual model of rifle discussed, and if the mandrels were not indicated as being .48-inch in diameter (the proper size for making cartridges for the .577 Enfield), I would have assumed the pattern provided was for the P1851 Minié rifle with its .690 (or .685) caliber bullet. This pattern has an *enormous* outer wrapper labeled the “Trapezium Envelope” that is 5½ inches on the longest side. Out of curiosity, I made a cartridge using this pattern and an original .568-caliber Pritchett bullet. Even when using thin tracing paper, the finished cartridge measured about .578-inches around the bullet, with the Trapezium Envelope outer wrapper making nearly 3 complete wraps around the bullet. This was with 16lb weight paper 0.0025-inches thick, while the historical “white fine” paper was known to be just slightly lighter at 13lb weight, and about 2-thousandths of an inch thick. This means the historical cartridge with white fine paper would come out almost exactly to .577 in diameter; there is *no windage* with the cartridge pattern provided in *Instruction of Musketry* (1854). It fits the bore precisely. Bear in mind that the official change from a .690-caliber to a .685-caliber bullet for the P1851 had not yet been made at the time that the Enfield-Pritchett cartridge was developed in late 1852 and throughout 1853, and therefore the Enfield-Pritchett cartridge was made to have as little windage as possible (this would become a problem later). Like the P1851 Minié cartridge before it, the excess paper at the bullet end was twisted together and stuffed into the hollow in the base of the ball. The lubricant was “grease” of six parts tallow to one part beeswax.



The cartridge-making illustrated instructions from *A Companion to the New Rifle-Musket*. Note the “twisting” of the excess paper at the base of the bullet, which was then stuffed into the hollow of the Pritchett ball.

We have another pattern for the Enfield-Pritchett cartridge from this very early period that is found in S. Bertram Browne’s *A Companion to the New Rifle-Musket*, a privately published work with a first printing in 1855. Browne, who was one of the early instructors at the School of Musketry at Hythe, produced his *Companion* at the urging of Colonel A. Lane-Fox, who was then

**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 A B, the base of the bullet at  $\frac{1}{2}$  an inch from the base A C of the envelope (Fig. 6); press the point of the bullet into the cavity, roll the envelope tightly on the bullet and on the Mandrel (Fig. 7), twist the remainder of the envelope into the hollow of the bullet (Fig. 8); 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 9).**

Text of the instructions in *A Companion to the New Rifle-Musket* corresponding to the illustrations above; again, note the instructions to “twist the remainder of the envelope into the hollow of the bullet.”

the Chief Instructor at Hythe. This is the same Colonel Lane-Fox who sided with Boucher against the Minié system, and we will hear from him again. The *Companion* is filled with lots of useful information about the early P1853 Enfield rifle, which Browne describes as “one of the most perfect weapons” that science has put into the hands of soldiers.<sup>45</sup> It also clearly came after the 1854 *Instruction of Musketry* because it repeats several sections nearly word for word. However, under the heading “Manufacture of Cartridges” the *Companion* provides a vastly different pattern

<sup>45</sup> Browne, 5

than the one in *Instruction of Musketry* (1854).

I made up a cartridge with the *Companion* pattern, which used a much smaller Trapezium Envelope, and found it to have an overall diameter of .574 inch. At first this was baffling, but then I considered that this *Companion* was purely a soldier's handbook and the cartridge pattern provided was probably modified from the *Musketry* version to deliberately produce a cartridge with a smaller overall diameter. This way, if soldiers did not roll the cartridges as tightly as the "professionals" at the Royal Arsenal, their cartridges would still load. This was emergency ammunition, and if the cartridges had a little more windage, that was to be immensely preferred over being made too large to be loaded at all. Colonel Lane-Fox, and Instructor Browne himself, would have seen soldiers struggling to master the making of cartridges (which was part of the instruction at Hythe), and therefore they certainly saw first-hand the useless monstrosities that the soldiers produced. Making cartridges requires patience, dexterity, and a "knack" for it that some people do not naturally have. Painting with a broad brush, the period sources written primarily by senior Army officers and others with "Lord" or "Sir" in front of their names have a less than flattering opinion of the common soldier, and the *Companion* even entreats the soldier with a passionate plea to take care of the expensive, delicate P1853 rifle lest he break it from pure stupidity. (Before casting judgment on the bluebloods of the mid-19<sup>th</sup> century British Army, consider that a recent Army chief of staff said that the "number one" priority of the U.S. Army is eliminating sexual assault, i.e. getting soldiers to stop raping people.) When soldiers in the British Army *did* have to make their own ammunition during the Siege of Lucknow in the Indian Mutiny, their ammunition was serviceable, so enough must have mastered the skill at Hythe to teach their comrades during the siege. Lubrication was the same as the *Musketry* cartridge, six parts tallow to one of beeswax.

Was the *Instruction of Musketry* pattern of 1854 similar, or possibly identical, to the regulation cartridges produced by the Royal Arsenal? With little definitive proof but strong circumstantial evidence, I believe it was. This is the pattern given by the official government publication, therefore it is reasonable that it would provide the official regulation cartridge. It produces a cartridge with essentially no windage that fits the bore of the .577 rifle almost exactly. In Hans Busk's *Hand-Book* he mentions that "Great care must be taken that, whatever the paper used, it

may not increase the diameter of the bullet when the cartridge is completed more than 9 thousandths of an inch.”<sup>46</sup> He also mentions that the windage of the original Enfield-Pritchett cartridge with .568-caliber bullet was only 0.001-inches, which gives an overall exterior diameter of .576-inch of the complete, *correctly-made* cartridge.

And “correctly made” are the key words. When made properly, by all accounts these cartridges performed wonderfully, even though they were a very tight fit in the bore. This meant that regardless the mechanism that expanded the Pritchett ball (whether “upsetting” or the Minié principle or a mix of both), it only needed to expand a few thousandths of an inch at most to fill the constant-depth rifling of the early Pattern 1853 rifle. The lubricated patch coated the bore with tallow, which would liquefy instantly upon touching a warm rifle barrel and anoint the bore as the charge was rammed. Fouling from the previous shot, when moistened slightly with the tallow, was loosened from the interior of the rifle barrel and blown out with the firing of the next bullet. Then the process was repeated with the next loading, and therefore even with an incredibly tight-fitting cartridge of .576-inch diameter in a .577-inch bore, the *fouling was controlled*. The name “lubricant” is technically incorrect: the tallow (and later primarily beeswax) was an anti-fouling composition that did nothing to “lubricate” the bullet as it was rammed. More on the lubricant later.

Colonel Lane-Fox recalls that as First Instructor at Hythe (before 1855), “as many as 150 rounds were frequently fired out of the same barrel” without any fouling or difficulty of loading. Even more remarkably, the rifles were left to sit overnight without any cleaning “in order to make the test severe.” They still loaded and fired “without experiencing the slightest difficulty in loading.”<sup>47</sup> Busk’s *Hand-Book* says rifles were fired “200 times successively without any difficulty in loading.” As long as everything was *just right*, with properly made ammunition, the P1853 was a remarkable weapon. It had been the undisputed winner of a fair competition; it utilized a solid bullet that satisfied the anti-Minié system critics like Boucher; it solved the fouling problem so completely that a soldier would collapse from fatigue before his rifle could no longer be loaded. The word “perfect” was used by intelligent, rational men to describe it.

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<sup>46</sup> Busk, 88

<sup>47</sup> Lane-Fox, 28

Then the Enfield-Pritchett rifle went to war.

*The Flaws – the P1853 Enfield in the Crimean War, 1855-1856*

The P1853 rifle caught the tail end of the Crimean War. The Russians had some rifles, but they were mostly garbage comparable to the old English Brunswick rifle, and inaccurate beyond close range. Most of the Russians were armed with smoothbore muskets, and they could only crouch behind their earthworks at Sevastopol because their muskets could not reach the British lines several hundred yards away, while the British riflemen easily could.

In March of 1854, Lt Colonel Hay had ordered the reduction of the P1851 bullet from .690 to .685 inches. This solved the fouling problem for the P1851, which by this time had been in service just long enough for it to be sent all over the British Empire, and for ammunition to degrade in transport and storage. It took very little for a cartridge that fit the barrel with one thousandth of an inch to spare to loosen up, or have the lubricant dry out, which would quickly make the rifle-musket unloadable (with the associated stories of soldiers pounding ramrods with stones, etc.). I don't know why these very intelligent men did not think that the same thing would inevitably happen to the ammunition for the P1853 Enfield when subjected to the same service conditions.

There were, in fact, two separate complaints about the service ammunition. The first resulted from combat experience in the Crimea, while the other issue was encountered in the carefully controlled shooting grounds at Hythe with fresh, brand-new ammunition.

Colonel Lane-Fox reports that when P1853 Enfield rifles began to arrive in the Crimea, they were “probably in an extremely dirty or oily condition.”<sup>48</sup> We have, thanks to Lane-Fox, an exact description of the flaws with the early Enfield-Pritchett cartridge. Using very tight fitting cartridges, any dirt or excess oil (which collects dirt and particles) in the rifles would lead, as Lane-Fox describes, to “difficulties” under the best of circumstances. When combined with

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<sup>48</sup> Lane-Fox, 28

cartridges that had been made at Woolwich and then shipped thousands of miles by animal-drawn cart, railroad, and steamship through climates from chilly England to the sweltering southern Mediterranean, it was a recipe for disaster. The ammunition (which should not be a surprise to anyone) suffered the same ill effects as the P1851 Minié cartridges, which had arrived in India “unserviceable” a few years earlier. The tallow-based grease melted off the cartridges once exposed to heat (the 6 to 1 tallow/wax composition will melt into a pool in the palm of my hand from body heat alone). With no lubricant left on the cartridges, they failed to control fouling and soldiers quickly found themselves struggling to ram the bullets home after firing only a couple of rounds. Lane-Fox was in Malta when he learned of these problems (mid-1855) and he immediately conducted tests with soldiers armed with the new P1853. Out of 60 soldiers in the test, 15 of them had P1853 Enfield rifles “rendered unserviceable” and unable to be loaded before they had fired 60 rounds. Trying the same test with the P1851 Minié rifle (which my mid-1855 would have the .685-caliber bullets), Lane-Fox found some difficulty in loading “but in a less degree” than the new P1853’s. He submitted a report, in August of 1855, summarizing his findings.

