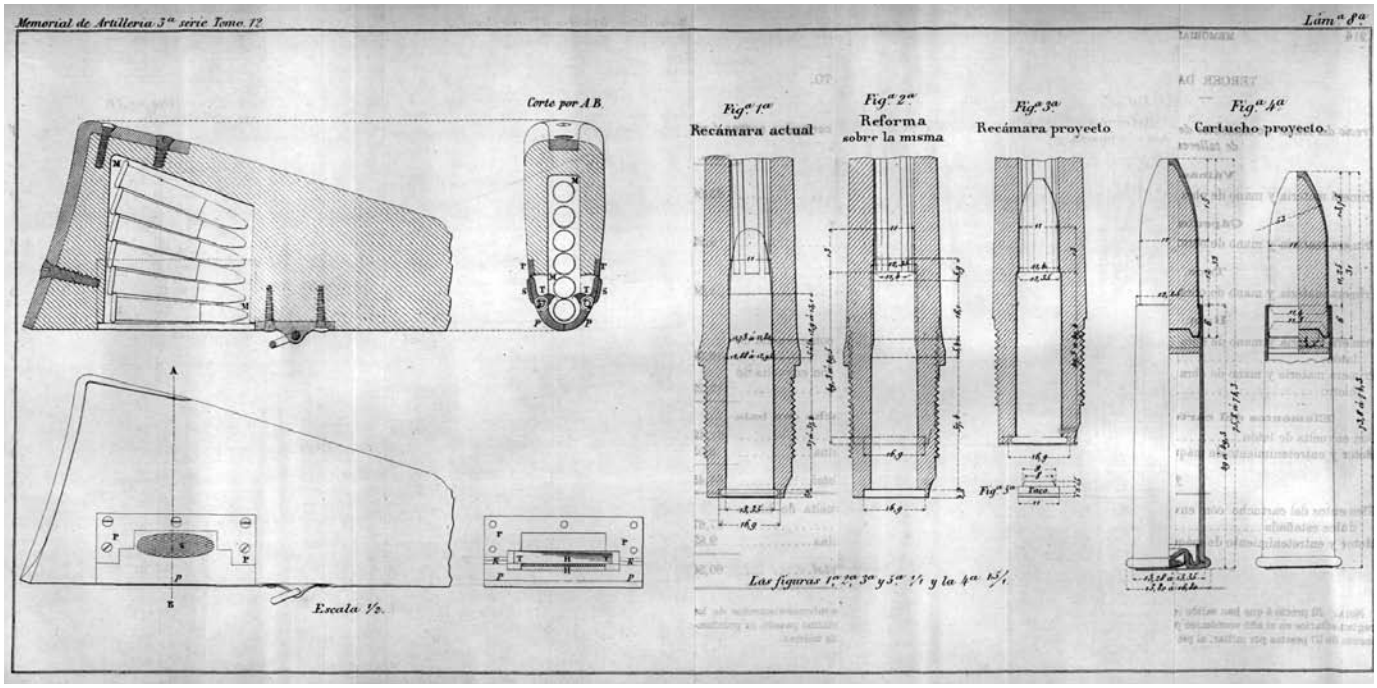
The Journal of the Historical Breechloading Smallarms Association



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The cover picture are: Original diagramme of proposed modification of .43 Spanish rifle to Reformado from El Ministerio de Defensa De Espana and Remington Rolling-Block rifle by Guy West.

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Gunmaking by Machinery

Birth of the consumer society

by

Peter Smithurst

For centuries, gunmaking corresponded to the fondly imagined romantic idea of the craftsman in his workshop meticulously crafting something by hand. However, as with all else where production depends on the skill of the individual worker, in the absence of those skills, production grinds to a halt, unless it is replaced by an alternative. And this is what happened, pioneering mechanised mass production with standardised parts in the process. The way in which this came about is due certainly to one, and arguably to two events.

The story begins in France in the middle years of the 18th century. General Jean-Baptiste Vaquette de Gribeauval (Figure 1), hailed as one of Europe's most able military engineers, became Director of Artillery and in this capacity was able to determine policy and exercise control over the design, manufacture and quality, not just of large guns but smallarms as well. Apart from his quest to improve the standards of the army and its equipment, he also sought to bring some rationality to military stores by introducing standardized weapons *with standardized parts.* [author's italics] [1]

Figure 1. General Jean-Baptiste Vaquette de Gribeauval.

He appointed Honoré le Blanc to undertake that task in respect of the manufacture of muskets. Le Blanc had been apprenticed in the gunmaking trade. By the age of 27 he was a master armourer at the Charleville manufactory when he was transferred to St. Etienne to become *controlleur* of gun lock making. For someone so young to be given such responsibility speaks highly of his personal qualities and technical ability. This ability, whilst principally applied to achieving a particular goal, was also directed to such things as experimenting with new ways of tempering steel and forging gun barrels as well as making presentation muskets for officers.

In 1777 le Blanc designed the new French military musket and, in 1786, Gribeauval made funds available for the establishment of an armoury at Vincennes to manufacture muskets with interchangeable parts. However, the death of Gribeauval in 1789, shortly followed by the French Revolution, brought le Blanc's patronage to an end. Le Blanc had however achieved the goal of making each of the lock's components identical in size and form so that they could just be dropped into place, without the need for individual final adjustment with fine files (Figure 2). Unfortunately the methods by which he was able to achieve this remain unknown.

But the project foundered not only because of the death of Gribeauval and the coming of the French revolution; the gunmakers of France realised their livelihood was at stake if le Blanc's work went any further and they rioted. So, end of part 1.

Part 2 unfolded in America shortly after that time. In some senses it was precipitated by The War of Independence. Once the new United States of America had stabilised, Thomas Jefferson was sent to Paris as its representative. He saw le Blanc's work and was able to attest to this new "interchangeability" of components and was so impressed that he sent samples of the muskets back to the United States.

Having gained independence, the United States wanted to keep it and to ensure that, it needed an army. One of

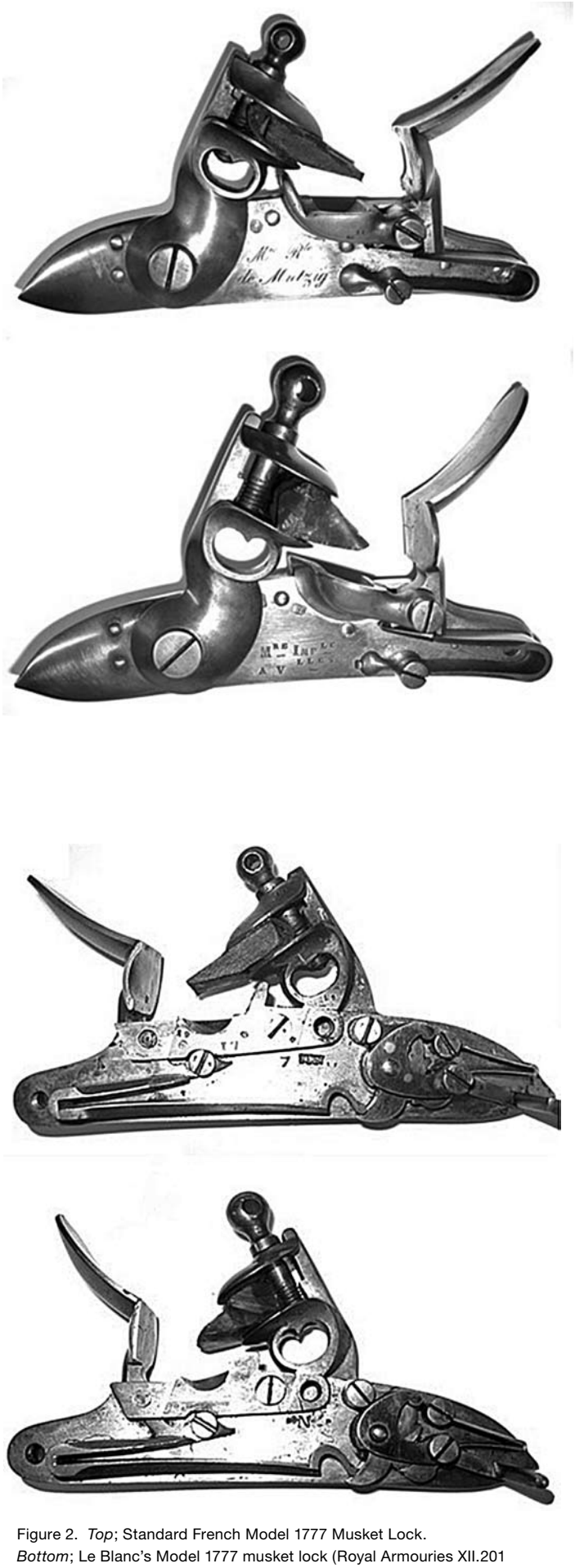
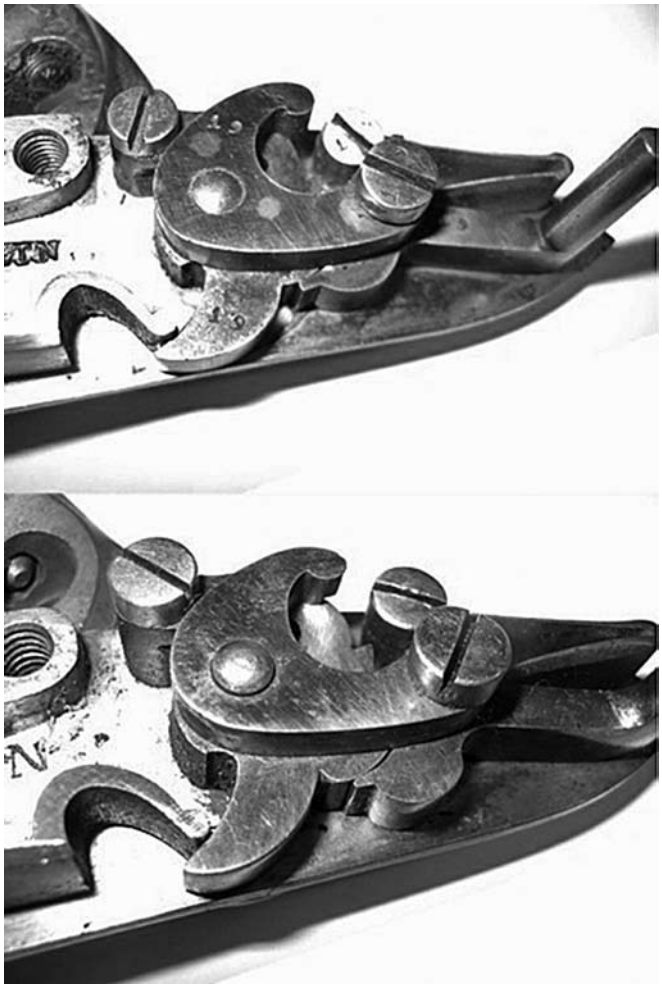


Figure 2. *Top*; Standard French Model 1777 Musket Lock. *Bottom*; Le Blanc's Model 1777 musket lock (Royal Armouries XII.201 and XII.2031 respectively)



internal views of the same locks – the major difference is the lack of any assembly marks/numbers on le Blanc's lock (bottom)

Jefferson's comrades in government, Alexander Hamilton, first Secretary of the Treasury (Figure 3), had put the matter very succinctly in his report on manufactures:

> *"Not only the wealth, but the independence and security of a country, appear to be materially connected with the prosperity of manufactures. Every nation, with a view to those great objects, ought to endeavour to possess within itself all the essentials of national supply. These comprise the means of subsistence, habitation, clothing and defence."* [2]

When it came to defence, the United States was in a difficult position. Hitherto, most of its arms, in the form of privately owned firearms, had been imported from Britain. The only military firearms were, of course, those in the hands of the British Army. Firearms supplies from Britain were no longer possible, and to produce sufficient to equip an army, a corresponding army of craftsmen would be required, and this was an army America could not muster. As Eli Whitney noted, gunmaking was *"a species of skill which is not possessed in this country to any considerable extent".*[3]

However, another of Hamilton's observations is decidedly prophetic:

> *"If there be anything in a remark often to be met with, namely, that there is, in the genius of the people of this country, a peculiar aptitude for mechanic improvements, it*

Figure 3. Alexander Hamilton

> *would operate as a forcible reason for giving opportunities to the exercise of that species of talent, by the propagation of manufactures."* [4]

An alternative to the hand-crafted gun had to be found. In this respect Jefferson's report from Paris came at an optimum time, and what had been a curtailed experiment in France became the holy grail of gunmaking in the United States. Hamilton's faith in that *"peculiar aptitude for mechanic improvements"* was harnessed to create machines as a replacement for craftsmen in the manufacture of firearms. It was the birth of a second industrial revolution which eventually was to reach into almost every corner of society.

The French 1777 musket, in effect, became the standard American musket and in 1798 when Eli Whitney contracted to manufacture 10,000 of them over a period of two years, the first step on the pathway of mechanised gunmaking was taken. This was an extremely ambitious and optimistic venture on the part of Whitney. Although he had already established himself as an inventor through his cotton gin, patented four years earlier, his attempts to manufacture it do not seem to have met with resounding success. At least one author believes that whilst Whitney had never manufactured arms before, this contract was entered into simply to save himself from financial ruin over the litigation surrounding the manufacture his cotton gin.[5] The bold nature of Whitney's venture is highlighted by the fact that even the Springfield Armory, the United States major manufactory, could not equal his proposed output. Before long, he was claiming to have manufactured muskets with interchangeable parts.[3] However, despite this claim being perpetuated in engineering history as a genuine accomplishment, it was, in fact, discounted even at the time[6] and has been further discredited in more recent years.[7,8] The contract was not completed until 1809, nine years after the appointed time, and the muskets produced were described as being of "wretched quality".[9,10] The so-called interchangeability was demonstrated to a group of influential persons including President Elect, Thomas Jefferson, in 1801. It consisted of nothing more than the ability to substitute 10 different complete locks in the same musket. It did not apply to the lock components themselves.[11] This

Figure 4. A Colt Navy '51 "Crystal Palace" model displayed at the 1851 Exhibition at the Crystal Palace.

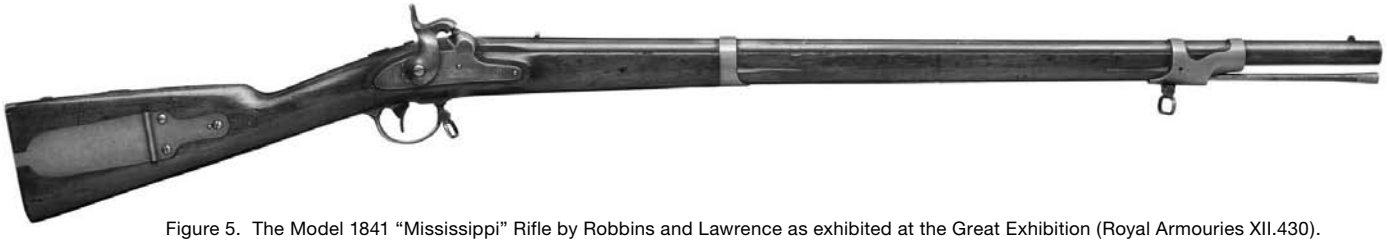


Figure 5. The Model 1841 "Mississippi" Rifle by Robbins and Lawrence as exhibited at the Great Exhibition (Royal Armouries XII.430).

must have been a disappointing episode to Jefferson especially who had submitted the original report on Le Blanc's achievements, and fell far short of the concept of interchangeability which was held even at that time.

Nevertheless, Whitney's contributions cannot be dismissed. In his observation that *"…machinery moved by water, adopted to this business, would greatly diminish the labour and facilitate the manufacture of this article. Machines for forging, rolling, floating, boring, grinding, polishing etc. may be used to advantage"*,[12] he displays a grasp of what was to become the mainstay of interchangeable manufacture.

During the next fifty years, that technology made remarkable progress and, as far as the rest of the world was concerned made its debut at the Great Exhibition in 1851.

Its great proponents were two very different companies. One was owned by the great showman and entrepreneur, Samuel Colt, whose stand was festooned with revolvers of all kinds (Figure 4). The other stand contained just six rifles, made by Robbins & Lawrence (Figure 5).

Whereas Colt made great play of the fact that his guns were made by machinery, they were not, contrary to popular opinion, truly interchangeable at that time. But in their factory in the tiny town of Windsor in remote Vermont, Robbins & Lawrence had achieved that Holy Grail; their rifles were fully interchangeable.