The problem, Lane-Fox determined, was with the cartridges. When shipped over long distance and subjected to heat, the cartridges “when saturated with grease became like wet leather, and [were] very liable to crease.” He describes the cartridges thus:

“The external case of the cartridge enclosing the bullet and charge was not rolled tight enough upon the sides of the bullet so that when the cartridge was put into the barrel the paper saturated with the grease in hot weather began to crease in the manner which was represented in a diagram that accompanied my report and this no doubt increased as the bullet went down the barrel In some of the charges which were afterwards punched out by the armourer the paper was found to be rolled up into a kind of string This I said would be quite enough to account for hard loading.”<sup>49</sup>



The Enfield-Pritchett cartridge “creasing” in the muzzle. In an illustration from Lane-Fox’s *On the Improvement of the Rifle*. Note the stuffed paper in the Pritchett hollow.

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<sup>49</sup> Lane-Fox 29

In other words, the cartridge had begun to “unravel” itself, because (as Lane-Fox recognized) the twist at the base of the cartridge that was stuffed into the cavity of the Pritchett bullet was liable to un-twisting itself. Only this twisted, stuffed paper held the cartridge together; it was not tied or “choked” with string like later cartridges. “The base of the Minié bullet is broader than that of the Enfield,” Lane-Fox accurately observed, “and is better adapted to hold the paper which is folded [twisted] upon it.” The Pritchett bullet had a shallower hollow, and a much narrower base that was also curved and smooth, unlike the more squared-off hollow of the Minié bullet. As a result, the twisted and stuffed paper tail in the hollow of the Pritchett bullet had relatively little to grab on to.



**Base of the P1851 bullet, with broad, square base. From authors collection.**

It is easy to imagine this tail un-twisting itself from the shallow, smooth hollow of the Pritchett bullet as the cartridge was jostled by the severe mid-19<sup>th</sup> century transportation methods. Then the grease melted off in the heat. Upon arrival, British soldiers attempting to load unraveling, unlubricated cartridges encountered the expected difficulties. Either the unraveling cartridge paper “creased” and bunched up at the muzzle around the bullet (which Lane-Fox very helpfully illustrated in his August 1855 report), or the cartridge untwisted and the bullet slipped “naked” through the paper. “The paper which ought to have gone down with the bullet frequently came out adhering to the head of the ramrod,” Lane-Fox

described. Such bullets were hopelessly inaccurate and led to uncontrolled fouling, rendering the rifle useless after a few shots. Even worse, as a painful irony for the new rifle described as “perfect” on its adoption, the new .685-caliber ammunition for the P1851 Minié rifle performed better than the new P1853 Enfield.

This led to a storm of criticism from combatant commanders who complained that the “perfect” weapon promised to them was troublesome at best, and useless under the worst conditions.

All of this must have been supremely humiliating for the Small Arms Factory at Enfield and especially the School of Musketry, its superintendents and leading instructors, who had promoted the P1853 Enfield rifle, praising its accuracy out to astounding ranges and boasting that it could be fired 150 or 200 times with ease. I find it *very* interesting that the staff at the School of Musketry (and the *Text Book* with the “official” account) never mention any problems with the Enfield-Pritchett ammunition in combat conditions in the Crimea. Instead, they blamed the manufacturers of the rifles and the cartridges for sloppy tolerances, and the only problem officially acknowledged was the loss of accuracy with bullets that were *too loose* in the barrels.

The government-published *Text Book* begins by observing that the Pritchett bullet will shoot well when the bullet is exactly .568 and the Enfield barrel is exactly .577, but that all bets were off if the dimensions of the bullet or size of the barrel varied. According to the *Text Book*, three-thousandths of an inch “are allowed as a margin in boring the barrel, and one-thousandth in manufacturing the bullet.”<sup>50</sup> In other words, the *Text Book* claimed, bullets sized as small as .567 could be fired from rifle barrels as large as .580 which results in the Pritchett bullet failing to expand enough to achieve consistent accuracy. This was “satisfactorily proved in a long course of experiments” at Hythe in 1855.

Hans Busk’s *Hand-Book for Hythe* gives a slightly different account, blaming only the ammunition. “In May, 1855, the ammunition supplied to Hythe was discovered to be in a most unsatisfactory condition,” Busk explains, “bullets of various diameters being found in every package of cartridges.” The correctly sized .568 Pritchett bullets shot well out to 600 yards, but “those of less diameter were most irregular in their flight.” In his brief description, Busk does not blame the rifle barrel tolerances as the *Text Book* does, only the ammunition. The problem according to Busk were the dies in use at Woolwich, which were “made small at first” because they would rapidly wear larger and be “replaced at once” if they became larger than .568-inch. Bullets made on the new dies were too small, and therefore were inaccurate.<sup>51</sup>

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<sup>50</sup> *Text Book*, 114

<sup>51</sup> Busk, 141-142

“To obviate this difficulty,” Hans Busk explained, “Hay, [the superintendent of the School of Musketry] recommended a return to the iron cup bullet when more uniform expansion resulted and consequently greater accuracy was attained.” The *Text Book* gives a similar explanation: to “correct any imperfections” in either the bullets or the bore of the rifle, “the cavity in the base of the bullet was altered, and an iron cup placed there as an auxiliary to expansion, on the strong recommendation of Colonel Hay.”

This was the end of Mr Pritchett’s bullet; for the rest of the service life of the P1853 Enfield, bullets with expanding plugs devised by Charles Crawford Hay and Edward Mounier Boxer would be used. The return to the iron cup, according to the *Text Book* and *Hand-Book*, was to ensure the positive, instantaneous expansion of a slightly smaller bullet that could be loaded into a slightly oversized rifle barrel. This way, regardless of what combination of bullet or barrel might be encountered, the expansion would be uniformly assured.

Therefore, according to both Hans Busk and the *Text Book*, the problem was first identified by the School of Musketry, and the solution proposed by the superintendent of the School of Musketry. No other problems with the ammunition were mentioned. This conflicts with Lane-Fox, who spoke of the problems encountered in Crimea and then in the very next sentence states “To remedy this, it had been proposed at Hythe [...] to re-introduce the cup.”<sup>52</sup>



The change from the solid Pritchett to a modified iron cup compound bullet was undertaken while Britain was at war. Fifty million iron cups were ordered from Greenfield, of Broad Street, Golden-Square.<sup>53</sup> The only depiction of this bullet with iron cup is in the *Hand-Book for Hythe*, described as “Regulation Enfield with box-wood plug (section), (the cup, formerly used, is shown at the side).<sup>54</sup> By all accounts, the iron cup bullet was employed very briefly,

perhaps only for a few months. Busk describes the iron cup bullet had “more uniform expansion” and that “greater accuracy was attained” with it than with the original Pritchett cartridge. After

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<sup>52</sup> Lane-Fox 28

<sup>53</sup> *Mechanics Magazine* 69 (October 30, 1858): 422. Golden Square was only a block away from the infamous pump at Broad Street, which was responsible for the tragic cholera outbreak in 1854.

<sup>54</sup> Busk, 144 (Plate 8, number 14)

Greenfield had already been paid for fifty million iron cups, Colonel Hay decided to use a boxwood plug, instead.

### *Colonel Hay's Boxwood Plug*

The available primary sources differ on how (and why) Colonel Hay decided to adopt a boxwood plug for the P1853 Enfield bullet only a matter of months after going back to the iron cup.<sup>55</sup> The *Text Book* states that experiments were ordered in 1855 to determine the “best material and shape for the cup or plug,” after Colonel Hay had already made his recommendation and the iron cups had already been ordered from Greenfield.<sup>56</sup> Hans Busk, who had just said the iron cup bullets performed with “uniform expansion” and great accuracy, says that Hay “subsequently suggested a most valuable and important improvement. He effected expansion infallibly, by the use of a wooden plug.”<sup>57</sup> The word *infallibly* is important. Writing about the adoption of the wooden plug over 15 years later in 1872, Major Majendie (an expert on the subject, as Assistant Superintendent of the Royal Laboratory from 1861 to 1871, serving primarily under Edward Boxer) stated “The Pritchett bullet was found to foul, from the simple reasons that the expansion was not so promptly effected as in a plugged bullet and thus a rush of gas over the bullet became possible.”<sup>58</sup> According to Busk, Majendie, and the *Text Book*, the plug achieved instantaneous and infallible expansion of the bullet, while the older Pritchett bullet’s expansion was thought to be gradual, not completely filling the grooves until it had moved an appreciable distance down the barrel. Even slight variations in the sizes of bullets and barrels could exacerbate such problems.

The *Text Book* gives three “advantages” of the newly adopted boxwood plug bullet:

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<sup>55</sup> Lane-Fox was in Malta in May or June of 1855 when he heard of the “retrograde step” of the Hythe proposal to “re-introduce the cup and subsequently a wooden plug” (p28) and he thereupon conducted his Malta tests, submitting his report in August 1855. This means the wooden plug was adopted before August 1855, and with Hans Busk stating that Colonel Hay proposed the adoption of the iron cup in May 1855, the iron cup bullet was abandoned only a few weeks after it was proposed.

<sup>56</sup> Text book 121

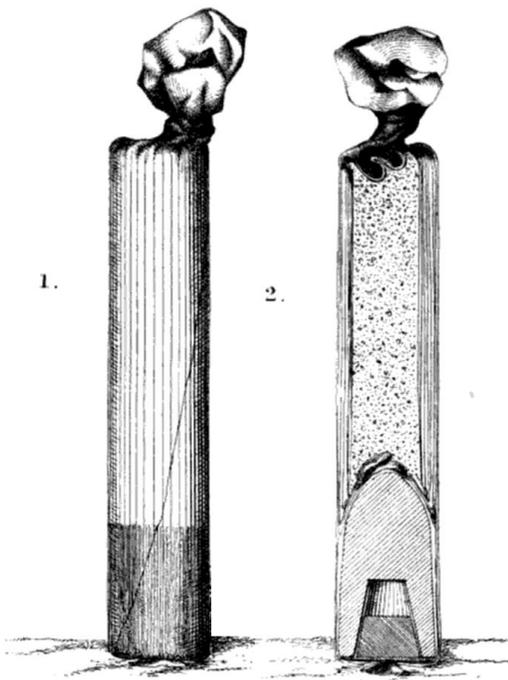
<sup>57</sup> Busk, 142

<sup>58</sup> Majendie, 11

1st Greater more certain and uniform expansion leaving at the same time a sufficient margin to cover any trifling inaccuracy in diameter either of bore or bullet of rifle caused by imperfect manufacture

2nd Great decrease of fouling with corresponding facility of loading

3rd Increased accuracy of shooting.<sup>59</sup>



Post-1855 Enfield cartridge with boxwood plug and double thicknesses of outer and inner wrappers twisted to seal the powder.  
From Hawes' *Rifle Ammunition*

The hollow in the bullet cavity was redesigned again, into what modern bullet collectors call the “plug cavity.” When the plug was in place, the base of the bullet was now completely filled up; there was no hollow to twist and stuff the excess cartridge paper into. Therefore, the boxwood plug cartridge had to be *choked and tied* with string. Boxwood was chosen for its hardness and ability to be machined to the correct size, but boxwood was also very expensive and already a fiercely sought after commodity as the wood of choice for woodcut illustrators. Period sources derisively blamed the “wiseacres” from the School of Musketry for wasting government money in the purchase of the now-useless

iron cups, and the switch to an expensive and largely foreign-sourced wood for plugs.<sup>60</sup> The machinery developed to make the wooden plugs was also expensive, promoting the critics to complain about the steadily

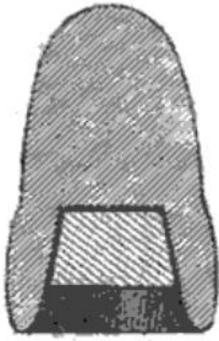
increasing cost of this new rifle-musket.

*The Hand-Book* describes the .568-caliber bullet with boxwood plug as having been “proved incontestably superior” following a “long series of careful experiments. [...] The more perfect the expansion, the less the barrel will be found to foul.”<sup>61</sup> Whether the genius of the plugged bullet was spontaneously discovered at the School of Musketry at Hythe, or a hasty yet effective response to nearly catastrophic flaws and difficulties encountered in the Crimea, I doubt we will

<sup>59</sup> Textbook, 121

<sup>60</sup> *Mechanics Magazine* 69 (October 30, 1858): 422

<sup>61</sup> Busk, 142



From *Rifle Ammunition*, depicting expansion caused by the wood plug

ever know. The treatment of the transition from Pritchett to iron cup bullet to wooden plug bullet seems rapid and hasty in Busk's account, and describes the search for a solution to a problem (fouling) that Busk never admitted existed until after the solution was adopted! The original problem, Busk said, were Pritchett bullets being slightly undersized, and therefore less accurate; no mention of difficult loading or fouling. The *Text Book* blamed undersized bullets and oversized barrels, making the rifle inaccurate; no mention of difficult loading or fouling. Lane-Fox blamed the tight-fitting cartridge that jammed in weapons subjected to field conditions, and forced the Pritchett bullet through the paper, resulting in

fouling. Majendie, writing almost a generation later long after the controversies over muzzleloading rifles had subsided, is probably right when he says the plug was adopted because the Pritchett bullet fouled.

The failure of Mr Pritchett's bullet was not the fault of the bullet itself, or even of the Enfield-Pritchett cartridge when correctly made and in good condition, for these cartridges shot well and accurately. It failed only when conditions and circumstances were less than perfect: when the bullet was slightly too small, when the cartridge unraveled from transport, when the grease melted away, when the size of the rifle barrel was slightly larger than .577, etc. As an accurate target bullet on the shooting grounds at Hythe the Pritchett was excellent, but that is not where it counts. Requirements for military ammunition, as well as military rifles, are different from their civilian and sporting counterparts. In some ways, there are parallels between Mr Pritchett's bullet, and Mr Ross's rifle developed for Canada in the years before the First World War. Both were capable of exceptional performance, but once subjected to the realities of a battlefield far away, they failed.

It is no understatement to say that Colonel Hay's wooden plug saved the P1853 Enfield rifle (although it would not be the last time the ammunition would have to be modified to keep the P1853 an effective military weapon). What the plug created was a bullet that would perform across a broad spectrum of conditions, from the swelteringly hot and dirty battlefield in far-flung colonial wars to the grassy fields of the School of Musketry at Hythe. This modification was

accomplished over a few months in mid-1855, undoubtedly with a sense of prudent haste and urgency amid reports of the P1853 Enfield being less effective than the old P1851. Colonel Hay also had the courage to propose a solution (the iron cup) and then take a great professional risk by immediately proposing a better solution (the boxwood plug), after the expenditure of public funds had already been made. Another officer, zealous to guard his career and avoid criticism, might not have taken such risks.

It also solved the problems described by Colonel Lane-Fox by ensuring that the cartridges no longer unraveled in shipment, as they were now held tight by the knot tied at the base of the bullet. Critics like Lane-Fox and Boucher were left exasperated and spluttering that instead of fixing a correctable problem with the Pritchett bullet, the School of Musketry went right back to the “delusion” of the Minié system with its cups and plugs. These critics would not go away, but following the adoption of the wooden plug bullet that could not be inadvertently rammed through the choked and tied cartridge which did not unravel or crease, the P1853 began to finally demonstrate its potential as an outstanding military rifle (as well as an accurate target rifle on the shooting ground). Other changes were made around this time (late 1855 to mid 1856) to the paper patterns used for making the cartridge (see appendix). Most importantly, three approximately inch long slits were cut into the paper where it wrapped around the bullet, which significantly improved the separation of the paper from the bullet as it left the muzzle. Cartridge paper clinging to the bullets was a frustrating cause of inaccurate shooting.

There would be no substantial changes to this cartridge for two years.

*Edward Mounier Boxer, Superintendent, Royal Laboratory, Woolwich*

Of the names associated with the development and perfection of the P1853 Enfield rifle-musket (among them being Hardinge, Pritchett, Hay, etc.), arguably the most influential was Edward Mounier Boxer. He was the son of a Royal Navy admiral and was a junior officer of Royal Artillery in the early 1850s when the P1851 and P1853 rifles were developed and entered service. By the Crimean War he was already an authority on ordnance, and an artillery fuse of his design (which replaced some that had been in British Army stores since 1812) was very successful. Captain

Boxer began his service at the Royal Laboratory, part of the Royal Arsenal at Woolwich, in 1854; the next year he was appointed Superintendent. Because he patented his inventions in a private capacity and then conveniently adopted them for British Army service in his official capacity, Boxer faced criticism later in his career. Despite this obvious conflict of interest, Boxer's inventions were so consistently successful that they usually overpowered any objections. Boxer is remembered primarily for inventing and patenting the metallic cartridge primer that bears his name,

As an artillery officer, Boxer may have brought a different perspective to the Royal Laboratory. Upon his appointment as superintendent in 1855, the use of tallow (thickened slightly with a small quantity of beeswax) as lubricant for the Enfield cartridge was questioned. According to Frederick Augustus Abel, the chemist for the War Department, "the question as to an improvement in the lubrication was first raised" in 1856.<sup>62</sup> In February of 1857, Captain Boxer reported that he "had for some time been engaged in trying experiments with beeswax as a substitute."<sup>63</sup>

### *Changes to the Lubricant*

In 1856, you will recall the lubrication composition was stills five parts tallow and one part beeswax. The predominate use of tallow hearkened back to the earliest military rifles including the Baker, the various German Jaegers, and American "Kentucky" rifles, when a true *lubricant* was required to help an oversized bullet (or patched round ball) as it was forcefully rammed. Tallow is derived from animal fats and at room temperature is a very soft near-liquid, that will melt completely in the palm of a hand; it is extremely slippery, abundant, readily available, and made for a cheap "grease" for several 19<sup>th</sup> century applications.