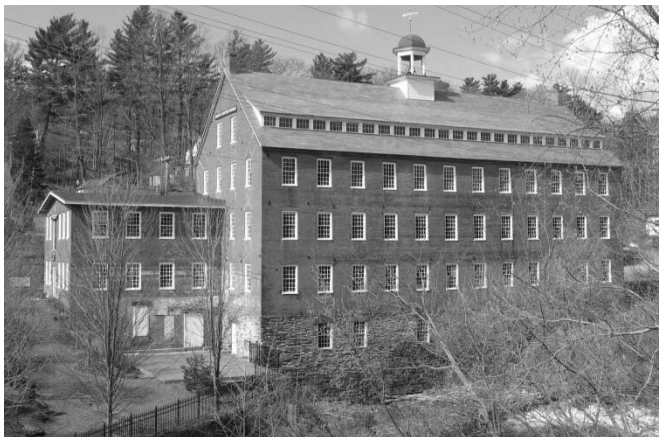


Figure 6. The Robbins & Lawrence building today (below) and circa 1855 (above) – home of The American Precision Museum

Both companies excited great interest at the 1851 Exhibition but when the new Pattern 1853 Enfield Rifle Musket came into existence, it was to Robbins & Lawrence (Figure 6) that the government turned when it came to equipping the new factory at Enfield for its manufacture.

Part of their contract to equip Enfield was to manufacture 20,000 P '53's and this led to their undoing! In brief, a drought meant that the sawmills preparing the black walnut for the stocks could not function; the blank stocks were therefore delayed; Robbins & Lawrence could not maintain supply of arms to Britain and defaulted on the contract; the British government's agents in the US foreclosed on them which led them into liquidation. But they had already left their mark. Their P '53's were the only ones permitted to have a name other than "Tower" or "Enfield" on them – in this case "Windsor" (Figure 7).

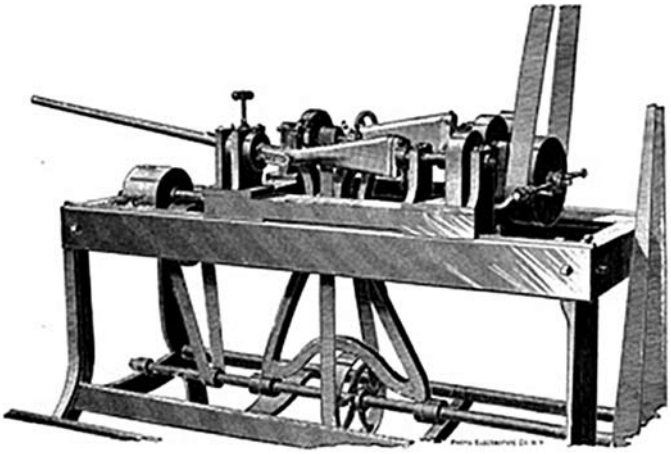
Figure 7. A Windsor P'53 (Royal Armouries XII.1628).

However, Robbins & Lawrence had left their mark in other ways – from the firearms historian's point of view, it was with that company that Benjamin Tyler Henry's work there that ultimately led to the Volcanic pistol, then the Henry Rifle and eventually the Winchester '66 rifle and its offspring – the "guns that won the West"! Robbins & Lawrence also perfected the manufacture of, and ran the factory in Hartford that produced, Sharps rifles. In the Windsor factory the first turret lathe and universal milling machine were conceived – both vitally important in the history of manufacturing. They also left their mark in one further way. The machines they had already supplied to Enfield became the patterns which were copied by Greenwood & Batley in Leeds and, in effect, provided the foundation of G & B's remarkable rise to fame as an international supplier of gunmaking equipment and plant right through to the 1960's.

There were two important features of "The American System of Manufacture" as it came to be known. One was the tenet "one machine for one job".

If we take the Enfield Pattern '53 rifle, it has (depending

upon which version we choose) around 63 components, and these required in their manufacture 719 separate machining operations which were carried out by 680 machines (for example Figure 8), enabling production of 1,200 rifles per week. Such an operation involved a very large capital outlay beyond the means of the traditional contractors – only the government could afford to do it. Production got underway in 1857 and by the year ending March 1858, 26,739 rifles were manufactured and a new era in gunmaking in Europe was underway.



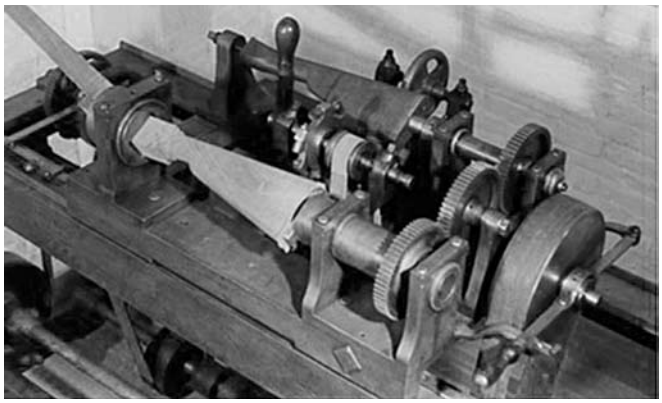


Figure 8. An original Enfield stock turning machine at the American Precision Museum.

The second feature was the reliance placed on gauges (Figure 9) to check both size and form of a component. This was much faster than usual measuring processes which, when it came to complex shapes like the tumbler – referred to by le Blanc as "the brain of the lock" – ordinary measurement was nigh impossible.

Both the use of dedicated machines, followed by gauges for checking components, greatly speeded up manufacture and reduced cost. Not only that, the uniformity of components also speeded up assembly and made repair

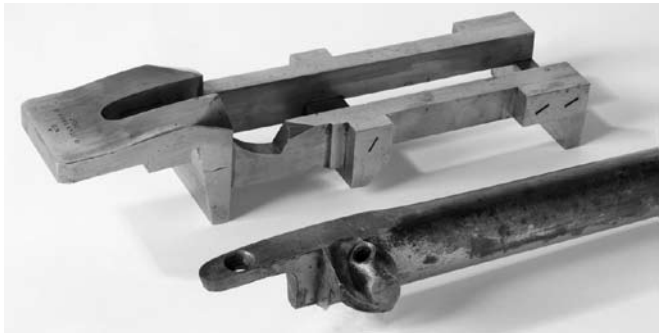


Figure 9. Gauges used in the manufacture of Enfield Pattern '53 rifles (all gauges are Royal Armouries, PR.10142).

much simpler. These factors were of primary significance in what was to follow.

Such methods applied to the manufacture of firearms became known in America as "armory practice" but it was quickly realised that the same technology could also be applied to the manufacture of other "engineered" goods. One of the earliest to adopt this method was Aaron Dennison who, in 1850, founded the Waltham Watch Company and thus laid the foundations of the American watch and clock industry. From being the province of the wealthy and functioning almost as status symbols, the "dollar watch" meant that now nearly every home could have one. The American watch industry grew and outstripped even that of Switzerland and effectively destroyed Britain's watch industries in Coventry and Prescott (Figure 10).

Figure 10. An ironic reminder of the growth of the American watch industry and its decline in Britain – an American Elgin watch bought in Coventry.

Another eager practitioner around the same time was Isaac Singer who produced what was probably the first commercially successful sewing machine. He also added another feature, the invention of the "instalment purchase plan", which greatly expanded his market by making sewing machines accessible to almost every home. Even gunmakers began to see a wider potential. After the American civil war when the demand for guns fell, companies such as Remington began to diversify, in this case producing the first commercially successful typewriter. Other products fell under its spell. Even as Colt was establishing his London factory another American, Alfred Hobbs, who gained fame at the Crystal Palace Exhibition for picking Bramah's "unpickable" lock, was establishing his London factory to produce door locks using the same technology. A few decades later, Henry Ford adapted the system to the production of the affordable motor car.

Before a century had passed, what had begun as a quest to develop a mechanical alternative to the craftsman for the manufacture of firearms had stimulated a new industrial, social and cultural revolution – the consumer society.

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3. Singer, C.J., Holmyard, E.J., Hall, A. and Williams, T.I. (1958) *History of Technology*, Vol. IV, Oxford University Press, Oxford, p437.

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Skin Deep: An investigation into protective surface coatings on firearms

by Suzanne J. Dalewicz-Kitto

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Introduction

Why surface coatings are required

Protective surface coatings have been used on firearms throughout their history. From keeping a working arsenal in good working order to preserving an antique collection, people have tried to hold back the tireless march of decay. The most effective method to reduce deterioration is preventive conservation i.e. reducing the causes of decay.[1,2] These causes include; pests, pollutants, incorrect temperature and relative humidity[3] which is a measure of the percentage saturation of the air by water.[4] 'Environmental stability is the key to successful preventive conservation',[5] however, the external museum environment is often rich in impurities that can attack a collection. Contaminants may also come from within the museum such as from visitors, construction, the artefacts themselves. Material testing, via accelerated aging of a material using metal coupons, can help us to avoid pollution from showcase manufacture materials, however, a protective coating may still be required if the object is to be handled, or the object is to be placed in close proximity with another object made from a material that will release unwanted contaminants into the atmosphere, such as certain plastics, felt, silk, wood etc.

The majority of firearms are composite, not just with wooden stocks but sometimes with bone inlays, plastic grips etc. If one part of a composite piece deteriorates, it can attack other materials, for example as metal corrodes it will create acidity that will attack and break down the organic components.[6] The quality of the environment "…will determine whether an object will survive for centuries, decades, or merely a few years",[7] so a physical barrier is required between the object and pollutants. Although the building itself will act as a 'physical envelope', a vital barrier between the outside world and a safe environment,[7] it is rarely enough. We can create further barriers using clean filtered air with a defined relative humidity,[8] although thematic approaches to displays may make specific environmental conditioning difficult. Further barriers include well-sealed showcases, but for metals we have the option of a final barrier; a protective coating.

From examining the collection at the Royal Armouries and the National Museums Liverpool, many coatings have been used in the past but many can fail. Failings can be caused by the inappropriate use of a coating; for example, no semi-protective coating should have a glass transitional temperature below 40˚C.[9] If it is too low the coating will remain soft and therefore attract dust, which acts as an abrasive causing damage to surfaces. It will lead to soiling and also become hydrophilic, attracting moisture that in turn may cause corrosion. If the glass transitional temperature is too high the coating may crack leaving the coating in a heterogeneous condition, and therefore no longer able to maintain its protective property.[10] Coatings may also fail due to ageing; a major factor in which is light. It can cause the polymers in the coating to decompose and to volatize, again leaving the coating in a heterogeneous condition,[11] In addition, as the coating decomposes it can cause: darkening leading to loss of surface detail; non-reversibility so the coating can no longer be removed; moving parts to become fixed; or the coating may release acid and directly attack the object and others around it (Figure 1).

Figure 1: Moving parts of a firearm fixed due to application of a coating.

An interesting case discovered at the Royal Armouries was that of a cellulose acetate revolver grip that had been coated in grease. Normal deterioration of cellulose acetate would give a smell of vinegar,[12] however in this case it was more "vomit" like. A white powder was present on the grip, which was identified by FTIR (Fourier Transmission Infra red) analysis to be decanoic acid.[13] Decanoic acid is part of the plasticizer component and this fitted the smell. It is likely that the grease encouraged the migration of the plasticizer component to the surface and thus accelerated the deterioration of the plastic that in turn caused accelerated corrosion of the attached iron screw (Figure 2). If a different protective coating had been chosen this object may not have suffered such irreversible damage.

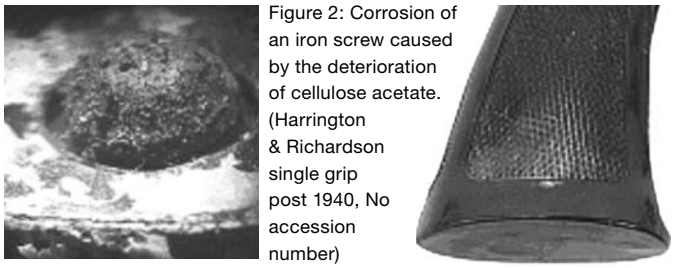

Figure 2: Corrosion of an iron screw caused by the deterioration of cellulose acetate. (Harrington & Richardson single grip post 1940, No accession number)

Many firearms are meant to have a coating added. This can be to lubricate moving parts or to protect a surface from corrosion. Such surfaces are usually keyed purposely to take this coating, such as shown by a French sporting rifle in Figure 3. For such specific and also more general protective purposes, the British military have their own range of oils and lubricants and these are still in use within many museums with a military connection. However, by custom and practice a wide range of other coatings are also in use but without data to guide choice in specific situations.

Figure 3: French sporting rifle with metal surface keyed to take a coating.

Aims of the investigation

The aim of the study was the investigation of the merits of different products used in the conservation of firearms. The long term effects on metals, and on organic materials in composite object that might also come in contact with coatings, were subject to experimental study.

From a questionnaire sent to museums asking which products were used, it was clear there were different approaches to the treatment of firearms (Table 1). Thus, one military armourer used military-provided oils and lubricants; gunsmiths used a range of gun oils and sprays, and a conservator used various waxes and oils. From the questionnaire, a list of materials for investigation was made which included waxes, historic coatings, gun oils, other oils and the MoD (Ministry of Defence, UK) range.

UK

British Museum; Imperial War Museum; National Maritime Museum; Victoria and Albert Museum; Glasgow Museums

Europe

Palace Armoury, Valetta, Malta; Royal Army Museum, Brussels, Belgium

India

Jodhpor Fort

USA

Springfield Armory National Historic Site; Colonial Williamsburg

Australia

Australian War memorial

- **Historic Coatings**
  - Lanolin
  - Turpentine
  - Linseed Oil
- **Waxes**
  - Renaissance Micro-Crystalline Wax (pre-mixed)
  - Micro-Crystalline Wax (WA05)
  - Johnson's Paste Wax
  - Staples Wax
  - Bowling Alley Wax
- **Gun oils**
  - BrunOx Oil
  - Youngs 303, Oil
  - Rangoon Oil
  - Pendletons gun oil
  - Other Oils
  - 3inOne Oil
  - Supertrol 001
  - WD 40
  - MOD range
  - G403
  - OX24
  - PX4

Table 1. Preservative coatings used by the 11 centres which provided answers to the questionnaire.

Each product underwent two material tests based on a Getty version of the Oddy Test.[14] This provides information both on how protective each product is, and also on any deleterious effect it may have on the surfaces to which it is applied.

The experiments were carried out with a glass flask with a lid, inside which was placed a second glass jar. All the glassware was washed and degreased thoroughly before use. Coupons of silver, copper, lead and mild steel were surface cleaned with a glass bristle brush to remove oxides and then degreased in acetone (Figure 4). The coupons were bent so that they could be placed over the edge of the inner glass jar, taking care that no coupons came into contact with each other, and were left at 60°C for one month (Figure 5).

Figure 4: A coupon being prepared for testing.

Figure 5: Material testing jars placed in the incubator.

In the experiments to assess protective effect, each metal coupon was coated with one of the products being tested and a 5% salt solution with acetic acid to pH 3[15] was placed in the outer jar in order to mimic a polluted atmosphere. In the experiment, to assess the potential for a damaging effect, uncoated coupons were exposed to 2mls of each product in the inner jar, with 2ml deionised water placed in the external jar. The jars were incubated at 60°C for one month.

Testing was also considered on the effects of the protective products on materials such as leather straps and textile linings of armour as well as wooden stocks on firearms since these coatings have potential close proximity to such materials. For this purpose unbleached cotton and silk, were chosen to give a basic understanding of any effects on organic materials. Strips of the cotton and silk were taken and saturated in the product being tested. A strip of each was left in its natural state to act as a control. One set of saturated strips with controls was left on a windowsill to determine the effects of light damage, a second set including controls was placed in the oven at 60°C and a third set with controls was left in a dark cool place (Figure 6). The strips were assessed after one month's exposure.

Figure 6: Textile samples left in bright light to assess photolytic degradation.

Results

The results are shown in Tables 2-5 and Figure 7. For waxes it is of interest that although Renaissance Microcrystalline wax worked well, the WA05 version which has to be mixed by hand works better than the pre-mixed product. Although turpentine and linseed oil are not usually applied directly to metal, it was decided to test them as they can come into contact with metal in their application on a wooden stock. Linseed oil caused heavy corrosion of the coupons for lead and mild steel, and would not be recommended even in this indirect use. It also showed evidence of thermal deterioration and therefore would alter its properties over time. Turpentine covered

Material	Silver		Copper		Iron		Lead	
Renaissance Microcrystalline (pre-mixed)	P	P	P	P	P	U	P	U
Renaissance Microcrystalline WA05	P	P	P	P	P	T	P	P
Johnson's paste	P	U	P	P	P	P	P	U
Staples Wax	P	U	P	P	T	U	U	U
Butchers Bowling Alley Wax	P		U				U	

Table 2. Results for wax on metal coupons, after one month exposure. Left columns = protection afforded in a polluted atmosphere; right columns = effect of products on uncoated metal coupons. P= Good for permanent use. T = Temporary use e.g. 6 months U = unsuitable for use.