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<sup>62</sup> *Reports of a Special Committee on Breech-Loading Rifles; Together with Minutes of Evidence, Etc. Etc.* (London: HM Stationary Office, 1869), 64

<sup>63</sup> *Mutinies in East Indies, Presented to Both Houses of Parliament by Command of Her Majesty* (London: Harrison and Sons, 1857), 2

For a modern military rifle-musket like the P1853 that used a bullet that expanded as the gun was fired, there is no need for actual lubricant. “At the time when loading was performed by force,” wrote Captain Arthur Briscoe Hawes in his fantastic 1859 *Rifle Ammunition*, “some (then properly called) lubricating agent was required to enable this operation to be performed at all.” With the P1853 and its expanding wooden plug bullet, lubrication was not required: what was required was *an anti-fouling agent*. The “real duty” of the so-called lubrication, Captain Hawes explains, is “to prevent the fouling [...] from adhering to the sides of the barrel, and so, by combining with this residue, enabling the gases of the power to expel it upon ignition.”<sup>64</sup> The importance of an effective anti-fouling agent is paramount, as Captain Hawes elaborates:

It is difficult to over estimate the loss in efficiency of a corps in the field consequent upon the issue of ammunition has been imperfectly or improperly lubricated or has been defectively made up It is not merely a whether more or less accuracy is attained but *any firing at all* can be maintained against the foe.<sup>65</sup>

The British Army had already discovered that tallow was a less than satisfactory lubricant. It worked well enough in England’s green and pleasant land, with brief and mild summers, but in any sort of a warm climate the tallow would start soaking into the cartridge paper and quickly melted away. This was an enormous problem, as we have seen, with the P1851 cartridges. As an emergency remedy, the regulations were updated to instruct soldiers to wet the end of cartridges with their mouths if the tallow had melted away; this was not ideal, but would at least allow the soldier to fire several more rounds before the barrel hopelessly was fouled. The problems with the tallow were also about to get *much* worse: not only would issues caused by the tallow threaten to cause the abandonment of the entire P1853 rifle, but it would help trigger the enormous human tragedy of the 1857 Indian Mutiny that led to hundreds of thousands of deaths.

After Captain Boxer had been actively seeking an improvement over tallow for nearly a year and conducting many experiments, he proposed using pure beeswax as the anti-fouling agent due to

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<sup>64</sup> Captain Arthur B. Hawes, *Rifle Ammunition. Being Notes on the Manufactures connected therewith, as conducted in the Royal Arsenal, Woolwich* (London: W.O. Mitchell, 1859), 2

<sup>65</sup> *Ibid.*, 53. Emphasis in the original.

“its valuable properties of not injuring the cartridge in store.” A committee that included General Hay (who had been promoted, and was still commander of the School of Musketry) and Frederick Abel, the War Office chemist, met in July of 1857 and determined that beeswax had considerable advantages over tallow for long term storage and transportation. However, against Captain Boxer’s recommendation, the committee was not fully convinced that beeswax alone was sufficient for the loading and firing of the Enfield rifle. General Hay was apparently the chief opponent of using pure beeswax, but he consented to an inversion of the old composition.<sup>66</sup> Based on the committee’s report, the new anti-fouling composition of five parts beeswax and one part tallow was officially adopted in August 1857.<sup>67</sup>

Three months earlier, the Indian Mutiny had broken out, and the grease on the P1853 Enfield rifle became the infamous subject of much controversy, debate, investigation, and human tragedy on a scale rarely seen before the industrial age.

#### *Greased Cartridges and the Indian Mutiny*

The “Enfield cartridge” is probably most well-known for its role in the outbreak of the Indian Mutiny in 1857, when Indian units began to receive the new P1853 Enfield rifles. At this time, the Enfield boxwood plug cartridges were lubricated in the 5 to 1 mixture of tallow to wax; some cartridges were shipped to India from England, while the balance were manufactured in India, mostly at the Dum Dum Arsenal. When stored in the heat and humidity of India, the tallow began to run and spread, soaking into the entire length of the cartridge and contaminating even the top portion of the paper which the soldier would bite off. It is also one of the ironic tragedies of history that before the outbreak of the mutiny, Captain Boxer was already searching for an effective replacement for the tallow lubricant and was strongly advocating perfectly inoffensive beeswax, clean to Muslims and Hindu alike, which would stay put around the bullet without melting and soaking the paper. Rather than an insidious English scheme to cause sepoys to break caste, *nobody* wanted to keep using the tallow. It is beyond the scope of this work to discuss the

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<sup>66</sup> Hawes, 54

<sup>67</sup> Text Book, 121

causes of the 1857 Indian Rebellion; it was certainly not the tallow on the Enfield cartridge that *caused* it, and the role of the cartridge in triggering the uprising is still debated.<sup>68</sup>

All I will say is that I am sympathetic to the Indian sepoy who were legitimately concerned with defiling themselves with unclean substances that had soaked into items they were expected to place into their mouths (to tear open the cartridge prior to loading). I must also, in all fairness, defend the British authorities who took preemptive measures to respect the religious sensibilities of the sepoy, going so far as to issue unlubricated cartridges to the troops so they could grease them in inoffensive substances. Following an “uneasiness” among sepoy preparing cartridges at the Dum Dum Arsenal, the Governor-General of India directed in January of 1857 that “in order to remove the objection the sepoy may raise to the grease used for the cartridges of the rifled muskets, all cartridges are to be issued free from grease, and the sepoy are allowed to apply with their own hands whatever mixture suited for the purpose they may prefer.”<sup>69</sup> It was also directed that no more cartridges would be sent from England to India, to remove all doubt among the Indian troops about the lubrication of their cartridges. This directive, in January, was four months before the violent outbreak of the mutiny.<sup>70</sup>

While the rebellion raged in India, winter set in England. The predominantly beeswax-lubricated cartridges adopted in August 1857 worked well enough in the warmer months, but “difficulties arose in loading in cold weather” due to the hardening of the wax. General Hay was very concerned and in January 1858, he “expressed his opinion that beeswax would *not* do as a lubricating agent,” insisting that for rapid, easy loading in cold weather, the composition should remain mostly tallow.<sup>71</sup> He suggested something of a happy medium, of perhaps a 4-to-1 tallow to wax composition, which would be soft enough to facilitate easy loading in the cold, and the larger proportion of wax would help prevent running and melting in hot climates. Because General Hay was an expert marksman, an undisputed authority in the field of rifle shooting, and

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<sup>68</sup> Most modern scholars get it wrong; their understanding of the Enfield cartridge is at best inaccurate, while others simply have *no idea* what they are describing. It is truly horrifying.

<sup>69</sup> *Mutinies in the East Indies*, 2.

<sup>70</sup> For an excellent review of the role of the Enfield cartridge in the India Mutiny, I highly recommend Daniel R. LeClair’s *The Greased Cartridge Affair: Re-Examining the Pattern 1853 Enfield Cartridge and its Role in the Indian Mutiny of 1857*, IAA Journal No. 544, July/Aug 2015

<sup>71</sup> Hawes, 54

formed his opinions based on years of experiments and research, his beliefs understandably carried enormous weight. Severe weather precluded further experiments until late February of 1858.

During this period, despite General Hay's support for tallow-based lubricant, the Royal Arsenal was quickly learning that the problems with tallow were far worse than previously thought. The War Department's chief chemist, Frederick Abel, realized that a chemical reaction was taking place between the tallow in the lubricant and the lead bullets. In 1868, Abel was questioned by a commission held to determine the best form of breech-loading rifle to adopt for the British Army, and he was specifically asked about the qualities of tallow as a lubricant. "The action of any fatty material upon the bullet is to promote a gradual oxidation," Mr. Abel told the commission, "and to produce upon the bullet a crust, which is in fact white lead, or rather a mixture of white lead with the fatty acid that is produced from the fat which is used."<sup>72</sup> This problem was noted in late 1857, when Mr. Abel examined some ammunition that had been returned to England from India after "a very short time; and in that instance the corrosion had proceeded to a very considerable extent, although the lubrication at that time consisted of only one part of tallow mixed with five parts of beeswax."<sup>73</sup> The consequence of this discovery was that *any* quantity of tallow in the lubricant, even a small percentage, exposed the ammunition to the possibility of "corrosion" and the build-up of the crusty deposit on the bullet. With bullets of .568-caliber, made into cartridges that measured .576-inches and had only one-thousandth of an inch to spare in a .577-caliber barrel, it is very easy to see how a hard, crusty deposit on the bullet could lead to trouble. And it did.

### *The crisis of the P1853*

Initial reports from field commanders of British Army units, deployed to India to put down the rebellion, widely praised the Enfield rifle. Sir John Kaye's voluminous history of the Indian Mutiny describes the Enfield rifle's superiority over the old smoothbores of the Indians with some

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<sup>72</sup> *Reports of a Special Committee on Breech-Loading Rifles; Together with Minutes of Evidence, Etc. Etc.* (London: HM Stationary Office, 1869), 65. The "white lead" is lead carbonate, used until recently as pigment for white paint, and was traditionally produced by immersing lead in vinegar, which is an acid. Tallow contains fatty oleic acids, which react similarly with lead.

<sup>73</sup> *Ibid.* I have seen similar patinas form on .575-caliber bullets for "American-style" cartridges, back when I was using a 50/50 wax to tallow mix.

flourish. “Presently,” Kaye describes, “the Enfield rifles of the 52nd began to give deadly proof that the smooth-bored muskets of the Sipahis were as playthings contending against them. With all their gallantry in doing and their fortitude in enduring, what could “Brown Bess” and the old station-gun do against our batteries and our rifles?”<sup>74</sup>

This praise was soon to be eclipsed by reports that the Enfield rifles were impossible to load. Controversy and crisis makes for compelling reading in the newspapers, more so than good news and praise. Soon, a statement “appeared in the press” that as a result of bad ammunition, “the men found it almost impossible to load their Enfield rifles at all, having to call in the aid of trees and stones against which to butt the ramrod, in order to force the bullet home.”<sup>75</sup> Major General Hugh Henry Rose, later to be Field Marshal Rose, commander of the Central Indian Field Force that defeated many of the principle Indian centers of resistance, gave a severe indictment of the Enfield ammunition. “The Enfield rifles had made up a good deal for my inferiority in numbers,” General Rose explained in his official report. “That advantage, however, no longer now existed. The heat and other causes had had such an effect on the ammunition of the rifles that their loading becoming difficult, and their fire uncertain, that the men lost confidence in their arms.”<sup>76</sup> Majendie, writing over a decade later, recalls that “loading was almost impossible. The men were seen striking the ends of their ramrods against walls and trees, to drive home the bullet, and the evil was so serious as to have threatened at one time to lead to the abandonment of the Enfield rifle.”<sup>77</sup>