Material	Silver		Copper		Iron		Lead	
Lanolin	P	P	P	P	P	P	P	U
Turpentine	U	U	U	U	U	U	U	U
Boiled Linseed Oil	P	P	P	T	P	P	U	U

Table 3. Results for Historic coatings after one month's exposure to metal coupons. Left columns = protection afforded in a polluted atmosphere; right columns = effect of products on uncoated metal coupons. P= Good for permanent use. T = Temporary use e.g. 6 months U = unsuitable for use.

Material	Silver		Copper		Iron		Lead	
BrunOx Oil 1.75	P	P	P	P	P	P	P	U
Youngs 303 Oil	P	P	P	P	P	P	P	U
Rangoon Oil	P	U	P	P	P	T	P	U
3inOne Oil	P	P	P	T	P	P	P	U
Supertrol 001	P	P	P	P	U	U	U	U
WD40	P	P	T	P	T	P	T	T
G403 Grease	P	P	P	P	U	U	P	U
OX24 Synthetic Oil	P	P	T	P	P	U	U	U
PX4 Synthetic Preservative	P	P	P	P	P	P	P	U
Pendleton Gun Oil	P	P	P	P	P	U	P	P

Table 4. Results for Oils and MoD range after one month's exposure to metal coupons. Left columns = protection afforded in a polluted atmosphere; right columns = effect of products on uncoated metal coupons. P= Good for permanent use. T = Temporary use e.g. 6 months U = unsuitable for use.

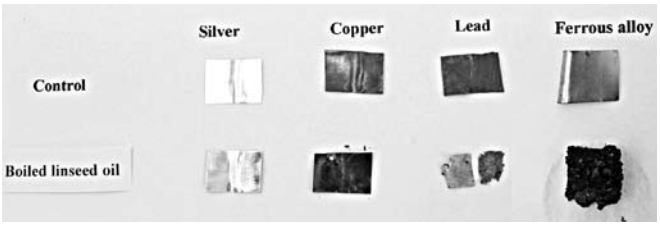

Figure 7: Material test results for boiled linseed oil.

the coupons in a light surface corrosion, but as it is only used indirectly, it generally would be fit for purpose. For the oils and MoD range the biggest surprise was the lack of protection provided to metals by WD40; this is probably due to evaporation and probably explains the positive results gained on the thermal and photolytic tests.

The cotton and silk strips showed no difference in their susceptibility to the different preservative products. A number of the products suffered either thermal or photolytic degradation (Table 5; Figure 8). Failure in one such category however may not be important depending on the use made of the product. For example lanolin, whilst deteriorating in light, remains stable under prolonged exposure to heat and since it is used on the interior of mechanisms, this failure in light should not be a problem.

Material	Suitability with organics
Renaissance Microcrystalline	P
Staples wax	P
WD 40	P
Pendleton gun oil	P
G403	P
Rangoon Oil	P
OX24	P
BrunOx Oil	P
3inOne Oil	T
Supertrol 001	U
Lanolin U	U
Boiled Linseed Oil	U
Youngs 303 Oil	U

Table 5. Effect of preservative products on cotton and silk strips after one month's exposure to thermal and photolytic degradation.
P= Good for permanent use. T = Temporary use e.g. 6 months
U = unsuitable for use.

Conclusion

These tests have provided a greater understanding of the materials used to care for firearms, and have led to a change in working practice at the Royal Armouries. WD40 has now been replaced by BrunOx oil, and 3inOne is considered no longer ideal as a lubricant. However the experimental findings with the above coatings should be considered within the limitations of the study. This version of the Oddy test placed all the coupons in a single flask for reasons of time, space and reduced equipment costs. According to Fenn, since the metals will compete for the gases, the sensitivity of the test might therefore

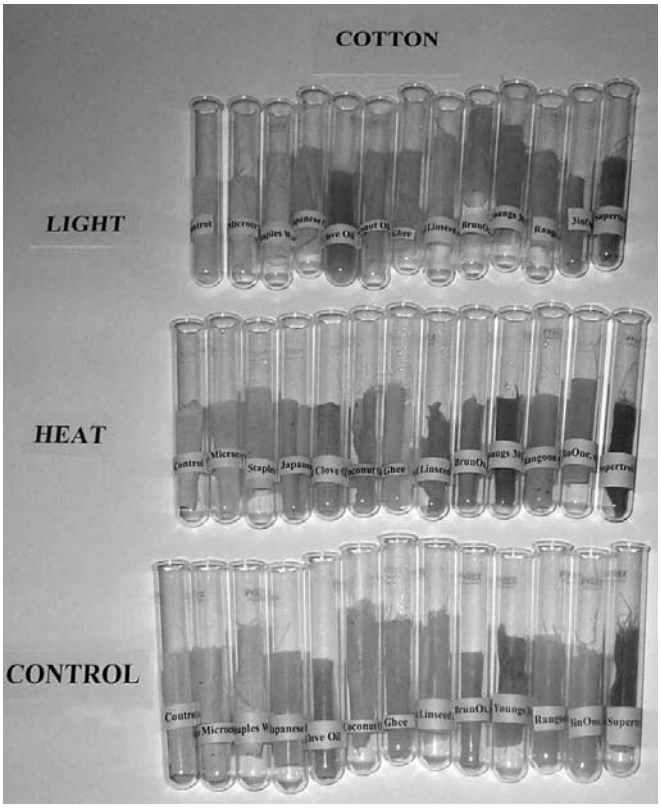

Figure 8: The effects of coatings on cotton after one month.

be impaired; however this has been disputed.[16] Also, the results of the thermal and photolytic degradation tests may be skewed by the progressive evaporation of certain of the coatings being tested. In addition, in Horrie's opinion: "It should be expected that all coatings will be damaged and replaced periodically".[17]

How long a coating lasts will depend on the environment it is in and how it is handled. For example Renaissance Micro-Crystalline wax passes all the tests and was found to still offer protection to armour after ten years' display in the Royal Armouries Hall of Steel. This is an eight-storey staircase following a hollow inner octagon with 2586 pieces of arms and armour displayed on both sides and with an exterior outer octagon, made entirely from glass from the first floor upwards. The environment is relatively unconditioned and temperatures can reach 40°C and the relative humidity 63%.[18]

Dust analysis carried out by McCrone Scientific Ltd, revealed the main components of dust in the museum were dead skin with resin, paint flakes and fibres.[19] The build-up of dust had caused some corrosion to the objects on display, but was considered light given the objects had been displayed for over 10 years. In extremely dusty conditions, however, Renaissance Micro-Crystalline wax can fail. In 2001 the Royal Armouries conducted tests on mild steel with different coatings of B72, Micro-Crystalline wax and nitro-cellulose lacquer. These tests were carried out in the extreme environment of Malta, which suffers high levels of humidity, temperatures, pollution and salt. A set of coupons was left in a case and another was left in the open gallery. After six months the waxed and lacquered coupons in the showcases showed no corrosion; however, outside the cases the Renaissance waxed coupon failed (Figures 9,10). Part of the efficiency of a coating can be affected by the cleanliness of the surface to which it

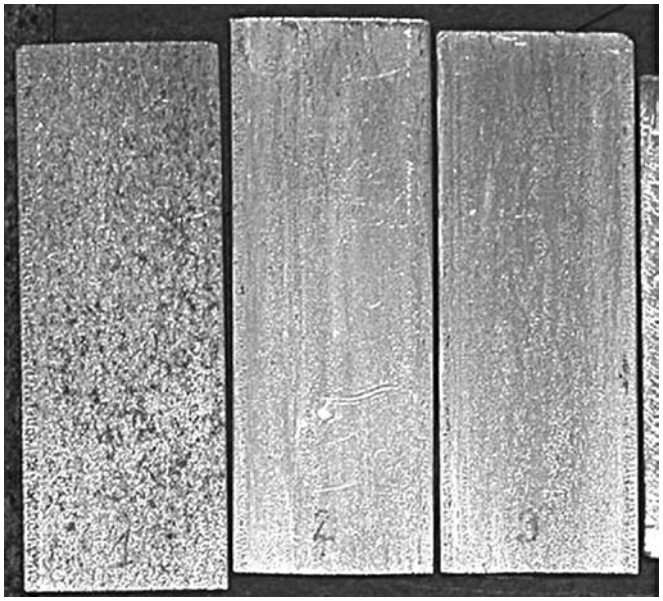

Figure 9: Mild Steel coupons coated with, (left to right) untreated, Paraloid B72, Renaissance Micro-crystalline wax kept in a showcase.

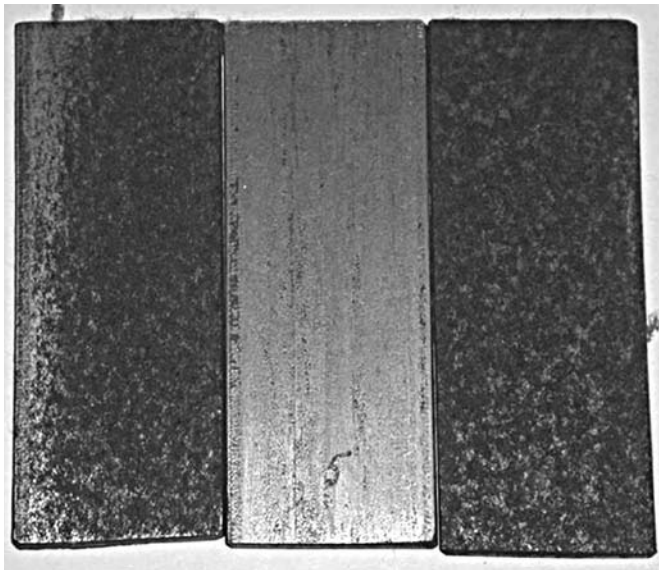

Figure 10: Mild Steel coupons coated with, (left to right) untreated, Paraloid B72, Renaissance Micro-crystalline wax kept in the gallery.

is being applied and also how it is applied. For example Emma Schmuecker, a conservator at the Royal Armouries, carried out tests again using Renaissance Micro-Crystalline wax. She coated a mild steel coupon with wax applied cold and then coated a second coupon with the wax applied hot. After three months in an uncontrolled environment the difference in efficient protection was startling, indicating that a hot wax application is far superior to the cold wax application in providing protection (Figures 11-13).[20]

In addition to the above it must also be considered that while a wax coating may offer increased protection, it will not lubricate moving parts. As we have seen a material such as Lanolin, which is mixed with oil to prevent it running out of the mechanism, may fail in light but since its use is internal and therefore in the dark, it may be still a suitable choice.

Finally we must be mindful of the other materials with which the coatings may come into contact. In the above tests we have seen the unwanted staining that may occur and although no structural changes were observed to the base materials of cotton and silk in these tests, further investigations are required.

This is a continuing project. The author would be pleased to hear from anyone with further suggestions of materials to test or indeed the results of any evaluations that have been made.

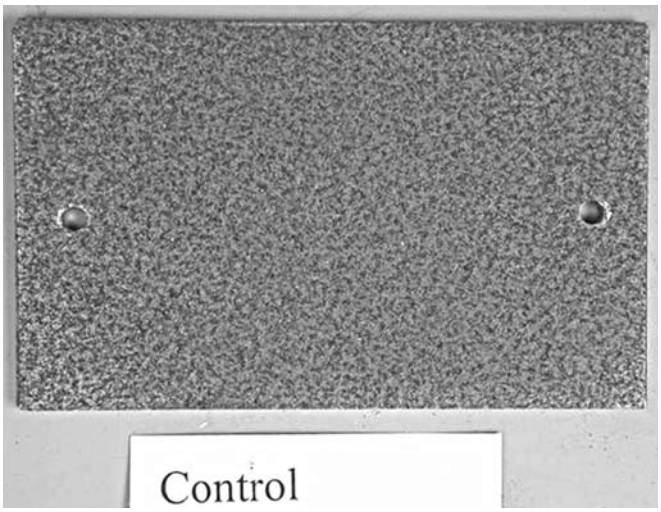

Figure 11: Mild steel untreated coupon.

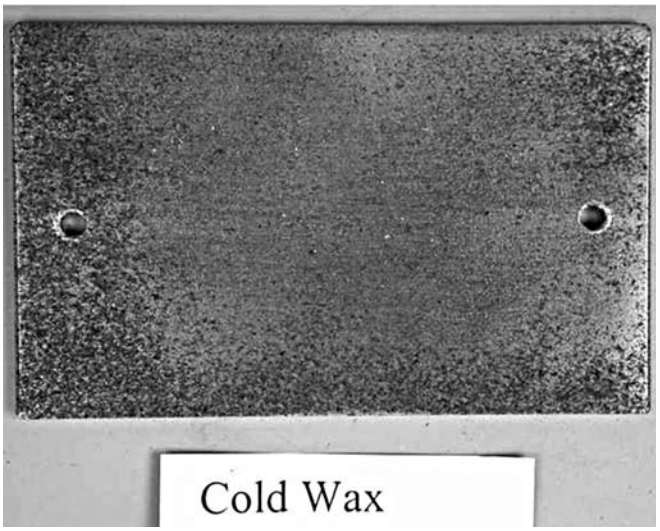

Figure 12: Mild steel coupon treated with cold Renaissance Micro-crystalline wax.

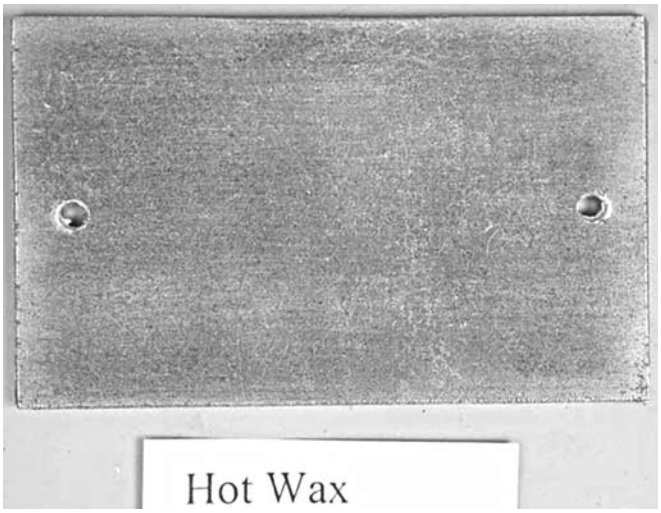

Figure 13: Mild steel coupon treated with hot Renaissance Micro-crystalline wax.

Acknowledgements

With many thanks to Alison Draper and Emma Schmuecker, Royal Armouries, John Henshaw, MoD Pattern Room and Jack Truscott, private gunsmith for their support, generous sharing of knowledge and discussions. To Rose Lees, Icon Heritage Lottery Intern, for her assistance in preparing samples. To the museums listed in Table 1 for their sharing details of their arms and armour treatments. All illustrations are copyright of the Royal Armouries, Leeds.

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The internet and firearms research with reference to the .43 Spanish Remington Rolling-Block and its ammunition

by

David A Thombs and Stephen P Barrett

Abstract

The paper examines the role of the Internet as a source in firearms research and uses as an example the .43 Spanish Remington Rolling Block and its ammunition. The advantages and disadvantages of the Internet are illustrated and two contradictory theories are analysed. The Reformado cartridge development is traced and a new hypothesis is proposed regarding the conversion of the rifles to the Reformado cartridge. Tips on the effective use of the Internet are given.

Introduction

It was noted in the HBSA journal[1] that Edward McShane, writing in 1949 stated[2]:

> … a considerable amount of second-rate material has been published on problems of ballistics, and even the search for the origin of a useful idea would entail much winnowing.

Stephen Sambrook writing about the Vickers Luger in the HBSA Journal[3] noted that:

> ... the historiography of the topic, is itself highly interesting and worthy of careful study. Much of what has appeared in book and magazine articles in the English language has lacked attributable sources and the reliability of some of it could not be tested even at the time it appeared.

The observations made nearly sixty years ago and others made more recently, illustrate the problems of research in our chosen field. The main difference today is that the amount of poor quality material has significantly increased. The search for primary sources is a major problem. In particular in the case of military weapons much of the data is not available in the public arena and often the same unreferenced passage is repeated verbatim by even the most prestigious of authors. The Internet offers many advantages to the modern researcher but also releases a torrent of problems.

To illustrate the opportunities and problems which the Internet can provide, we have chosen as an example the .43 Spanish Remington Rolling Block rifle.

Background

The subject of this paper is a .43 Spanish Remington rifle (Figure 1) which is a well-worn 3rd contract Remington manufactured rifle with the RV and crown stamp

Figure 1. The well-worn 3rd contract Remington-manufactured No.1-model Rolling Block rifle (Remington model 71) in .43 Spanish calibre found to have disappointing accuracy. Replacement cleaning rod and rear sling swivel courtesy of Kenn Womack.

for Recomposicion Vascongada described in Layman[4] as substandard and refurbished at the Vascongada Arsenal. However, Layman[i,5] maintains that the latest information indicates that RV stands for Reglamento Voluntario, the Cuban Volunteers, during the Spanish American War. A chamber cast confirmed the calibre to be .43 Spanish (11.15 x 57R Remington Spanish), with a long gap (leade, throat or freebore) of 0.885" before the start of the rifling. Reloaded ammunition duplicating the service round as closely as possible resulted in large groups and elongated bullet holes on the target. The questions to be answered were:

> Why is the rifle exhibiting the external ballistic characteristics observed?
>
> What can be done to improve the accuracy of the rifle?
>
> Was the observed behaviour typical of the military Spanish Rolling block?

Discussion

Why is the rifle exhibiting the external ballistic characteristics observed?

External ballistics is a very complex science and is subject to much ill informed comment and discussion. This is a serious problem when dealing with material obtained from the internet, in particular on Discussion Forums. The qualifications and experience of the authors are mostly not known and only in very few cases are sources cited. In the case of bullet stability, little experimental work was performed before 1879, when Sir George Greenhill published the results of work carried out while he was Professor of Mathematics at the Royal Military Academy, Woolwich[6]. Over the years many authors have modified Greenhill's Formula, to little useful effect. In addition the internet has many sites which display a complete lack of knowledge of even the basic principles of the subject and are based on hearsay, prejudice and guesswork. A notable exception is Don Miller's work on the subject over many years, which has resulted in a number of papers updating Greenhill's work and provides a very practical approach to calculating bullet stability factors. In particular a paper in the HBSA Journal[7] and three papers published in Precision Shooting provide, in detail, all the information needed to calculate bullet stability and twist rates[8,9,10].

Applying the Miller equations to the Remington Spanish Rolling-block requires the following data:

Calibre - 11.10 mm
Bullet Weight - 25.0 grams
Bullet Length - 28.05 mm
Muzzle Velocity - 400 m/sec
Rifling Twist - 50.8 cm

This gives a Stability Factor, s, of 2.7 which is well over the accepted minimum of 2.0 required to ensure a stable bullet. However as Miller noted in Part 2 of his work:

> ... At transonic and subsonic velocities, things get much worse because those non-linear aerodynamic coefficients (mostly the Magnus moment) induce dynamic instability. Unfortunately there are very little experimental aerodynamic data of any kind in the transonic region (700-1300 ft/sec) for any bullets, especially the round, blunt, or elliptical nose bullets used by black powder shooters. Therefore, calculating the actual yawing motion is seldom possible.
>
> ... For black powder velocities, the twist rule does predict quite well the actual twists used in 19th century guns using the "safe" s=2.0. However, because of the nasty dynamic stability problems in the transonic region, which can sometimes be cured with faster twists (higher stability factors), many black powder shooters now recommend stability factors of 2.5-3.0 to estimate their twists. Even higher s values may be needed.

The Spanish Remington Rolling Bock was a mid-19th century design and therefore, since it predated Greenhill's work, the twist rate can only have been based on limited experimental studies. It would therefore seem likely that little can be done to improve the bullet stability problem.

What can be done to improve the accuracy of the rifle?

One characteristic of the rifle remains to be examined - the very long leade from the front of the chamber to the start of the rifling. A long leade is claimed to reduce pressure, e.g. Weatherby used a long leade on all rifles chambered for their proprietary magnum cartridges. However, high pressure is unlikely to be a problem in the case of this rifle. The usual reason cited for a long leade on black powder military rifles is to allow loading of cartridges in a badly fouled rifle.Wide manufacturing tolerances for both the leade, chamber and the ammunition could also cause problems. Assuming the leade is larger than the bullet diameter, this could result in tipping of the bullet before it enters the bore, causing an unbalanced bullet, hence reducing accuracy and increasing bullet instability.

Searching the internet revealed a relevant article on The Society of Remington Revolver Shooters web site[11]. Dykstra found that seating the bullets to just engrave on the rifling resulted in good accuracy. The overall length of the round was 82.5 mm compared with the length of the standard military round of 74.3 mm. This confirmed observations made with the subject rifle. This practice would not have been practicable for military use.

Was the observed behaviour typical of Spanish Rolling Block rifles?

The Spanish Rolling-block can be found in two calibres, firstly the .43 Spanish (11.15 x 57R Remington Spanish) and secondly the .43 Spanish Reformado (11.4 X 57R Reformado), (Figure 2). The designation of both cartridges is very variable, the Reformado is sometimes referred to as 11.5 and both cartridges can be designated as 58mm

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i. George J. Layman is the foremost authority on the military Remington Rolling-block and has published two books on the subject. In the Preface to his latest book he describes the Rolling-block as "one of my life long intimate love affairs, with what I feel was the world's greatest single-shot military rifle". He has owned 1,200 Rolling-blocks and examined twice as many more. But he admits that even after 40 years of research, "new challenges keep popping up".

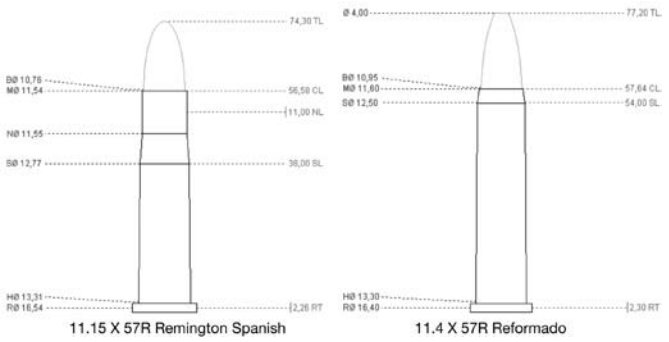

Figure 2. Dimensions of the .43 Spanish and Reformado cartridges.

long. The history of the rifle is open to some dispute and two conflicting histories can be found. Barnes[12] states the following:

> The 11.5 X 57Rmm Spanish Reformado ... This was the original centerfire, Berdan primed Spanish military cartridge. It was adopted about 1867 and used in early Rolling-block rifles manufactured by Remington for the Spanish government. It was also used in some Berdan and Snider conversions of the Spanish muzzleloader. Over a million rounds of this ammunition and many Rolling-block rifles were captured by American troops in Cuba during the Spanish-American war. It was replaced by the 11.15 Spanish Remington cartridge in 1871. Although this cartridge is listed as .43 calibre, the bullet has a base band that is actually 0.454 inch in diameter. The bullet is brass covered and has a 10 degree bevelled base. In the tropical climate of Cuba, the brass covered bullets often turned green with verdigris and were thought to be "poisoned" bullets by American troops.. Rim and base diameter and case length are almost identical to the 11.15 Spanish Remington and cases could be made by expanding and trimming 11.15 cases.

The Springfield Armoury Museum has two Spanish Rolling-blocks in its collection. One is probably identified incorrectly as chambered in 11mm Mauser calibre[13]. Springfield incorrectly attributes the following to Layman:

> In 1866, Spain purchased 10,000 rolling block rifles which were merely an overrun of .58 Berdan chambered conversions of Civil War vintage .58 muzzleloaders utilizing the Remington rolling block action once intended for U.S. military assessment. With the order of these test pieces at hand, Spanish military ordnance officials subjected the guns to a most rigorous and abusive series of climatic tests (e.g., leaving the guns in saltwater for extended period and extreme humidity testing). As Spain still retained possessions in such near-tropical climates as Cuba, Puerto Rico, and the Philippines, appraising the rolling block's ability to stand up to their rigorous climates was paramount prior to official acceptance of this new firearm. After attaining highly satisfactory results in its overall rating, the Spanish decided to push for the rolling block's official adoption. In 1869, the first large order was placed for 85,000 rifles and 10,000 carbines. For some months prior to the actual production haggling took place with the Spanish who demanded that the entire order be chambered in Spain's own .43 Reformado caliber, which was a straight-cased .454-inch diameter cartridge developed by them specifically for the new Remington rifle. The 11mm or .43 Reformado most likely was the first metal-jacketed cartridge as its 396-grain bullet was comprised of a brass jacket backed by 74 grains of blackpowder, and it attained a muzzle velocity of 1,280 feet per second. Remington designers, however, engineered an improved bottleneck cartridge that utilized a 375-grain bullet and 78 grains of blackpowder to reach a muzzle velocity of 1,380fps, but it bullet was pure lead minus a metal jacket. After some difficult persuasion, the Spanish were sold on Remington's innovative cartridge and the entire Spanish order was for the new 11.15 x 58R Spanish Remington cartridge. The Spanish were satisfied, but in order to nationalize their feelings, the entire previous lot of 10,000 .58 Berdan rolling block rifles was converted and rechambered to the .43 Reformado cartridge. Spain's 1869 purchase of the Remington rolling block set a precedence that caused the so-called Spanish Model to be catalogued in its own sobriquet in future Remington sales listings and advertisements. The No. 1 Remington rolling block rifle in .43 Spanish Remington caliber (11.15x58R) accounted for more than one half of all military rolling block sales between 1869 and 1885. The Spanish Model was a big hit, especially with those countries in Latin America whose cultural relationship with Spain was at times close, due to their linguistic similarities, thus the following Hispanic nations also made purchases of the Spanish model.

> 1871-1873 - Colombia - 6,800
> 1871-1874 - Chile - 12,000
> 1871-1874 - Cuba - 10,000
> 1871-1874 - Puerto Rico - 5,000
> 1872 - Dominican Republic - 5,000
> 1879 - Argentina - 75,000
> Unknown - Venezuela - Unknown
> Unknown - Brazil

This version of events is repeated verbatim, on many Internet sites.

To paraphrase Layman[14], the second version of events is as follows:

> Spain began a search for a new breech-loader in 1867-68. First delivery of 10,000 Remington Rolling-blocks in .43 Spanish was made to the Spanish Army in Cuba in 1869. A further set of trials in 1869 and the Remington was again selected and a contract for 50,000 rifles placed in 1871. Further contracts were placed, making in total 90,000 rifles. In addition to the central government, cities and departments throughout Spain placed contracts for rifles, possibly giving a grand total supplied by Remington of 125,000 rifles. Domestic production of the rolling-block began in 1869 or 1870 at the National Armoury at Oviedo and total production was 350,000 rifles. The rifle was known as the Remington Model 71. Spain was not satisfied with the performance of the .43 Spanish cartridge and in the 1880s Lieutenant Colonel Luis

Freire[ii] y Gongora and Captain Jose Brull y Seoane redesigned the cartridge from bottle-necked to straight case, with a larger diameter bullet, from 11.15 to 11.32-11.46. The new cartridge was approved in April 1889. The only change made to the rifle was to ream the chamber to accept the new cartridge. The rifle was known as the Remington M71/89. All existing rolling-block rifles were rechambered to the new cartridges. This included American made rifles from the 1868-73 contracts. Spanish manufactured rifles have a letter R stamped over the chamber. American made rifles have FB stamped over the chamber. The rolling-block was replaced by the 7mm Spanish Mauser in 1893. The obsolete rolling-blocks were relegated to militia forces or use by friendly tribes.

Bastida[15], writing in Spanish, in "The catalogue of the Arms Collection of the Californians Grenadiers", confirmed most of Layman but also provides further information. The first 10,000 rifles were converted .58 calibre Springfield muzzleloaders, confirmed in private communication between Bastida and Jack Heath of the Remington Museum. They were referred to in the 1877 Remington catalogue as the Springfield Model and chambered in 14mm Berdan. Even before the final adoption of the model, and because of the urgent need for rifles for the Army Overseas, Spain placed new orders, this time in .43 Remington. Although the figures differ somewhat from one author to another, the U.S. firm exporting 95,000 units in 1869, 10,000 more between 1871 and 1874 that are billed directly to Puerto Rico , and an equal number in the same period, which are billed directly to Cuba. He also noted that when the Model 1871/89 was introduced, in addition to reaming the chamber of the M871 to accept the Reformado cartridge, a front and rear volley sight was added to extend the range to 1200 metres.

Clearly the two versions are very different, but which, if either, is correct? Searching the internet unsurprisingly revealed very little useful information, except on a site dealing with the 1898 Spanish American War in Porto Rico[16]. The site contained new information on the M1871 and M1871/89 rifles. The author invited readers to contact him for further information on items of interest. The author was contacted and replied rapidly with further details of the two rifles, including references to primary source Real Ordens (Royal Order) dealing with the acceptance of the Reformado cartridge in 1889. Clearly the Layman/ Bastida version is correct and the Reformado cartridge was introduced because of the poor performance of the .43 Spanish. The information supplied also quoted from the specification adopted by the Oviedo factory in 1882. The calibre of the rifle was quoted as 11.0 +/- 0.1mm which would seem to be a very large tolerance. The primary source for this data could not be located and the tolerance specification could not be validated.

Development of the Reformado cartridge.

Clearly the research carried out by Lieutenant Colonel Luis Freire y Gongora and Captain Jose Brull y Seoane is of major importance. Layman[17] states that:

The Freire - Brull notebooks - These are the actual notebooks kept by Spanish Officers, Lt. Col. Freire and Capt. Brull on the development of the .43 Reformado cartridge. Thirty years ago they were in the possession of a collector in New England who allowed the author to read them and take notes from them. Unfortunately their present whereabouts are unknown.

Freire and Brull published a "Ballistic Study" paper in 1885[18] which made a number of important observations. Infantry tactics during the Russo-Turkish War of 1877-78, demonstrated a requirement for longer range, improved accuracy and better penetration. Development in other nations rifles were examined and the best rifle in service at the time was judged to be the Martini-Henry but the ammunition was found to be too heavy and the recoil excessive. They also noted the move in Britain to reduce the calibre of the Martin-Henry to .40. In 1883 Professor Freidrich Hebler gave a series of lectures at the Toledo Shooting School and did comparative test of the M1871 rifle and a Vetterli rifle fitted with a barrel of his own design. The results were decisively in favour of the Vetterli. Taking results from ballistic studies such as Bashforth and Whitworth in England and Siacci in Italy relating to artillery, they adapted the theory, with difficulty, to small arms and defined the ideal rifle / cartridge combination as 10mm[iii]. Freire and Brull looked at the M1871 Rolling-block rifle and found major problems in range, accuracy and penetration, mainly because of deformation of the lead bullet in the long leade. Because of financial constraints, Spain could not afford to develop a new 10mm rifle and they proposed rechambering the M1871 to a new cartridge. This required the chamber to be reamed, removing the bottleneck portion of the .43 Spanish chamber, the breech end of the barrel to be shortened by 15mm, and the chamber shortened to 49mm. 29 and 27.5 gram bullets were shown with a brass jacket, an 11mm bore sized cylindrical portion, and a 11.4mm diameter 6mm long driving band at the rear of the bullet, which engaged the start of the rifling. This followed best artillery shell designs of the day. The bullet also had a small boat-tail and a shallow hollow base. The modifications are shown in Figure 3 which also shows a proposal for a butt magazine. The paper also provided detailed costing for the conversion.

In 1888[19] they published a paper showing a comparison between the M1871 and the proposed Reformado rifle. The comparison covered the following aspects:

Muzzle velocity.
Accuracy at 50, 200, 400, 1000 and 1200 metres.
Penetration at 50 metres and other ranges if possible.
Recoil.
Bore fouling.
Bore wear.
Angles of elevation.
Maximum ordinates of trajectory.
Determination of danger zones.

ii. In the literature the name is found with two spellings, Freire and Freyre.

iii. This was just around the time that smokeless propellants came into use in the Lebel in 1886, which changed the ballistic models completely and resulted shortly after in the adoption by Spain of the 7mm Mauser.