This was the crisis moment of the P1853 Enfield rifle. The ammunition for the Enfield had failed in the Crimean War, but because the P1853 had only arrived at the tail end of that conflict, the result was not catastrophic. It was a much different situation in 1857-58, when the P1853 had been widely adopted and issued throughout the British Army. Now, again, the ammunition had failed. “The Enfield rifles, from the difficulty of loading them, were found almost useless,” one period source lamented, “and officers declared that they would infinitely prefer the old smooth-

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<sup>74</sup> Sir John Kaye, *Kaye's and Malleson's History of the Indian Mutiny of 1857-8* (London: W. H. Allen, 1892), 482

<sup>75</sup> Greener, 386

<sup>76</sup> T. L. Behan, Superintendent, *Bulletins and Other State Intelligence for the year 1859, Part 1, Compiled and arranged from the official documents published in the London gazette* (London Gazette Office, 1860), 892

<sup>77</sup> Majendie, 10

bore.”<sup>78</sup> For the Royal Arsenal and the officers of the School of Musketry, there could not be a greater humiliation than for line officers, engaged in active combat against determined enemies, to prefer the old, crude smooth-bore musket to the modern small-bore P1853 Enfield rifle that had shown so much promise during extensive tests. Captain Boxer himself wrote, in 1867, that “the defects which existed in the ammunition” for the Enfield rifle “were proved, by the experience in India during the Mutiny, to be of so serious a character, that the rifle, as a general arm for the service, must have been abandoned, if a remedy had not been found.”<sup>79</sup>

The experiments with various mixtures of beeswax and tallow conducted at Woolwich in February 1858 concluded that the best overall composition was the 5-to-1 wax to tallow that had been adopted in August of 1857. Difficulty loading in cold weather was completely solved by an absurdly simple remedy: Captain Hawes explains that, “after dipping, the cartridges should be passed through a warmed gauge .582 of an inch in diameter.” The cartridges so gauged “were thus enabled to be entered into the barrel without any considerable force being required.”<sup>80</sup> Captain Boxer’s advocacy for beeswax was vindicated, but he was about to propose a far more radical improvement, which remains controversial among black powder shooters to this day. In the spring of 1858, with criticism of the P1853 Enfield rifle mounting and even prominent, respected officers like Major General Rose declaring that his soldiers had lost confidence in the “impossible to load” weapon, Captain Boxer made another recommendation: reduce the diameter of the bullet from .568-inch to .550-inch.

#### *Twenty-Seven Thousandths of Windage – Captain Boxer’s .550-caliber bullet*

There were three serious problems with the Enfield cartridge encountered in India. The first we have considered already: the chemical reaction between the acids in the tallow and the lead bullet, which forms a very undesirable crust of lead carbonate on the bullet that can cause difficult loading. The second problem has also been addressed: the tendency of the tallow to

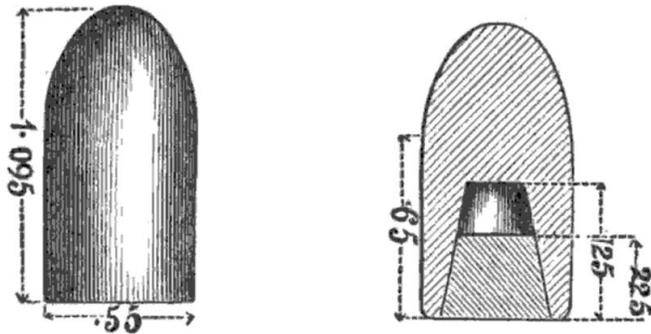
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<sup>78</sup> *Hansard’s Parliamentary Debates, Third Series, Commencing with the Accession of William IV, Vol CC, 1870* (London: Cornelius Buck, 1870), 2063

<sup>79</sup> *Accounts and Papers of the House of Commons, Vol 42, 140*

<sup>80</sup> Hawes, 56

melt away, leaving a cartridge without any anti-fouling agent. Rifles fired with such unlubricated cartridges would rapidly foul to the point of being impossible to load. Both problems were mostly solved with the adoption of the 5-to-1 wax to tallow lubricant. But the last issue was with the size of the bullet itself, that no amount of modifications to the manufacture of the cartridge



**Fig. 1.—BULLET USED IN ENFIELD RIFLE.**

The .550-caliber Boxer bullet. From Majendie's *Arms and Ammunition of the British Service*.

or changes to the lubricating mixture could solve. Since the inception of Mr. Pritchett's rifle bullet for the .577-caliber P1853 Enfield rifle, the bullet had been .568-inch in diameter. Cartridge paper added nine thousandths of an inch, resulting in a paper-patched cartridge of .576 or even .577 inches in diameter, which just barely fit the barrel of a clean, serviceable P1853 Enfield rifle. Improvements had been made to the cartridge that included a wood plug to effect instantaneous expansion and superior anti-fouling properties, as well as the choked and tied paper at the base preventing the push-through of the bullet. These were all steps in the right direction, but once again when the P1853 Enfield rifle went into combat in conditions vastly different from the shooting grounds at Hythe, dirt and heat and humidity and rough handling and all the other realities of real war, soldiers were reduced to beating the ramrods of the "perfect" Enfield rifle against trees. Majendie, with the perspective of time, blames the diameter of the bullet without any mention of white incrustations caused by tallow acids. "It was found in India, during the mutiny," Majendie recalled, "that great difficulties occurred in loading owing to the size of the bullet, which was [...] .568-inch, leaving a windage of only .009 inch – quite insufficient, when the rifle became foul, to admit of easy loading."<sup>81</sup>

I have been unable to determine when exactly Captain Boxer made the radical proposal to reduce the bullet from .568 to .550 inches. It was probably very late in 1857, or early in 1858, after the reports from India had arrived in England and had been digested. Recall that years earlier, the bullet for the P1851 rifle had been reduced from .690 to .685 inches at the

<sup>81</sup> Majendie, 10

recommendation of then-Colonel Hay, with much improved ease of loading and no loss of accuracy. The precedent had already been established that reducing the bullet was a plausible option, and Captain Boxer understood that the P1853 rifle could not survive another crisis. Whatever the Royal Arsenal did, it had to be a permanent, effective solution. Reducing the bullet a few thousandths, like Hay had done for the P1851 bullet, might not be enough to solve the problem. Leaving nothing to chance, and placing enormous trust in Major General Hay's wooden plug to produce sufficient expansion, Captain Boxer made his recommendation to reduce the bullet by eighteen thousandths of an inch. Such a generously undersized bullet and cartridge would be easy to load, even in a rifle that is fouled and dirty from intense combat conditions.

Tests began at Hythe with the .550-caliber bullet in the spring of 1858. When made into cartridge, it had a diameter of 0.559 inches, or fully eighteen thousandths smaller than the .577-caliber bore. Captain Hawes, in his *Rifle Ammunition*, observes that, "At first thought, this would appear to those who have studied musketry theoretically, as a mode of procedure calculated to injure the efficacy of the weapon."<sup>82</sup> It is important to grasp the magnitude of this proposal. Before Captain Boxer's recommendation, no rifle-musket cartridge had ever been more than a few thousandths of an inch smaller than the size of the rifle bore. The amount of windage an expanding bullet was expected to overcome upon firing was always kept as small as possible. To Captain Minié or any of the other early developers of the expanding rifle-musket bullet, five thousandths of an inch of windage was considered a substantial challenge to obturate. Even thousandths of an inch of windage was unfathomable; Norton, Greener, Delvigne, Minié, and the others would have said it was impossible to achieve this kind of expansion. The critics and skeptics (and there were many) "fully anticipated the loss of range, less accuracy of fire," and even rammed bullets falling out of the barrel if the rifle was shaken or turned upside down.<sup>83</sup> Boxer, writing much later, recalls a "long controversy" that simmered in the press and public conception long after extensive experiments and the expenditure of millions of rounds at musketry training at Hythe had proven that the .550-caliber bullet worked.<sup>84</sup>

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<sup>82</sup> Hawes, 56

<sup>83</sup> Ibid.

<sup>84</sup> *Accounts and Papers of the House of Commons, Vol 42, 141*

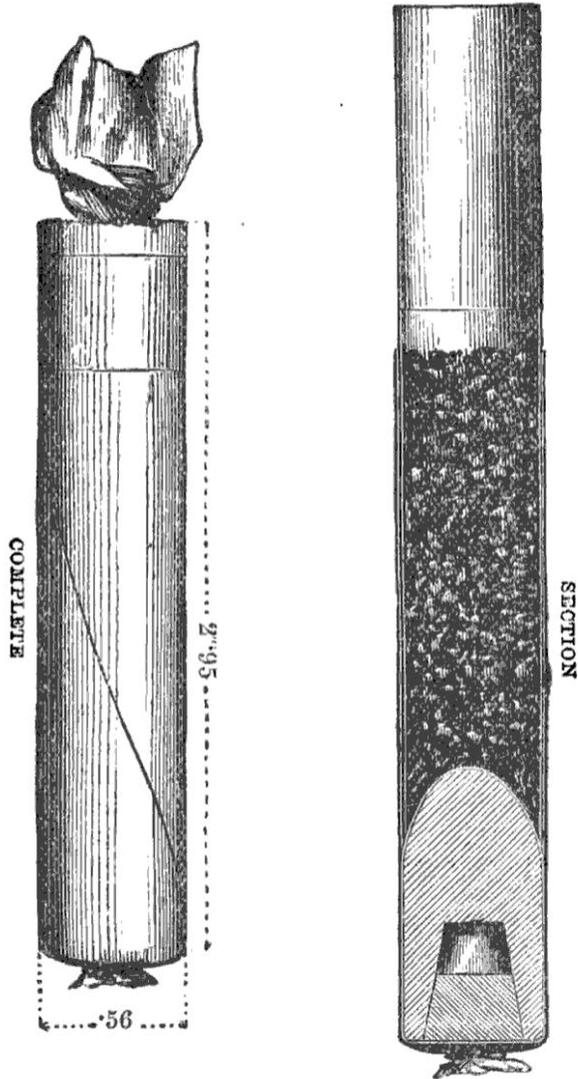


Fig. 2.—CARTRIDGE USED IN ENFIELD RIFLE.