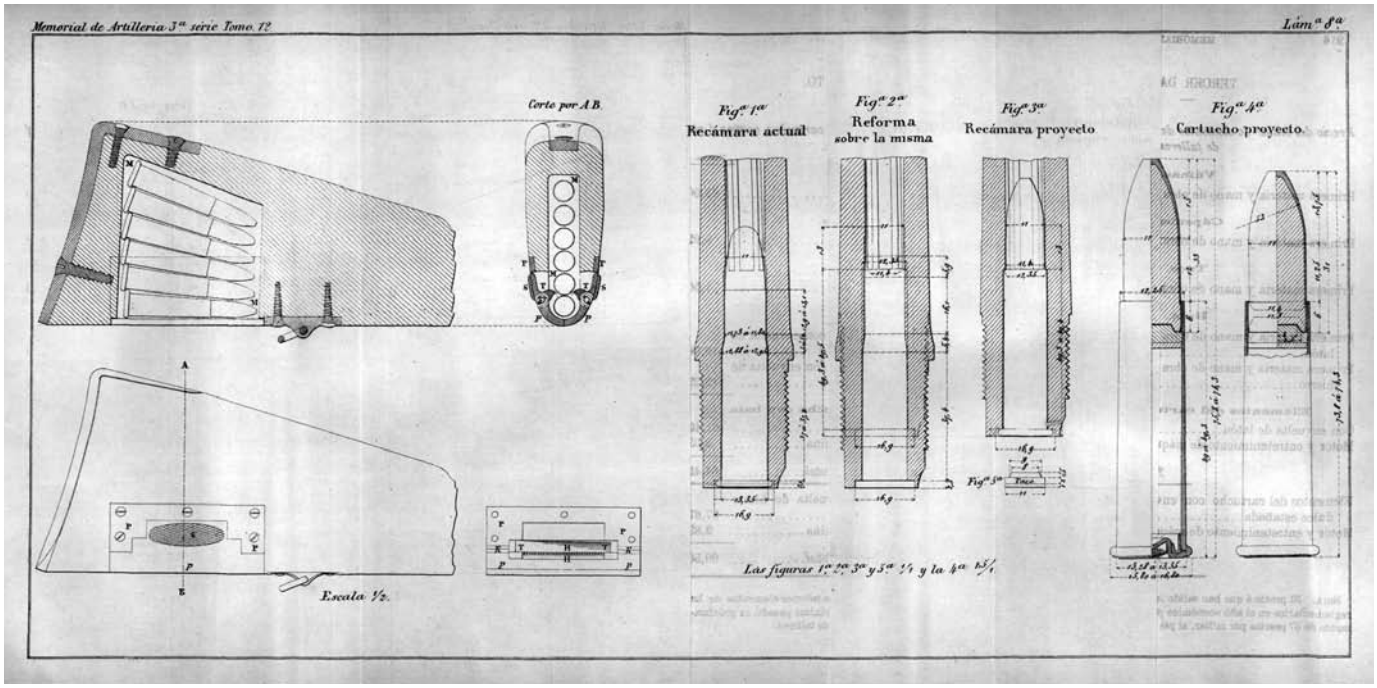

Figure 3. Original diagramme of proposed modification of .43 Spanish rifle to Reformado.

They went to considerable trouble to test the cartridge and reduce the number of variables, such as weighing the blackpowder on a laboratory balance for each round and using a machine rest. The results showed the Reformado, especially with the 29 gram bullet, to be vastly superior to the .43 Spanish For example, with regard to accuracy, comparison targets shown at Figure 4 illustrate the startling difference in group sizes at all ranges. Thirty shots were fired on each target and the Reformado is the lower target in each case. Freire and Brull noted the lack of accuracy of the M1871 rifle at all ranges, exemplified by the results at 50 metres where only 22 out of 30 shots hit the 0.7 by 0.5 metre target. It is not clear from this paper whether the 49mm case and short chamber or the 57mm case found in production cartridges was used.

Some secondary sources are available, in particular Arjona[20] writing in the Military Health Journal in 1891, noted that the problem with the .43 Spanish rifles was the "small dead space" i.e. freebore in front of the projectile, resulting in a shock when the bullet hit the rifling, reducing velocity and range. The jacketed bullet and redesigned case were claimed to reduce this problem and to give better external ballistic characteristics, increased velocity and range. (This resulted in the addition of the 1200 metre volley sight to the M1871/89). It is interesting to note that the bullet mentioned in this paper is 25 gram, which was not tested in the trials but was the weight adopted by the Real Ordens below. He also goes on to discuss the humanitarian aspects of the new jacketed bullet compared with the previous lead bullet.

Iriarte[21] noted that dimensions of the Reformado cartridge which were published by a Circular of the General Directorate of Artillery July 5, 1889 were incorrect. The bullet diameter was specified as 11.04 to 11.05 mm

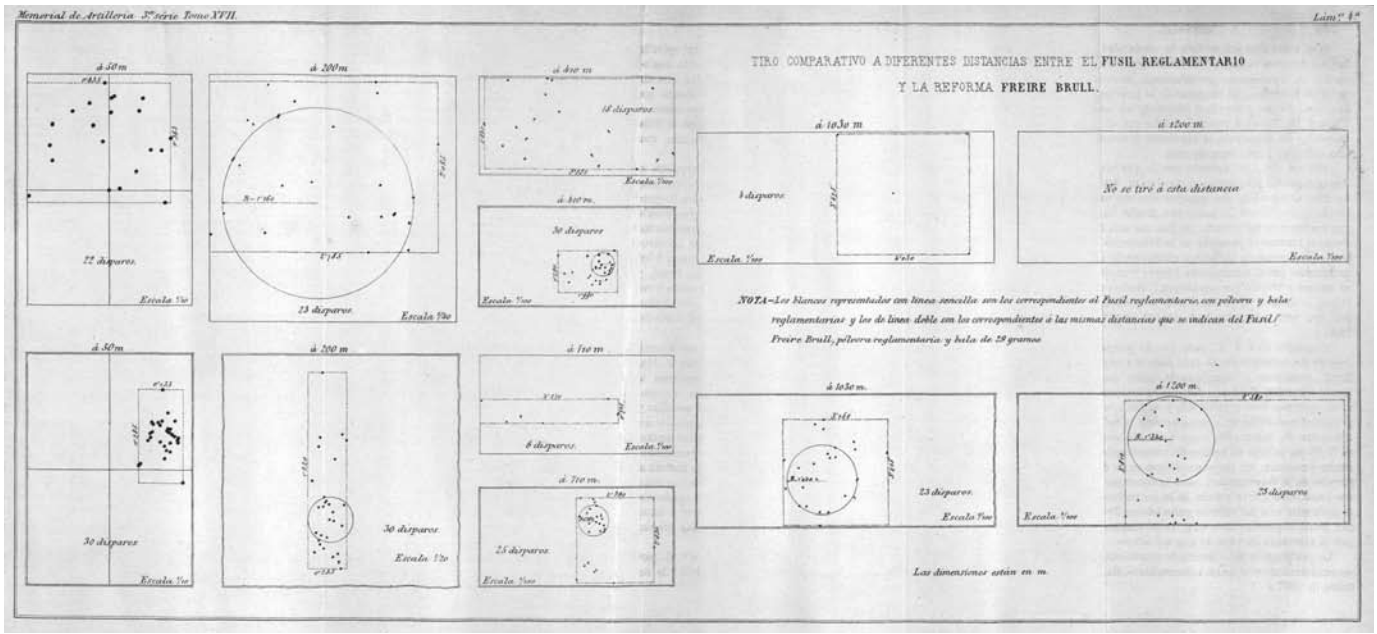

Figure 4. Extract from Freire and Brull's report on comparison of the accuracy of the .43 Spanish and Reformado cartridges.

and the length as 28.05 to 29.00 mm. This was corrected on January 15, 1890 by another circular issued by the General Inspectorate of Artillery, correcting the errors and specifying a bullet diameter of 11.40 to 11.50 mm and length of 28.50 to 29.00 mm. It is not known whether these errors were "typos" or genuine engineering errors.

Bastida[22] describes two Oviedo rifles, believed to have been used in the Freire - Brull experiments, the first with "maximum chamber" engraved on the barrel, the second with "minimum chamber". Interestingly the one marked "maximum chamber", shows signs of high pressure but will not chamber the Reformado cartridge.

The formal order for the Reformado cartridge conversion can be found in the Real Ordens of 1889[iv]. It was accepted in principle by Royal Order of February 12, 1889[23]:

> Dear Sir: In view of the instruction given by that commission about the modification to the regulation arm, Remington 1871 proposed by the Lieutenant Colonel of Artillery Don Luis Friere and commandant, captain Don Jose Brull; Considering that we accept in principle the modification while limiting the weight of the bullet to 25 grams and the powder charge to 5, means that this can only be carried out on rifles fabricated after the year 1876 for the use of those in the armed forces, without prejudicing the continuation of studies into the adoption of this new weapon, the King (God save him) and in his name, the Queen regent of the realm, the accordance with that which the commission has told us and that which was proposed by the Director General of Artillery have resolved to do the following:
>
> 1. That Lieutenant Colonel Friere and Captain Brull are invited to present, in as short a time as possible, a new cartridge as previously described.
>
> 2. That 1000 cartridges are made, of which 100 shall have a felt wad, another 100 of card wads, both in the highest position possible and of one piece construction, and the remaining 800 with lubricant.
>
> 3. That for the purposes of the Chief and Captain six new regulations rifles for the new cartridge are made by the Military Explosives Factory, as well as two loose barrels able to measure pressure with the crusher apparatus.
>
> 4. That the rifles and cartridges are placed at the disposal of the commission for trials, and will also graduate the sights whose form and dimensions will be so determined.
>
> By Royal Decree we inform you all for your knowledge and action. God save you all for many years
>
> Madrid 12th February 1889

Final acceptance came with the Royal Order of April 13, 1889[24]:

> Dear Sirs.: In view of the expedient instruction by the General Directorate of Artillery, in relation to the change of the regulation rifle model 1871, and its new cartridge with brass jacketed bullet, proposed by the officials of Artillery Lieutenant Colonel Don Luis Friere and Gongorrra and commandant captain Don Jose Brull and Seoane, both at the Military Explosives Factory in Seville bearing in mind the exhaustive and detailed tests carried out over a long period of experimentation, have proven the worth of the modification and cartridge through tests of large and small scale as many for the bodies of commissions and technical faculties of many different bodies of the armed forces; considering the small cost of the modification, which can be applied to all existing arms, as well as parts of the existing cartridge, resulting in an infantry rifle that is competitive with rifles of the same calibre and system of other armies, as a result of the thorough study that its importance demanded whereupon it must be equipped to the army, and in the name of the King (God save him) and in his name the Queen regent of the realm, in accordance with the information of the Combined Commission of Small Arms and the recommendation of the Director General of Artillery have fully approved the modification so proposed by Lieutenant Colonel Don Luis Friere and Gongorrra and commandant captain Don Jose Brull and Seoane to the regulation rifle Model 1871, declaring regulation the rifles so transformed, the cartridge with the twenty-five gram brass jacketed bullet, charged with four and three quarter grams of powder and a lubricating wad.
>
> It is also the will of His Majesty that the opportune orders of the Directorate of Artillery for the modification of the arms and ammunition be carried out, and also the manufacture of sights in accordance with the data provided by the Mixed Commission proceed to the change the arms in those terms and as laid down by the Royal Decree of the 6th of march 1885 (C. L. núm. 101) concerning the provision of arms and munitions of the new system.
>
> By Royal decree we inform you all for your knowledge and action. God save you all for many years
>
> Madrid 13th April 1889.

It is interesting to note that the powder charge was reduced from 5.0 to 4.75 grams between February and April, coinciding with the pressure testing which occurred between February and April 1889.

Since a Royal Order could not be found for the conversion of Remington manufactured rifles, and since all US manufactured rifles were made before 1876, it must therefore be tentatively concluded that the American contract, Remington manufactured rifles were not officially converted to the Reformado cartridge and Oviedo rifles manufactured before 1876 were also not converted. This is not to say that rifles were not rechambered to other calibres on a non-official

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[iv] The Spanish Ministry of Defence has a splendid web site (Biblioteca Virtual De Defensa) which provides the user with a digital collection of material kept in their archives, libraries and museums . This collection consists of a diverse document types such as manuscripts, prints, engravings, videotapes, photographs, etc.

basis, some of which may have been for the Reformado cartridge, especially in Cuba.

Observed numbers of .43 Spanish and Reformado rifles

Layman maintains that all existing rolling-blocks were converted, including the American contract rifles, to the Reformado cartridge. However, observations indicate firstly that very few Reformado rifles are ever seen and secondly that American contract rifles for sale or in collections far outnumber the Oviedo produced rifles, even though four times as many rifles were made at Oviedo.

After the defeat of the Spanish in the Spanish American War of 1898, the US Government shipped back to the USA massive quantities of captured War Materiel, 90% of which was acquired by Francis Bannerman[v] at public auction[26,27]. This included 20 million rounds of 7mm Mauser ammunition and tens of thousands of Spanish Mauser rifles. He also acquired Spanish Rolling-blocks and ammunition. The Bannerman Catalogues of Military Goods are a gold mine of data[vi] and have much relevant information regarding the Spanish Rolling-block. (However, like all catalogues the information must be treated with caution and verified from other sources).
The 1902 catalogue lists:

> 10,000 captured Spanish Remington Breech Loading rifles in .43 calibre centre fire purchased at New York Arsenal Sale Sept 21 1900 ... captured from the Spanish Army at Santiago, Cuba, July 1898... It shoots what is called a "bottle-neck" cartridge with a .43 calibre bullet... Our price for the rifle, refinished, like new, is $3.95.
>
> 2 million captured Spanish .43 calibre lead ball cartridges. Intended for use in the Remington rifles. Price $18.00 per thousand.
>
> Over 2 million captured Spanish brass covered ball cartridges.. only small number reserved, destroying the balance for the value of lead and brass Valuable relics. Price $18.00 per thousand.

The 1903 supplement to the 1902 catalogue shows 7,800 rifles still for sale, not refinished at $3.00 each and 1,000,000 cartridges for sale. Also listed are an unspecified number of Spanish made rifles, rusted trophy guns $2.50 each... "We can also furnish the captured Spanish ball cartridges for these guns at $1.50 per hundred". The 1927 catalogue listed two types of rifle:

> 4,000 captured Spanish Remington Breech Loading rifles in .43 calibre centre fire, with bayonets, sold to us by the US Government as "Captured Spanish Arms". Sold As is - Poor, Price $1.95 each[vii].
>
> 1,000 Spanish Remington Breech Loading rifles .43 calibre made in Europe for use with the brass covered lead ball, styled as the Spanish Reformado cartridge, Relics only, Price $1.95 each.

In five places ammunition is listed:

> Total of 3 million rounds of captured Spanish lead ball cartridges intended for use in the Remington rifles. In good serviceable order. Price depending on condition from $1.45 to $1.75 per hundred.
>
> Total of 1.5 million rounds Spanish Remington brass covered lead ball cartridges made for use in European made Spanish Remington rifles classified by the Spanish as Reformado cartridges, the brass covered bullet giving longer range. Price depending on condition from $1.75 to $2.20 per hundred.

One interesting snippet can be found on page 248 of the 1927 catalogue in the uniforms section:

> We shipped from Havana to our European Agent over 5 million rounds of ammunition and over 11,000 rifles in December 1898.

Bannerman's Agents in Europe included Adolf Frank of Germany and Jules Pire of Belgium[28]. The Adolf Frank Export Catalogue (ALFA catalogue)[29] of 1911 lists 2,000 American Original rifles, Cal 11/43mm Spanish. Interestingly, it also lists 800 Spanish Remington carbines, made from the rifles, which may raise some doubts about the authenticity of some US manufactured .43 Spanish carbines. The 1899 Pire catalogue[30] also lists the Spanish Remington in .43 Spanish but also offers for sale the rifle converted to 11mm Beaumont.

It is therefore clear that the captured rifles were either US manufactured rifles in .43 Spanish or Spanish manufactured rifles converted to the .43 Reformado cartridge. Examples of US manufactured rifles converted to the .43 Reformado cartridge are very elusive. Mike Carrick[31] has one example, described by him below:

> Spanish military rolling block rifle made by Remington Arms. cal. 11.4 x 57R Reformado. Three barrel bands held with springs in stock, barrel is 35.1. 2-line

---

v. Francis Bannerman (1851-1918 was born in Scotland and built up a massive arms business, mainly by buying surplus war materiel. In 1900, because of storage problem in New York City for his massive ammunition holding be bought Pollepel Island 50 miles upstream from New York on the Hudson River and built Bannerman's Castle, a mock Scottish Castle and store. By the 1950s the company was in decline and Bannerman hired Val Forgett, founder of Service Armament and Navy Arms to deactivate the live artillery ammunition, some of which dated back to the Civil War. Bill Edwards, editor of Guns Magazine wrote in the January 1959 issue about the visit he made with Forgett and finding one inch gatling gun ammunition in their original boxes, so corroded they disintegrated on picking them up and a dozen gatling guns smashed beyond repair for the brass their actions would yield.

vi. The 1927 catalogue also lists WW1 items and illustrates very well how times have changed. On the same page are listed a captured German Machine gun - Spandau model, price $100 and US Army trench knives, Price $5.00 each.. The trench knives have the following restriction in upper case bold -
"PLEASE NOTE THAT RESTRICTIONS REGARDING DANGEROUS WEAPONS APPLIES TO THE SALE OF THESE TRENCH KNIVES. WE MUST HAVE PERMIT FROM YOUR CHIEF OF POLICE WITH YOUR ORDER".

vii. For comparison, on the same page, are listed new.50 calibre US Government Rolling-block rifles at $9.50 each.

> Remington address on tang, the oldest style marking, prior to 1872. Peep hole in rear sight. Extractor screw in receiver. The rear swivel has patent marks and date Feb 11th 1868. Interesting proof mark (squiggle) on left side of barrel near receiver. Top of the barrel is stamped: 520 US. Left side of receiver is marked 102 over 13. Right side or buttstock is stamped 1550 or 1530 Left side of buttstock is stamped: 100109 within a box, and 10002. This gun was sold to me as a captured gun from Cuba in the Spanish-American War. It was also confirmed that the barrel over the chamber was not stamped "R" or "FB".

A chamber cast was also kindly provided which shows a very loose Reformado chamber, approximately 0.25mm larger in diameter than the Reformado cartridge. Discussion forums on the Internet often show people claiming to own a US manufactured Reformado chambered rifle, but very few have taken a chamber cast. The usual method recommended to determine the calibre is to try a dummy Reformado cartridge in the rifle. If it won't enter the chamber fully, then it's .43 Spanish, if it enters fully then it's .43 Reformado. However, this can be very misleading since as mentioned earlier, chambers of the period were often oversize and can now be very worn. It must also be noted that the conversion to the .43 Reformado involved reaming out the chamber by a very small amount at the neck of the cartridge.

Calvo[32] shows a "Alza del Fusil Remington norteamericano reformada". H. J. Meruelo[33], Juan Calvo's friend and translator states in a private communication that:

> ... regarding Spanish Remington Rolling block rifle sights as illustrated in the 3rd volume of his 1977 publication on Plate 15, where he compares the standard Remington sight on Spanish contract 1871 rifles with the one he called "reformado"; the "Alza del fusil Remington Norteamericano" (North American Remington rifle's rear sight) and what he called the "Alza reformada del fusil Remington Norteamericano" (North American Remington rifle's reformed rear sight), were taken from two different specimens of American made rolling blocks when he noticed the two different types of rear sight, one bearing the original sight, and the other one exhibiting some characteristics of the original American sight and also some of the Spanish made M1871 sights, and this second one he concluded to be a hybrid modification or "reforma" made in Spain utilizing American and Spanish parts.
>
> He does not recall if he made the observation in a rebuilt or in a completely original rifle, and, was never able to document the date of this "reforma". The above discussed rear sight modification was not related to the change in cartridge to the 71/89 Freire-Brull modified case and load but simply part of a refurbishing process.

The other major source of rolling-blocks was Sam Cummings of Interarms, who acquired over 100,000 Rolling blocks in the 1950s from arsenals in Europe and South America[34].

Despite far more rifles being produced in Spain than in the USA, many more US produced rifles are seen than Spanish. Layman[35] notes that some may still be in storage in Cuba. The authors are unable to comment on this point.

Observations on the use of the Internet

The authors will not comment on broader methodological research issues but merely on the use of the internet. The internet is a very valuable resource for firearms research but the volume of worthless information is enormous and the same care must be taken as with any non-archival, non-refereed source. Poor information can be difficult to filter out in some cases. In all cases the credibility of the author must be considered, level of expertise ascertained and the target audience established. In addition references, if given, can be checked and bias in the material established. Any organisation affiliation claimed can also be checked. The date of the information is often important and if old may have been superseded by later information.

A key way of confirming that the information is accurate, up to date, reliable and appropriate is to triangulate – that is, to check the information with recognised academic sources, such as research journals. However, it must be remembered that some information on the internet has all the signs of being academically respectable, but is in fact misleading, inaccurate or an outright hoax.

Google Scholar can be used to ensure that the material comes from an academic source but it is wise to use several search engines to get maximum coverage. Also the advanced search facility on most search engines allows much more refined queries than the standard search. The ability to contact the author via a web site and ask for further information can provide useful information.

Access to major libraries is facilitated by the Internet. Most librarians are keen to help and often speak English. In the case of this paper, The British Library, Spanish Parliament Library, Spanish National Library and the Spanish Ministry of Defence Library all provided very useful information.

Automatic translation can prove useful but in many cases the style of language used proves to be a major problem. In the case of this paper archaic technical Spanish was a problem for all of the translation engines. However, trying to find someone able to translate these types of document can also be a problem.

Conclusions

This study reaches the following conclusions concerning the .43 Spanish and Reformado rifles, and the use of the Internet in researching historic firearms.

The M71 Spanish Rolling-block suffered from very poor accuracy, which was the direct cause of the creation of the M71/89 Reformado rifle, with much improved accuracy.

It is tentatively suggested that American contract, Remington manufactured rifles were not officially converted to the Reformado cartridge and Oviedo rifles manufactured before 1876 were also not converted. In the main, only rifles of Spanish origin are chambered for the Reformado cartridge.

The chambers of .43 Spanish and Reformado rifles now encountered may show individual variation, and so the use of a dummy Reformado cartridge to determine chamber type may not be foolproof.

With respect to the starting point of the study, namely the poor accuracy of an individual rifle, it is evident that the loading obsolete cartridges, in particular for old military rifles can be difficult. Various factors contribute to this. Reliance is made on specifications published in modern manuals which are not themselves immediately taken from original data and leave the reloader uncertain he is imitating the original cartridge. As exemplified by the .43 Spanish cartridge, it may also be that the original was in any case suboptimal, and would require modification to achieve acceptable accuracy – as the Spanish themselves concluded 125 years ago.

The internet can be a useful research tool if the same skill sets are applied to it as any other research source. The researcher must distinguish bona fide research and original data from opinion and commentary, whilst recognizing that although the latter can be misleading, it can sometimes point to useful avenues of investigation.

Opportunities for further research and open questions

The missing Freire - Brull notebooks may provide a major research source on the development of the Reformado cartridge and clarify why the Reformado cartridge length increased from 49mm to 57mm. The reason for the disparity in observed numbers between US and Spanish produced rifles and between .43 Spanish and Reformado chambered rifles is unclear and information on Cuban rifle depositories may throw some light on the question. Data exist about the accuracy of contemporary military rifles from modern and historical testing but little has been done to correlate these data in a systematic manner.

The authors would be pleased to hear from anyone with further information. (e-mail journal.editor@hbsa-uk.org).

Acknowledgements

Mike Carrick for invaluable information, chamber casts and never failing help.

Chris Reid for major efforts translating archaic technical Spanish.

Carlos Garcia-Minguillan, British Library

Biblioteca del Congreso de los Diputados

La Biblioteca National De Espana

Luis Iriarte

Jonathan Ferguson and Adam Hyman, Royal Armouries, Leeds

Richard Hughes

Heather Dawson, London School of Economics Library

El Ministerio de Defensa De Espana

Figure 2 ECRA/ECDV, Francis Latoir, Jean Renard, Jordi Camerón Vinaixa.

Figure 3 El Ministerio de Defensa De Espana.

Figure 4 El Ministerio de Defensa De Espana.

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In Memoriam

This paper is dedicated to the memory of Dr Donald Gabriel Miller, 29 October 1927 - 3 February 2012

In early 2007 I was placed in contact with Don Miller by Clifford Bryant, the former editor of the HBSA Journal. Don had contributed a paper on rifling twists of nineteenth-century military breechloaders to the same issue of the HBSA Journal as my paper on the history of Internal Ballistics. We both recognised each other as kindred spirits, with similar backgrounds, and this resulted in a series of emails which I found both informative and which sparked a large number of new ideas. Don kindly agreed to provide very constructive critical reviews of my two papers on external ballistics and even agreed to draft a section covering one aspect of external ballistics I had managed to miss entirely.

Dr. Donald Gabriel Miller died of cancer at the age of 84 on February 3, 2012 at Livermore, California. Don was born and raised in Oakland, CA, the son of Nathan Harry Miller, the chief deputy District Attorney to Earl Warren in Alameda County, and Edith Levy Miller Balaban. He graduated with a B.S. in Chemistry from U.C. Berkeley in 1949, and received his Ph.D. from the University of Illinois, Urbana-Champaign in 1952 with a thesis on the statistical thermodynamics of rubber. He then secured a post-doctoral fellowship at the Brookhaven National Laboratory in New York. Don returned to California to work as a research chemist for the rest of his career of over 50 years at the Lawrence Livermore National Laboratory. He also spent time at universities and laboratories in France, Italy, Germany, Australia, and Spain, Wisconsin and Texas. In 1960-61, he was awarded a prestigious Fulbright Teaching Fellowship at the Universite de Lille and the Faculties Catholique in Lille, France. Don was the author of 174 published papers covering physical chemistry, ballistics and the history of science.

Don had an early interest in rifle shooting and ballistics. In one of his seminal papers on twist rules in Precision Shooting Magazine of February 2008, he described how his interest developed:

> "Once upon a time, even though we were starving students, my bride of two years let me buy an 1867 Danish Rolling Block. Although advertised as a .45-70, it was actually the Danish 11.7 mm (.462 caliber) with a twist of one turn in 29 inches. The .45-70 Government's faster 22 inch twist stabilizes its 500 grain (gr.) bullet. Would this 500 gr. bullet be stable in the 11.7 mm? If not, what shorter and lighter bullet would be stable in its 29 inch twist? A simple rule for estimating rifling twist or stability factor can answer."

Soon after moving to Livermore Don became interested in local politics and was appointed to the Livermore City Planning Commission in 1964. He was elected to the City Council in 1968 and 1972 where he served for eight years, including one of the terms as Mayor.

Don was a gifted amateur musician who played the piano and harpsichord, and composed ragtime music. He was a founding member of Del Valle Fine Arts, serving on its board and as its representative to the Cultural Arts Council for almost 50 years. He was an active fund-raiser and supporter of the efforts to build the Bankhead Theatre. He was an active member of Congregation Beth Emek, where he and his wife Miriam were among the original members.

Don is survived by his wife of 62 years, Miriam Cohen Miller, two daughters, Nancy and Lynne and two grandchildren, Elena and Lucio Franco, all of them living in the Washington, DC area.

Don had planned a number of papers which would have been of enormous interest to those interested in the history of ballistics. In an email to me, he stated the following:

> "I have collected technical biography material for some time, starting 20 years ago. I wrote up some of this stuff about Siacci, Bashforth, Mayevski, and Didion on a page or less, but it is in Livermore as handwritten pages. The idea was to do a series of articles, similar to my one on Greenhill, which would include Siacci, Bashforth, Mayevski, Charbonnier, etc.
>
> Perhaps you and I could collaborate on an article on Bashforth? What do you think? I already have part of the material, and you have easier access to the rest. We come to DC to see our children and grandchildren 3 or 4 times a year. I suppose I could come to Cambridge after one of these DC visits and work on?"

Clifford Bryant had agreed to publish the first of the papers on Francesco Siacci but sadly it was not be.
DT

A "Poli-Chambered Gun" and James Thomson's Patent of 1814 by Graeme J. Rimer

by Derek Stimpson

Introduction

In the early 1800's, and indeed even long before that, the need for a multi shot, or repeating firearm was evident. The move to breechloader was highlighted by this need. As is often the case in human affairs the primary reason was for military purposes, but sporting multi shots would also be well received. Above all they would make money for their inventors.

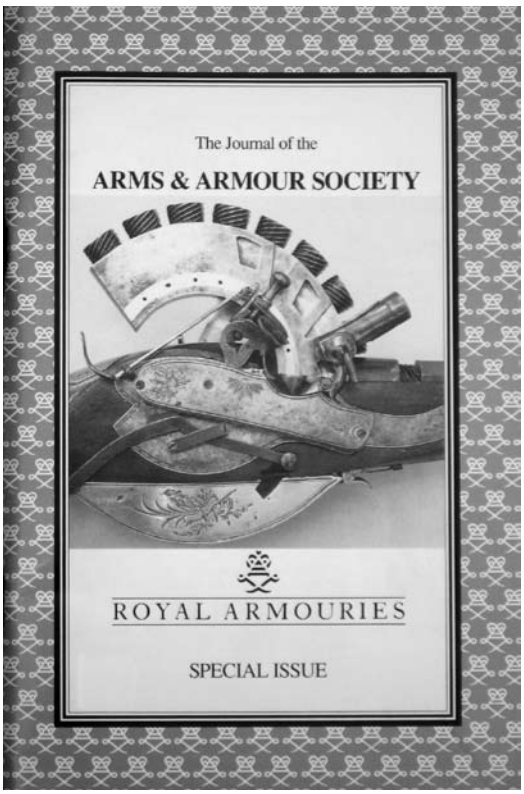
Various systems were looked at and tried and there is one very rare, indeed unique, example, the Thomson Rifle, owned by The Worshipful Company of Gunmakers and kept on display in the Proof House. James Thomson, a merchant of Colebrook Terrace, Islington, patented his design and this may be one of the few examples that exist of a Patentees original trial firearm.

The article by Graeme Rimer was first published in 1990 in the Journal of the Arms & Armour Society and we thank Graeme Rimer and the Arms & Armour Society for their kind permission to re-publish.

The Gunmakers Company has has recently published a note in its newsletter "Lock Stock & Barrel" about this rare piece and republication now of the complete article is also to complement that.

Graeme Rimer joined the curatorial staff of the Royal Armouries as a Museum Assistant at the Tower of London in 1975. He remained with the museum for the rest of his career, occupying gradually more senior curatorial posts, including Keeper of Firearms, Head of Collections, and finally Academic Director. He left the Royal Armouries in February 2012. He is a Fellow of the Society of Antiquaries of London, a Freeman of the Worshipful Company of Gunmakers of London, and a member of the Arms & Armour Society and the Society of Archer-Antiquaries. In 2008, in recognition of his contribution to the study of arms and armour he was appointed a Visiting Professor to the University of Huddersfield, and is now a member of that university's Arms & Armour Research Institute. He remains associated with the Royal Armouries as a Curator Emeritus. He is now developing his clientele as a Consultant on Arms and Armour. He can be contacted on graeme.rimer@btinternet.com. Some of the photographs have been updated, where possible, for clarity.

Derek Stimpson Chairman HBSA



A "POLI-CHAMBERED GUN" AND JAMES THOMSON'S PATENT OF 1814

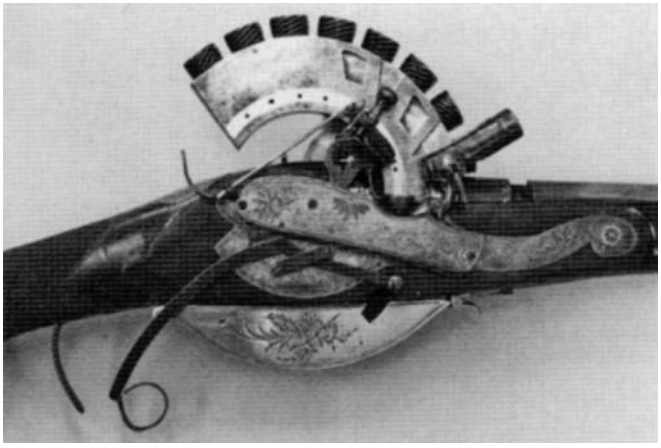
by Graeme J. Rimer

In December 1987 the author was part of a small group from the Royal Armouries which visited the Proof House of the Worshipful Company of Gunmakers in Commercial Road, London. Having been given an excellent tour of the operations of the Proof House by the Proof Master we were invited into the Company's Court Room, where over tea we were shown a most interesting multi-chambered repeating flintlock rifle, about which, apparently, little was known (see Figure 1).

The rifle was chiefly remarkable because of its very unusual breech mechanism, and the construction of its lock

1. The repeating flintlock rifle in the Proof House.

(see Figure 2), but it was also puzzling because although it was of good quality and had areas of well-executed engraved decoration it had no single identifying feature; it had no signature on its lock or barrel, and no proofmarks. It was evidently of English manufacture and the shape of various components, as well as the nature of the panels of engraved decoration, suggested a date somewhere in the second decade of the nineteenth century.