The post-1859 Enfield cartridge. Note overall diameter of .56, and the gummed band sealing the wrapper of the powder cylinder to the outer wrapper. From Majendie's *Arms and Ammunition*.

The proposal was formally assessed in the usual way, with a committee that opened in July of 1858 and “most carefully” worked its way through the objections, as well as the advantages, of the .550-caliber bullet. The rifles were loaded and then turned upside down, jostled, and shaken, and the bullets remained in place. They also found that with the new .550-caliber bullet, “in a clean arm it is possible to load without the ramrod, by striking the butt against the ground.”<sup>85</sup> Of course, the real test was the shooting: could a .550 inch bullet perform in a .557 inch barrel? Per Captain Hawes, “to the surprise of most theorists, it was found practically that the target results were not in the slightest inferior to those of the bullet .568 inch diameter.”<sup>86</sup> In fact, the trajectory was flatter with the same range as the older bullet. The only possible so-called disadvantage of the new .550-caliber bullet was that slightly more elevation was necessary when firing at very long ranges. Other than this, there were no facts for the critics and skeptics to cling to.

The bullets worked, and the wooden plug was responsible for expansion. Colonel E. C. Wilford, the assistant commandant of the School of Musketry, wrote in 1859 that, “I have no hesitation in stating

that no solid, pritchet [sic], hollow at base, or iron disk bullet in an Enfield rifle bore, with .27 windage, can receive sufficient expansion [...] without the aid of some auxiliary.”<sup>87</sup> Captain Hawes similarly states that it had been “proved beyond all doubt the fact that General Hay’s

<sup>85</sup> Majendie, 13

<sup>86</sup> Hawes, 56

<sup>87</sup> Colonel E. C. Wilford, *Three Lectures upon The Rifle* (London: John W. Parker & Son, 1859), 71

wood plug acts as an immediate expander even to the extent of more than .018 of an inch. The wood plug has proved itself indubitably fully able to perform the duty required of it.”<sup>88</sup> In the 1866 book *Match Shooting with the Enfield Rifle*, “ample proof” of expansion can be found around the targets of a shooting-range, where “any number of these bullets, in a tolerably perfect form, may be picked up [...] with the marks of the grooves as sharply and clearly defined as in bullets of the larger diameter.”<sup>89</sup>

The cartridge was also modified at about the same time, with the changes ordered in April 1859 (two months after the reduction of the bullet in February 1859). The outer envelope was shortened, leaving the wrapper of the powder cylinder to project (alone) beyond the rim of the outer wrapper. The two were joined together by a “gummed band” half an inch thick and two inches long.<sup>90</sup> This additional complication of the Enfield cartridge seems pointless at first glance, but the mystery is solved by considering the changes made in 1859 to the British musketry drill. Previously, while holding their weapon with the left hand, soldiers were instructed to take a cartridge from their pouch with the right hand, and tear the cartridge open with their teeth. This was a necessity for flintlocks, which were primed with powder from the cartridge. With percussion weapons primed with a cap after the bullet was rammed, the biting of the cartridge was no longer necessary (an irony, considering the objection of the sepoys before the Indian Mutiny was the placing of potentially grease-covered cartridge paper into their mouths). The new 1859 drill may have recalled the Mutiny when making the change: “bring the cartridge to the thumb and forefinger of the left hand, and [...] tear off the end of it with care, so as not to lose any of the powder.”<sup>91</sup> Tearing through the double thicknesses of paper of the old cartridge with two fingers, while simultaneously holding the rifle *and* not spilling any powder, proved to be difficult.<sup>92</sup> To preserve the ease of loading, the cartridge was modified with the shortening of the outer wrapper.

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<sup>88</sup> Hawes, 57

<sup>89</sup> Pseud., *Match Shooting with the Enfield Rifle* (London: Simpkin, Marshall & Co, 1866), 8

<sup>90</sup> Text Book, 121

<sup>91</sup> *Field Exercise and Evolutions of Infantry, as revised by Her Majesty's Command* (London: Jno W Parker & Son, 1859), 354

<sup>92</sup> I have tried it while live-firing a P1853 Enfield with cartridges constructed with the double-thickness of powder cylinder and outer wrapper, and after tearing about ten of these cartridges, my thumb and forefinger began to get sore.

It is worth mentioning, as an aside, that also in the spring of 1858, the P1853 rifle itself underwent a major change, as the constant-depth rifle barrel with 0.014-inch deep grooves was replaced by a progressive depth rifled barrel, 0.005-inch deep at the muzzle and 0.015-inch deep at the breech.<sup>93</sup> Again, I will leave the details of the P1853 rifle to those eminent scholars who have preceded me, but for our purposes it is worth observing that a .550-caliber bullet, to expand into the deep progressive rifling at the breech, has to cover the staggering distance of 42 thousandths in order to obturate the grooves, and not merely the 27 thousandths to touch the surface of the lands.

It is interesting to observe that we hear no more of the eminent critics of the Minie system, like Boucher and Lane-Fox, after about this point. One of the last holdouts (which I find surprising) was Hans Busk, who despite his long association with the School of Musketry, was concerned about the loss of range with the new bullet and as late as 1861 in his book *The Rifle: And How to Use It* he quoted an authority who said the wooden plug “assisted possibly” the bullet’s expansion. They were not entirely *wrong*, and bullets like the Wilkinson and Whitworth systems did fill the grooves without any hollow, cavity, plug, or cup, so their theories are to an extent correct.<sup>94</sup> But while the solid bullet worked well in a target rifle, it failed as a military rifle. What made the P1853 rifle (at the end of its long development) the best muzzleloading infantry weapon ever fielded was the plug of Charles Crawford Hay that ensured the bullet’s expansion and therefore its accuracy, and Edward Mounier Boxer’s reduced diameter bullet that ensured rapid, easy loading. Captain Boxer, in 1867, in defense of his achievements at the Royal Arsehal, “in 1858, I proved that the bullet might be reduced in diameter to such an extent to admit of easy loading under the most unfavorable conditions, *without effecting the accuracy of shooting.*”<sup>95</sup> He was right; he had turned the rifle (previously a delicate article found on the periphery of the battlefield) into the effective military weapon that is still carried by soldiers well into the 21<sup>st</sup> century.

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<sup>93</sup> Busk, 142

<sup>94</sup> Thompson Center, in the 1990s, developed the “Maxi-Ball,” a solid lead muzzleloader bullet resembling those developed by Wilkinson, etc., with no cavity or hollow and obturates into the rifling by the “upsetting” principle.

<sup>95</sup> *Accounts and Papers of the House of Commons, Vol 42*, 140. Italics in original

## *Swan Song*

After the official adoption of the purely beeswax lubricated cartridge with .550-caliber bullet in 1859, further improvements were slight. Attempts were made to make the cartridges waterproof, with the newly-promoted Colonel Boxer developing various varnished or metallic covers for the cartridges, but with little enduring success. There were only two small modifications made before the rapidly improving breechloading technology made the P1853 obsolete in the mid-1860s. The first change was an additional slit cut into the paper along the length of the bullet, after the cartridge had been fully assembled. This was done to make the separation of the paper from the bullet even more certain after it left the muzzle upon firing. Cartridges and bullets with this slit can be reliably dated after 1859. Captain Hawes described the change in *Rifle Ammunition*: “The outer bag of the cartridge for the Enfield rifle, after the cartridge has been made up, is cut from the shoulder to the base of the bullet with a longitudinal slit so that it may free itself easily from the bullet when discharged from the rifle.”<sup>96</sup>

The last change was some four years later in late 1863: a switch from boxwood to simple clay for the expanding plugs. Boxwood was expensive, and in the mid-1860s the public appetite for illustrated newspapers and periodicals was growing. These illustrations were engravings made in boxwood, and then printed from the engraving. Not only was demand soaring (and costs with it) but the primary exporter of boxwood was the Ottoman Empire and a political or diplomatic crisis could eliminate Britain’s only source of a strategic material. Fired ceramic clay plugs were found to be able to replicate the performance of boxwood plugs, with the advantage of being absurdly cheap. Majendie said the clay plug was adopted because it was “efficient and inexpensive.”<sup>97</sup>

And this was the end. There would be no further improvements to the Pattern 1853 Enfield rifle-musket ammunition. In late 1859, after years of incremental and sometimes radical change, the British Army had a rifle-musket that was a true soldier’s weapon: accurate, reliable, and effective in combat conditions. It could be loaded easily even after firing dozens or hundreds of rounds. Problems like dirt, fouling, and other battlefield realities left contemporary rifle-muskets

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<sup>96</sup> Hawes, 36

<sup>97</sup> Majendie, 11

uselessly jammed, while the Enfield could continue firing without loss of accuracy or rate of fire. At the height of *Pax Britannia*, there were few opportunities to demonstrate the effectiveness of the P1853 rifle alongside the capabilities of the new perfected ammunition. Colonial campaigns, including the Maori Wars in New Zealand, were fought against technologically inferior enemies. Another irony of the P1853 rifle was that the war in which it would be most influential, and used in enormous quantities, was not a British affair at all.

Rifle-muskets would be used extensively, more than in any other conflict, in the American Civil War (1861-1865). Professionally unprepared for the extent and nature of a modern war, both sides had profound difficulties with their rifle-muskets which fouled quickly in battlefield conditions. The American .575-caliber bullet, loaded naked (with no paper patch) in the .58-caliber standard Model 1855 and Model 1861 rifle muskets, had only five thousandths windage. It had performed very well in Ordnance Department- tests, but like the Pritchett bullet before, it was a target bullet praised for its accuracy and adopted for use in a military rifle; there were immediate complaints of fouling in field conditions.

Accounts from the American Civil War are abundant with soldiers struggling to load fouled rifles. The Confederates, however, immediately began importing P1853 Enfield rifles as well as Enfield ammunition, and discovered the obvious superiority. "In all cases where I had issued the English cartridge," wrote Captain Charles Semple, the ordnance officer of Breckenridge's Division on 11 October 1863, "no such consequences [of fouling] were reported to me, nor have I ever heard of a single instance during my experience as ordnance officer, nearly eighteen months."<sup>98</sup> By February, 1864 the Confederate chief of ordnance published a circular directing that "the only pattern of cartridge to be hereafter used with muzzle loading rifled small arms shall be that known as the English pattern of Enfield Cartridge."<sup>99</sup> Some Confederate Enfield ammunition was very good; much of it was poorly made, and suffered from the same problems experienced by the British nearly ten years earlier. The fact remains, however, that when engaged in the only

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<sup>98</sup> The War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies, Series I, Volume XXX, Part II, 202

<sup>99</sup> D. B. Minshall. 2015. Enfield Paper Cartridges. <http://britishmilitarylongarms.blogspot.com/2015/04/enfield-paper-cartridges-loading.html> (Accessed 9 December 2016)

major war of the muzzleloading rifle-musket era, the superiority of “the English cartridge” was quickly recognized, and copied by the Confederate ordnance department.

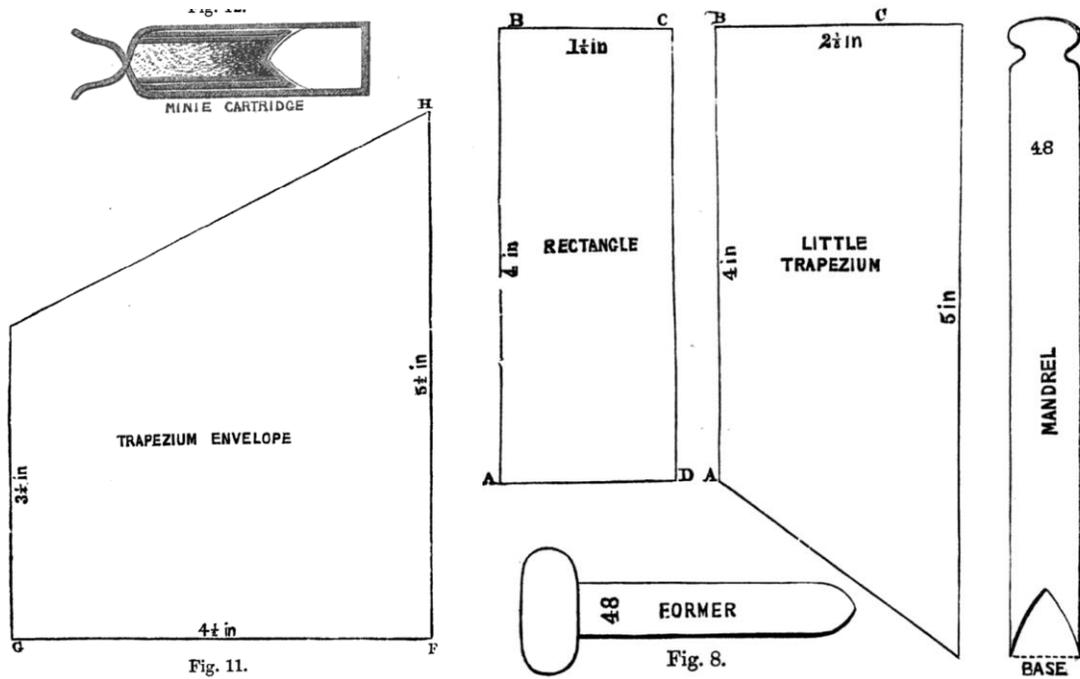
By itself, the Pattern 1853 rifle-musket was a good, accurate, generally well made, and battle-proven weapon; there was also very few differences in quality, accuracy, and battle-worthiness between it and its contemporaries, such as the Model 1861 “Springfield.” The *ammunition* made the difference. Without correctly made ammunition, the P1853 fouled just as fast as any other rifle-musket and suffered from all the same inherent faults of this short-lived type of infantry weapon, caught between the smoothbore musket of antiquity and the modern metallic cartridge breechloader. With the correct ammunition, however, I have argued that the P1853 rifle was the first modern infantry weapon, even if the tactics of its day did not fully appreciate the rifle’s capabilities.<sup>100</sup> For the first time, the individual soldier could accurately and reliably engage individual targets out to ranges that, previously, were strictly the province of the artillery. British soldiers of the first class of marksmen shot qualifications with the P1853 Enfield rifle out to ranges of 900 yards. In battle, the ease of loading and the self-cleaning action of the ammunition made it a combat multiplier and set the P1853 Enfield apart from virtually every other muzzleloading rifle. It was so highly refined that the muzzleloading rifle was never improved upon; the Enfield was replaced by a breechloader firing centerfire metallic cartridges, against which no muzzleloading rifle could compete.

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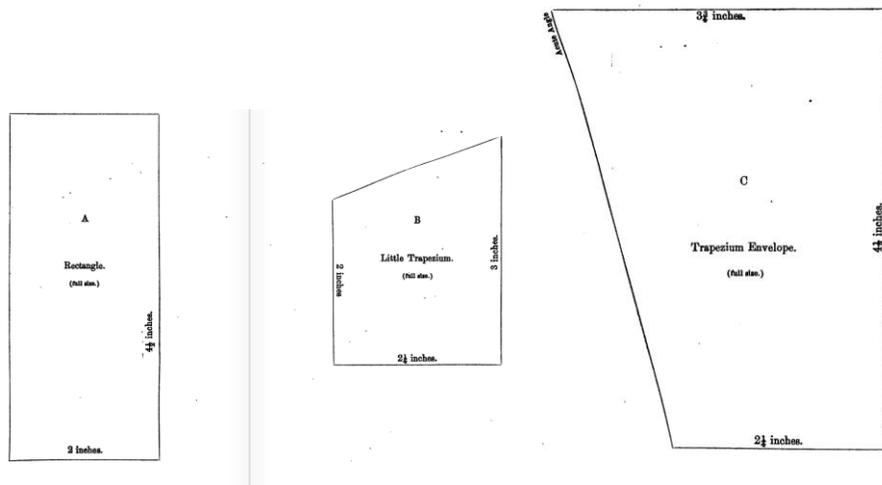
<sup>100</sup> When I mentioned this thesis to a knowledgeable friend, he immediately asked, “what about the needle gun?” While it is true the Prussian breech-loading, bolt action Dreyse Zündnadelgewehr (needle rifle) was developed before the P1853 and was a revolutionary design, it could be finicky, the needles often broke (soldiers had to be issued spares), it lacked range, and became unserviceable due to fouling after a number of shots.

APPENDIX

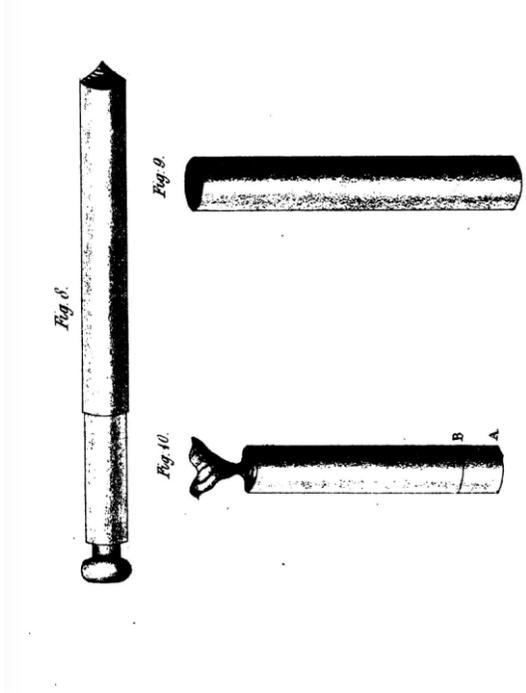
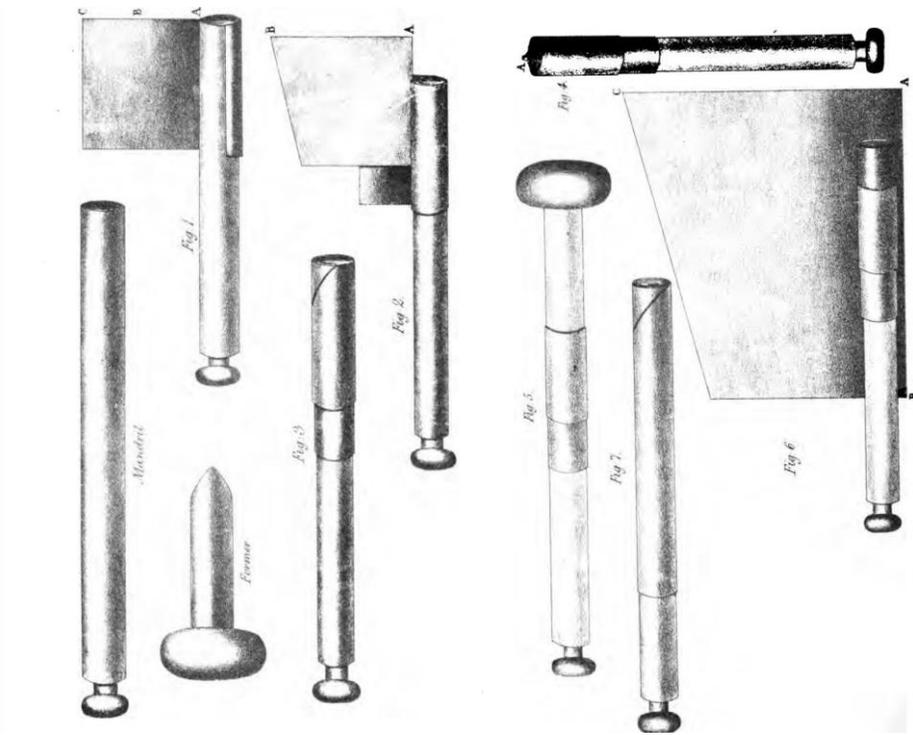
Cartridge Patterns