2. The lock and breech mechanism of the rifle in the Proof House.

Highly intrigued by this most unusual and previously unknown rifle, and convinced that a patent for such an odd design must have existed, the author searched through the copies of patents held in the archives of the Royal Armouries, working back from 1820. A patent was indeed discovered, that of James Thomson, number 3784, of the 9th of March 1814. This is an unusually full and extensive patent, which will be discussed in detail later in this article. One surprising feature of the patent was that its drawings almost exactly match the constructional features of the rifle in the Gunmakers' Company, suggesting that this piece may in fact have been the designer's original. As work on this article progressed this supposition became gradually more strongly confirmed, and as the information which follows will show, this rifle may now be regarded as one of very few examples of a patentee's original trial firearm surviving from the early nineteenth century.

Examination of the rifle

Thanks to the great kindness of Major D. H. L. Back, then Upper Warden and later Master of the Gunmakers' Company, who made representation to the Court of the Company on the author's behalf, it was possible for the rifle to be taken to the Royal Armouries where a full dismantling, examination and recording of this piece could be carried out.

The central feature of the rifle is its breech piece (see Figures 3 and 4). This is a substantial curved rectangular-section iron block slightly greater than one third of the circumference of a circle. It pivots about a hole in the end of a tongue projecting from its back face, and in its front face are nine chambers, arranged radially, whose mouths project as short cylinders cut with a rapid-pitch ten-start male thread. On the left side is a series of small circular blind holes to enable a spring catch to hold each chamber in line with the barrel; and on the right side is, firstly, an inlaid platinum band pierced with nine touch-holes, and secondly a series of nine ratchet notches to allow this breech piece to be moved by a lever the distance of one chamber at a time. Careful X-ray examination of the breech piece showed that it appears, with the exception of the ratchet extension piece, to have been made from a single piece of metal. This represents a remarkable achievement on the maker's part in his accuracy of thread cutting and positioning of the chambers, locating holes, ratchet grooves, and touch-holes.

3. The breech piece of the Thomson rifle. This view shows the right side with the touch holes and the elevating ratchet notches, and the form of the threaded chamber mouths.

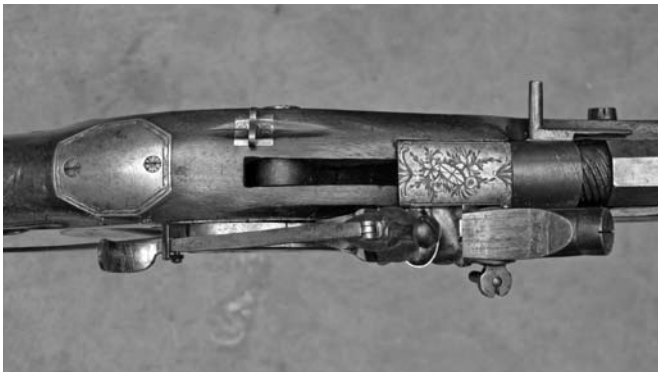
4. The left side of the breech piece, showing the holes in which the spring catch engages.

The breech piece is set centrally in the stock, pivoting on a larger than usual sidenail. Because of its bulk the breech piece takes up space normally occupied on a flintlock gun by its lock components, so in Thomson's design all the lock mechanism is mounted on the outside of the lockplate, enclosed by a very carefully made iron cover plate (see Figure 5). The lockplate is flat and inlaid flush into the stock, which further weakens this area, indeed in the pan area and lower rear part of the lock the stock has had to be cut away entirely (see Figure 6). To try to offset the dramatic weakening of the stock in this area the lockplate is carried forward in a long curved limb,

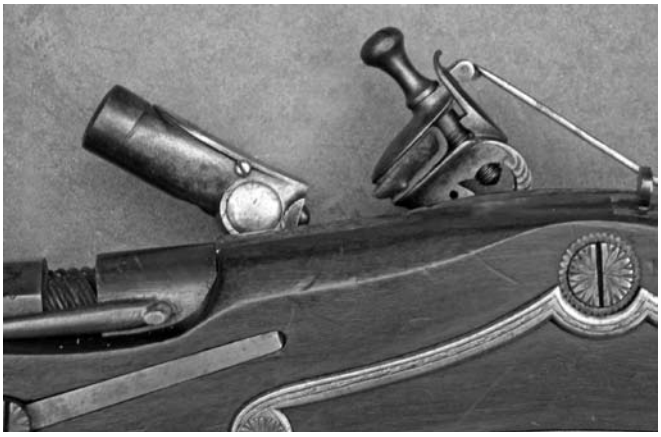
5. The lock mechanism with the cover plate removed.

but instead of devising some suitably robust fastening of this end of the lockplate, the designer simply had a small flush-fitting bun-nut recessed into the lockplate, screwing on to a minute thread formed on the end of the rearmost barrel slide.

The cock is similar in form to those of Henry Nock's 'screwless' enclosed locks, and has a similar stop beneath the lower jaw where it strikes the fence. It has a curious C-shaped throat hole. It pivots on a short stud projecting from the lockplate, the outer end of which is supported by the cover plate. A cocking piece, that is; a strip of iron pivoted to the top of the rear of the cock, passing through a small staple on the lockplate, and ending in an upturned knurled grip, is fitted. More mention of this will be made later. Also on the left side of the cock are two small holes in the throat (see Figure 7). These were originally to attach a link bar to the frizzle, again more on this feature later. The small sear acts directly upon half-cock and full-cock notches cut in the base of the cock, and is operated by a long strip of iron which is both trigger and breech-piece operating lever.



6. The breech area of the stock.



7. The nearside of the cock, showing the upper of two small holes in the throat, and of the priming magazine frizzle showing a small redundant screw. These would have allowed the fitting of a link bar.

8. The priming magazine frizzle. Note the tap valve and on the underside the two holes separated by a semi-circular fence.

The pan is of fairly conventional 'waterproof' form, but is pierced through to the centre of its base by a square aperture from the rear of the fence. This hole is now filled by a claw-shaped piece of iron fixed in place by a screw. The original purpose of this hole may be explained by the patent which will be discussed later.

The mainspring and frizzle spring are both quite conventional. The frizzle itself, however, has a tubular magazine built within it for priming powder (see Figure 8). A manually-operated rotary valve in the form of a cylindrical rod, cut with a rectangular cavity, delivered a measured amount of powder from the magazine through two holes in the underside of the frizzle, and thus into the pan. A small screw on the edge of the frizzle adjacent to

the breech piece suggests that the frizzle was originally attached to the cock by a link bar (see Figure 7). This magazine was filled by removing its cylindrical screw cap. The magazine's rear face is pierced with a 'safety-valve' hole originally filled by a bung designed to be blown out if the contents of the magazine accidentally exploded.

Although it has several unconventional features the stock is of classic English form for the period. It has an iron buttplate, the tang engraved with a globe, sheet music, a quiver and flags, and on the left side the butt has a raised cheekrest. The lobe of the pistol grip is made of a separate piece of wood carefully added to the stock, and the wrist is chequered. Behind the breech is an unusually large scutcheon; an irregular octagonal iron plate with 'wheat-ear' border engraving and held in place by two woodscrews. The stock is unusually deep in the breech area to accommodate the breech piece and the oddly shaped lockplate. The carved lockflat and sideflat areas are otherwise of characteristic English form with a well-shaped 'teat' at the rear. The sideflat is fitted with an elegant but sham open iron sideplate. This is held in place by a short woodscrew at each end and is quite separate from the iron cup washer for the true sidenail which acts as the breech piece pivot pin (see Figure 9). Further forward on the sideflat is a simple rocking catch, intended to be operated by the left thumb, which holds the breech piece in position in preparation for firing each chamber. At the forward end of the sideflat is the flat slide which not only retains the barrel but also the forward end of the lockplate.

9. The sideflat showing the sham sideplate. Note on the left the spring catch for the breech piece.

On the left of the upper surface of the stock, adjacent to the slot for the pivoting tongue of the breech piece, is a small heart-shaped iron peep sight mounted on a threaded rod screwed into a small iron block let into the stock. The sight must be offset to the left since after the first round the breech piece rises and would otherwise totally obscure a central line of sight (see Figure 10).

There is no triggerguard, since the trigger lever must work in both an upward and downward direction. Instead a short curved iron guard projects downwards from beneath the wrist, preventing the firer's hand slipping onto the otherwise vulnerable trigger lever. The forward end of the iron strap from which this guard is formed has a hinge, to which an engraved cast brass cover for the breech piece is attached. This cover was designed to protect the unfired chambers which project beneath the stock. The cover is held in the closed position by a simple sliding catch engaging on the cover's forward end and mounted on an iron plate forming a 'pineapple' finial.

10. A firer's-eye view of the breech area of the rifle when preparing to fire. Note the offset peep-sight on the left.

The plain fore-end extends to the muzzle and is in two parts. At approximately one-third of the barrel's length from the breech the stock divides vertically, each part separated from the other by an iron plate, the edges of which have wheat-ear engraving. The greater part of the fore-end is attached only to the barrel, by three flat slides and by the screw of the forward sling swivel. There is no provision for a fore-end cap, and a simple (possibly replacement) brass-tipped ramrod is retained by three plain iron ramrod pipes. The barrel is attached to the rear portion of the fore-end only by two fiat slides; one near the joint in the fore-end and the other the one also securing the lockplate. This means that the entire weight of the barrel is supported by the drastically weakened breech area of the stock and that there is no permanent joint between the barrel and the breech mechanism.

The straight octagonal browned iron barrel is the only part of the rifle which appears not to have been specially made for this patent model. It is surprising that it shows virtually no trace of taper or flare in either direction, and yet it has clearly been re-used unaltered from its original shape.

It was originally fitted with a foresight and a backsight dovetailed across the top flat, these grooves now having been carefully filled. On the underside four staples for barrel pins have been removed and their grooves filled in a similar manner when the five new flat slide loops and that for the sling swivel were fitted. A fifth barrel pin loop's groove is half cut away and left unfilled by alteration of the breech end of the barrel. This alteration was the cutting of a length of rapid-pitch ten-start thread, identical to but longer than those on the chamber mouths. The breech face was also made slightly concave to mate better with the convex faces of the chambers in an attempt to improve the gas seal. Fitted over this length of thread is an iron tube (called by the patentee rather quaintly a "coupling box") within which is a similar female thread. This device, when rotated half a turn to the left by its peg handle, ran back onto the threads of any adjacent chamber and locked breech and barrel together. The surviving "coupling box" is probably a restoration.

As with the backsight the foresight had to be offset to the left, and is a heart-shaped open notch iron sight on a threaded rod passing through a staple on the left of the muzzle.

Some dimensions and weights of Thomson's rifle

Overall length	51½ in. (130.8 cm)
Total weight	9lb. 12oz. (4.42kg)
Length of barrel	31 in. (78.7 cm)
Calibre	.360 in. (9.1 mm)
Rifling	6 deep narrow grooves, right-hand twist
Weight of barrel	4lb. 2oz. (1.87kg)
Weight of breech piece	1lb. 10oz. (0.73kg)
Number of chambers	9
Diameter of chambers	.370 in. (9.4 mm)
Depth of chambers	½ in. (3.8 cm)

Operating and firing Thomson's rifle

This rifle is most notable for combining some parts of considerable strength and weight with others which are small and feeble. Its heavy breech piece is intended to be moved by a thin and flexible trigger lever supported by a slender headless screw. Indeed a number of screws used in the lock seem to owe more to clockmaking than gunmaking. The not insubstantial barrel, too, is supported only by a short length of stock Which at the very point it should be at its strongest has been greatly weakened by being cut away to make room for the breech and lock mechanisms.

This rifle would seem to be the only surviving example of a repeating firearm of James Thomson's patent. If we consider the problems with which it would have faced a potential sporting or military user it is not perhaps difficult to see why.

Firstly the nine chambers would have been loaded with powder and ball, probably by bringing the breech piece to the fully elevated position since only then are all the chamber mouths exposed. By pressing the latch on the lockflat and by pulling outwards the forward end of the trigger-breech piece operating lever using the knob provided the breech piece could then (by employing a third hand?) be lowered to bring the topmost chamber in line with the barrel. The coupling box would then be turned to lock the barrel and breech piece together.

Having filled the priming magazine with suitable powder, brought the lock to half-cock position and closed the pan, rotating the tap or valve in the frizzle would deposit a measured amount of powder in the pan. Having brought the lock to full cock the rifle could be fired by squeezing the trigger in the usual way.

A second round would be fired by: bringing the lock to half-cock, closing the frizzle over the pan, and operating the priming tap valve. The coupling box would be rotated to the right to free the breech piece. Downward and slightly sideways pressure would be brought onto the trigger/breech piece lever while the spring catch on the left of the stock is opened by the left thumb. As the breech piece, thus released, rises the spring catch is released and engages in the locking hole for the next loaded chamber. Pressure on the trigger/breech piece lever may then be released and the coupling box locked over the chamber mouth. The remaining seven rounds would be fired in the same way.

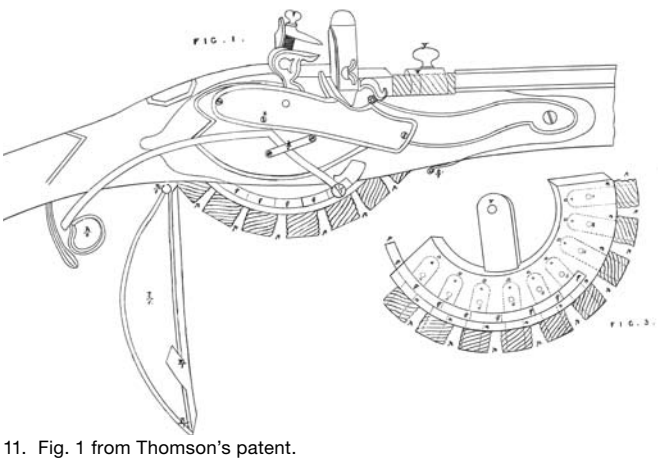
The problems which one may easily envisage in this list of operations would inevitably include the fouling of the breech chamber mouths, coupling box and adjacent parts by burnt powder, which would aggravate the stiffness of the operation of the breech piece and coupling box and render the feeble trigger/breech piece lever even more unequal to its task. Probably the greatest inconvenience however would lie in the very real possibility that while moving the breech piece to the next unfired chamber the ratchet pawl on the operating lever would become disengaged while the spring catch was also being held. This would allow the breech piece to fall back to the first chamber, and since the chambers are not numbered locating the last fired and next live chamber could be a dangerous and time consuming operation.

The Patent

The unique characteristics of the rifle described above made its identification as that covered by James Thomson's patent. No. 3784 of the 9th of March, 1814, comparatively simple.[1] That patent however, is unusually large and shows that Thomson, a "Merchant" of Colebrooke Terrace, Islington, London, was actively engaged in the invention of a number of firearms-related mechanisms. The parts of this patent dealing with other flintlocks help greatly in our understanding of some of the unexplained features on the surviving rifle, and shed light too on other matters which will occur later in this story.

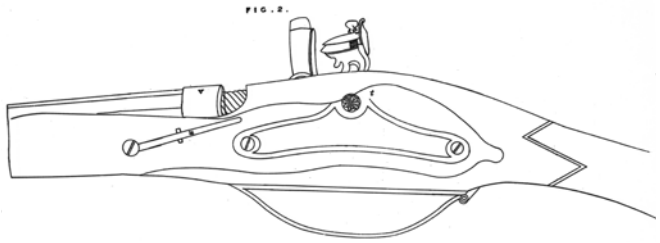
The patent's text runs to eighteen pages and is accompanied by a total of thirty-six drawings on eight sheets. Thomson sought to protect not only his "single barrelled and poli-chambered gun", which forms the first part of the text and the first nine drawings, but also his designs for: frizzles or 'hammers" equipped with priming magazines, waterproof and airtight pans using special sealing washers, waterproof pan covers, a lock which on cocking automatically closed the frizzle and primed the pan, locks with shutters to close off the vent to protect the main charge from moisture, a gun-flint protector, several methods of breech loading, and lastly a design for a restricted-breech musket intended to reduce loading time. We will see that pursuing and protecting his priming magazines and the vent cut-off designs would cause Thomson much distress in later years.