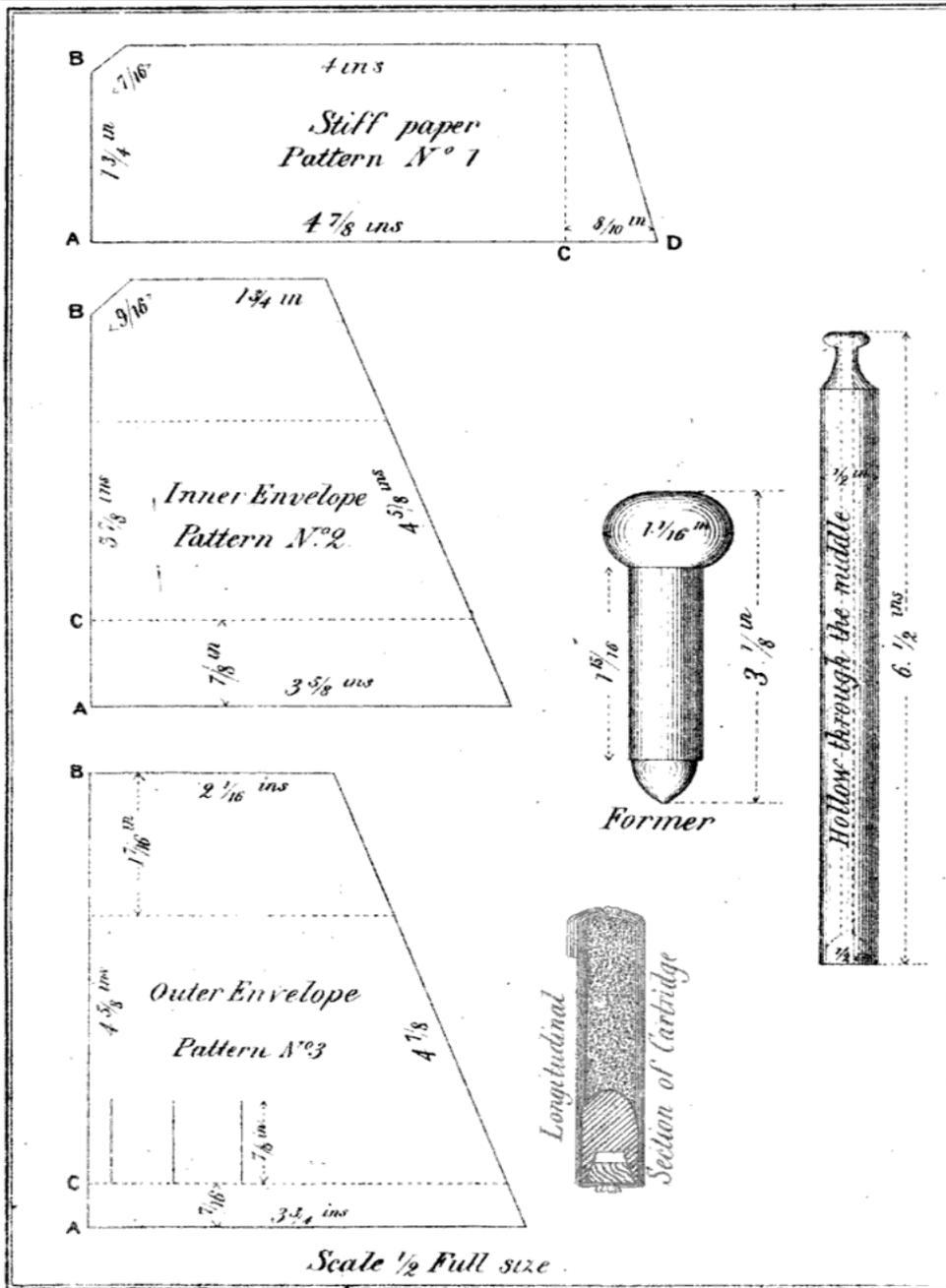
From the 1854 initial issue of *Instruction of Musketry*. This cartridge, like the earlier Belgian and French cartridges and also the P1851 cartridge before it, has an “independent” powder cylinder.



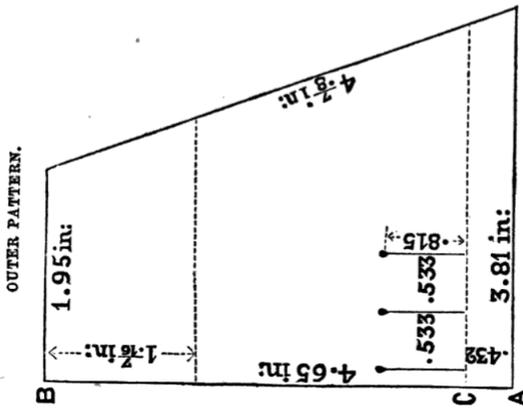
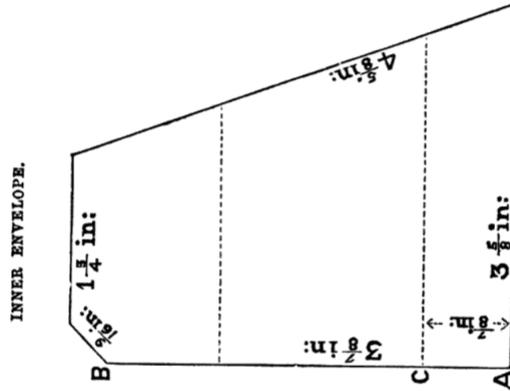
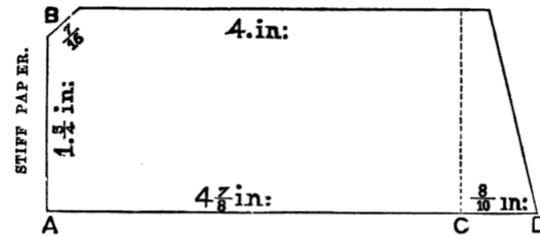
From the 1855 *Companion to the New Rifle Musket*. Consider that this pattern was intended for soldiers, for making their own ammunition in an emergency, and therefore differs from the pattern used at the Royal Arsenal. These are not “full size” here as they say.



Assembly of the cartridge. Note the large “trapezium envelope” (alternatively called outer envelope, outer wrapper, or outer forming paper in various other cartridge patterns) that likely identifies this as the “government” pattern, corresponding to the dimensions provided in the 1854 *Instruction of Musketry*.



From the revised and updated 1856 *Instruction of Musketry*. This is a nearly completely re-designed cartridge from those that preceded it. Image widened slightly from the original, to enlarge the numbers and make the writing more legible.



From Hans Busk's *Hand-Book for Hythe*, 1860. It is identical to the above pattern from the 1856 *Instruction of Musketry* but decimalizes some of the dimensions, which modern shooters may find useful. This is also for the .565-caliber bullet, not the .550-caliber bullet.

DESCRIPTION OF CARTRIDGE.	Forming Paper.			Slip or Packing.			Wrapper.			
	Description.	Breadth.	Longest side.	Shortest side.	Description.	Length.	Breadth.	Description.	Length.	Breadth.
Blank for all arms.....	Purple.	In. 4.4	In. 5.8	In. 3.25	..	In. ..	In. ..	Purple	In. 11	In. 5.75
Rifle Musket (1842)	1st Cylinder { Yellow wrapping }	1.66	5.0	4.55	Yellow fine	} 17.5	4 {	Yellow wrapping	} 9.75	6.25
	2nd Inside.. { Yellow fine }	4.3	5.6	3.5						
	3rd Outside .. { Y.F. }	4.52	5.6	3.4						
Rifle Musket (1851)	1st Cylinder { Red wrapping }	1.65	4.97	4.57	Red fine	} 17.5	4 {	Red wrapping	} 9.75	6.25
	2nd Inside.... { Red fine }	4.05	4.65	2.52						
	3rd Outside .. { R.F. }	4.45	4.57	2.33						
Rifle Musket (1853)	1st Cylinder .. Wrapping	2.05	5.05	4.5	White Brown	} 17.5	4	Wrapping	9.75	6.25
	2nd Inside.... { W.F. }	4.5	3.85	2.03						
	3rd Outside .. { W.F. }	4.65 4.65	3.81 3.67	1.95 1.95 for .55 bullet.						
Musket (Ordnance) .. } Carbine (Victoria)M.B. }	W.F.	4.3	6.65	5.25	{ White Brown	} 17.5	4	Wrapping	9.75	5

From Captain Arthur Briscoe Hawes' *Rifle Ammunition* of 1859, giving the paper dimensions for the old P1842 smoothbore, the P1851, and the P1853 Enfield. Notice the last row of the "Rifle Musket (1853)" giving dimensions for the .55 bullet. This is only a sized-down version of the previous cartridge, and not the later "gummed band" cartridge.