When comparing the surviving rifle with the relevant illustrations in the patent one is immediately struck by the number of small details common to both and which, for patent drawings, would not normally be necessary. In Fig. 1 of the patent, for example (see Figure 11), the rather odd shape of the ring of the trigger is faithfully reproduced, and

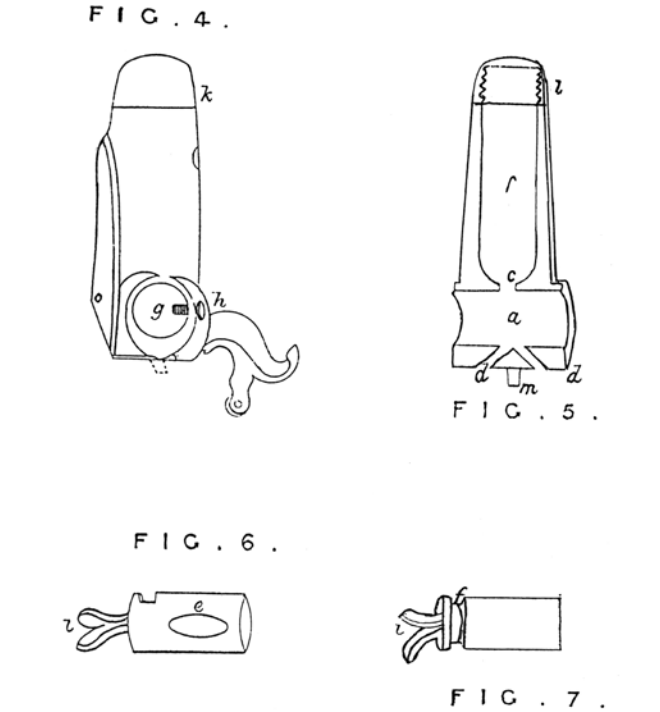


11. Fig. 1 from Thomson's patent.

the unusual form of the lockplate, the large scutcheon and the presence of chequering on the wrist are all carefully shown. In Fig. 2 (see Figure 12) the sideplate, which we now know to be a purely decorative and quite useless feature, is again included. At the time of the discovery of the patent it seemed likely that the illustrations relating to the "poli-chambered gun" had been made directly from the then already existing rifle, and were not impressions of what a weapon made under this patent might look like. In pursuing the story of Thomson and his designs further pictorial and written evidence was discovered which confirmed this view, evidence which will be examined in the following sections of this article. Certainly in all other respects the design and the method of operation of the mechanism described in the patent are as they are on the existing rifle. This includes the design of the frizzle with integral priming powder magazine, the drawings for which are Figs. 4 to 7 (see Figure 13). Much more of this part of the patent will be discussed later.

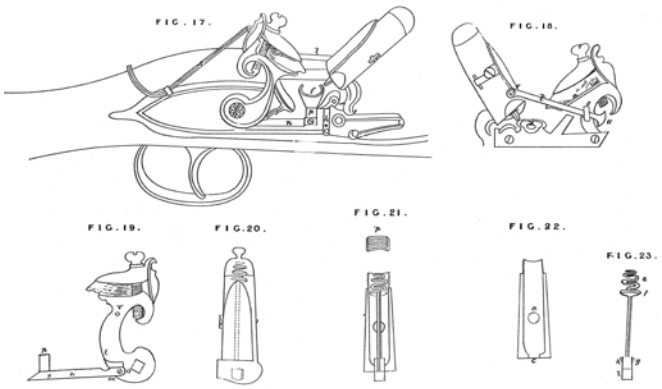


12. Fig. 2 from Thomson's patent.



13. Figs. 4 to 7 of Thomson's patent; his design for a priming magazine "hammer".

The surviving rifle and the related patent illustrations are not quite identical however. Most obviously the rifle has a cocking bar attached to the spur of the cock, and there are screw holes in the cock and frizzle and a filled hole in the base of the pan which require explanation. The solution seems to lie within the third sheet of illustrations (Figs. 17 to 23, Figure 14). Here Thomson describes a conventionally constructed lock, which, on cocking, automatically closes the frizzle over the pan and deposits a measured charge of



14. Sheet 3 of Thomson's patent illustrations (Figs. 17 to 23); an automatically-priming lock.

priming powder. The important features of this design are, most notably, the long cocking bar attached to the cock, a bar (Fig. 18) linking the cock and frizzle, and a hole in the base of the pan for a vertically-operating stud attached to a rocking bar operated by the movement of the cock. The priming magazine frizzle is of a different design to that in the earlier figures and on the surviving rifle; it had a spring-loaded piston valve inside, the end of which projected through a hole and down into the pan and the stud on the rocking bar rose to force the frizzle magazine's piston upwards, allowing a small quantity of powder to fall into the pan. The unfortunate firer was then expected to pull the trigger and hope that the valve had closed properly so that on firing the flash from the pan would not set off the contents of the priming magazine.

Looking again at the surviving rifle it seems that Thomson must have used it as a test-bed for some of these ideas. As we have already seen, the cocking bar illustrated in his second lock design (Fig. 17) is present although not shown in the patent illustrations of the poli-chambered gun, the screw holes are present which would have allowed a link bar to be attached to the type shown in Fig. 18 (see Figure 7) although he apparently tried this using the manually-operated tap-valve variety of magazine frizzen rather than the automatic piston-valve type. Lastly the now blanked-off hole in the base of the pan may well have been for a rocking bar or other device to operate one of his automatic priming magazines.

The acquisition of Thomson's rifle by the Gunmakers Company

After "discovering" the patent just described the author contacted the Proof Master to tell him of this discovery and to ask if it would be possible to study the weapon further with a view to possible publication. At the Proof Master's suggestion the author contacted Major David Back who very kindly and gently explained that the weapon had in fact been known to him for some time as Thomson's design, and suggested that for the full story I might care to consult the Minutes of the Court of the Gunmakers Company.[2]

Under "Matters Arising" in the Minutes of the Court of the 11th June 1959 is the following entry:

> "Mr W. Keith Neal reported that he had been approached by Canon Thomson of Kenilworth, who had produced to Mr Neat a very interesting gun invented by Canon Thomson's grandfather, with a

view to finding a permanent resting place for it. Mr Neal then produced the gun with the original drawings thereof for inspection by the Court and briefly explained its workings ..."

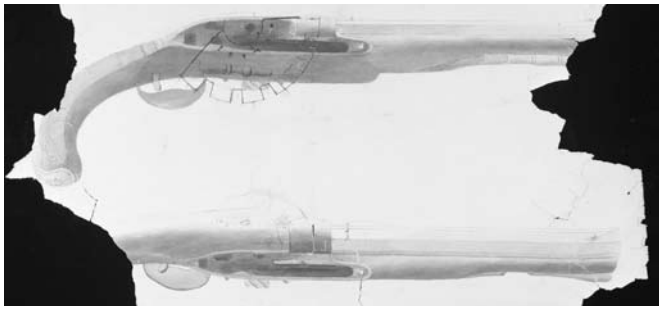
At this time the Gunmakers Company was evidently considering building up a collection of historic firearms. The Clerk of the Court was "instructed to get in touch with Canon Thomson to ascertain on what conditions he was prepared to part with the gun", and that he should "place the matter on the Agenda for the next Court". In the Minutes of the Court of the 10th of September 1959[3] it was reported by Mr W. Keith Neal that Canon Thomson had been offered, and accepted, the sum of £25 for the gun. The Clerk was asked to confirm whether or not the "various diagrams and documents" were an agreed part of this purchase, and at the Court of the 15th October 1959[4] he was able to report that "he had heard from the Rev. Canon Thomson confirming that all the drawings and other date were included in the sale".

At the time of the author's first visits to the Proof House the drawings mentioned were not in evidence, but, in April 1989, they were located thanks to the kind efforts of Major Back, who after securing the full agreement of the Court of the Company has now lodged them on indefinite loan in the archives of the Royal Armouries.

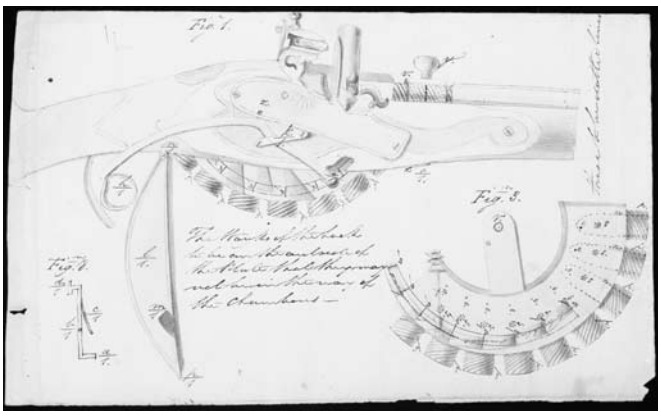
The papers concerned proved to be an immensely interesting and possibly unique group of documents relating to the preliminary thoughts and more developed ideas of an early nineteenth century firearms designer. They consist of four large double-sided sheets of notes and a total of twenty sheets of annotated drawings, all of which relate to Thomsons patent of 1814. By comparing the handwriting on these papers with that on documents, to be discussed later, which survive in the Public Record Office, it was firmly established that these notes had in fact been written by James Thomson.

Regrettably space will not permit the reproduction of all these documents here, but showing at least those most pertinent to the surviving rifle and other major parts of Thomson's patent may still indicate the importance of this group of papers.

The first (see Figure 15) is a group of four well-executed watercolour sketches of a typical late eighteenth century English duelling pistol with its lock removed. (This sheet is now much damaged at its edges having been the largest in the roll of papers.) On the third illustration from the bottom a design has been roughly sketched on in ink of a six-chambered breech piece of a type similar to that in the surviving rifle. An even sketchier version appears in the bottom drawing. These may represent an early design by Thomson for this repeating breech mechanism.



15. The bottom two of four watercolour sketches of a duelling pistol with its lock removed. They have additional rough sketches of Thomson's breech piece design.



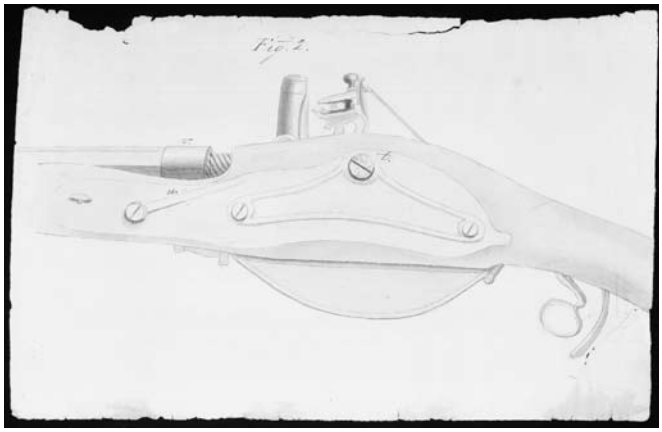
16. An original drawing of the surviving "poli-chambered" rifle, and the breech piece.

Another sheet (Figure 16) represents the fully developed breech mechanism and lock, and would indeed appear to be one of the original drawings from which the final versions for the patent later engraved for the published edition were taken. The characteristic decorative features already noted on the surviving rifle and in the patent are present, and it has the "Fig. 1" and the numerous indicator letters by which the operation of the mechanism is described, all of which are also in the patent. Interestingly Thomson has inserted a comment: "The Works of the Lock to be on the outside of the Plate that they may not be in the way of the Chambers—"

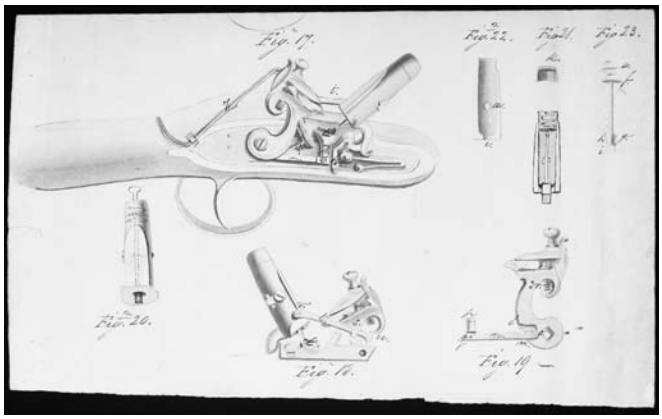
A very small but possibly significant difference between this drawing and that in the patent is that the small eye for the attachment of a cocking piece to the spur of the cock is present. One has the impression when studying these drawings that they were prepared by a competent artist who was not involved with the designing of the mechanism. He simply drew what he saw, which was then, usually rather unsubtly, amended by Thomson. In this instance one suspects that the attaching eye was drawn as part of the "test-bed" rifle, the cocking bar having been removed, but that Thomson had this detail removed from the engraving of the patent illustrations in order that it could be shown on his alternative automatically-priming lock. The bottom right-hand corner of this sheet shows the breech piece as on the surviving rifle, with a note from Thomson saying that the shape of the chambers (i.e. with hemispherical bases) should be indicated by dotted lines. They are so rendered in the patent illustrations. A small sketch of Fig. 8—the spring catch to secure the breech piece—is roughly executed in ink, apparently by Thomson.

A third sheet (Figure 17) shows the nearside of the breech area of the rifle. Here the decorative sideplate, the spring catch securing the breech piece, the coupling box, the oddly-shaped trigger ring and other features of the surviving rifle are clearly shown, together with a suggestion of the chequering of the wrist. In this drawing, however, the cocking bar is clearly shown attached to the cock. The drawing is labelled "Fig. 2". as in the patent, but in the final engraved version the cocking bar is omitted.

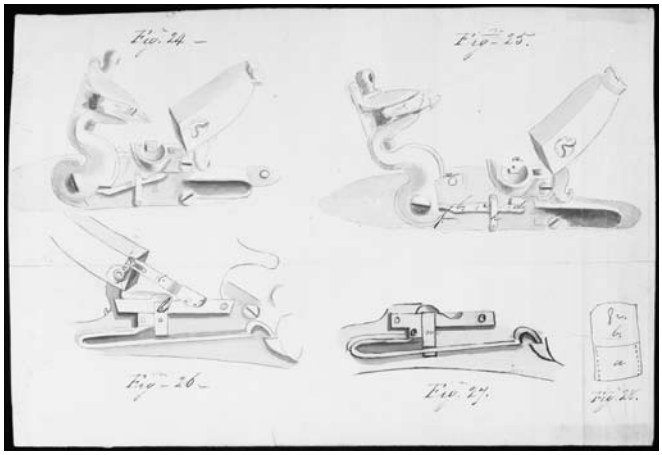
The good quality of these drawings, where they relate to items which eventually formed part of the patent illustrations, can sometimes make the mechanism being discussed more easily understood than in the later engraved published version. Two sheets in particular



17. An original drawing of the nearside of the breech area of the "poli-chambered" rifle.



18. Original drawings for Thomson's design for an automatically-priming lock.

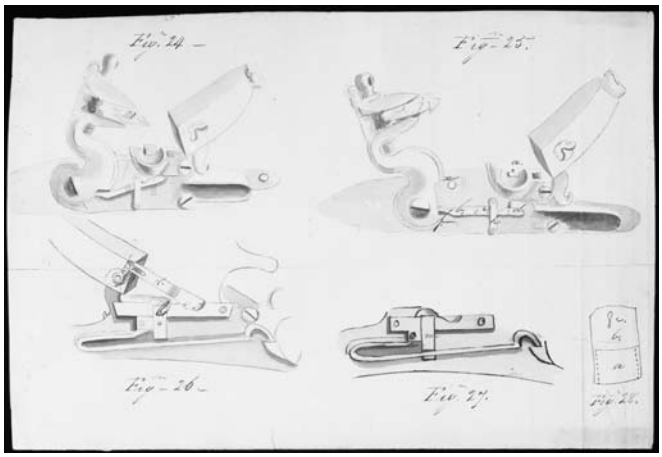


19. Original drawings for Thomson's designs for vertically sliding touch-hole covers. Figs. 24 to 26 use a rocking bar, that in Fig. 27 is operated simply by the movement of the mainspring.

achieve this. The first of these (Figure 18) covers Figs. 17 to 23 (patent sheet 3); the automatically-priming lock and its components. Here the cocking bar is illustrated as it appears in the patent, the working parts of the rocking bar and stud working through the base of the pan, and the internal parts of the priming magazine, are more easily understood. Indeed in a number of small details the engraver has apparently misunderstood the drawings and either rendered the parts incorrectly or left them out altogether. The second of these two sheets (Figure 19) refers to Figs. 24 to 28, (patent sheet 4). Here the first three sketches, rather less well executed than the previous drawings, show two external and one internal view of a lock with a vertically-sliding touch-hole cover operated by a rocking bar worked by the movement of the cock. A fourth sketch shows a simpler alternative design where the cover is moved up and down simply by the movement of the mainspring, and the last figure is a very simple sketch, probably by Thomson, of a cover for a gun flint to prevent accidental discharge. The layout and content of this sheet is strikingly similar to that in the later published patent but again is more easily understood.

The last drawing which space may allow to be illustrated is a small sheet (Figure 20) forming the contents of Figs. 36A, B, C and D of the patent (sheet 8). Here Thomson was concerned with reducing the time taken to load the common military musket by introducing a conical constriction In the breech. A musket ball dropped into the barrel would fall down the bore and jam into this tapered section, thus eliminating the time taken in ramming the charge. In drawings A and B Thomson suggested how a breech of this type might be made, while in C and D he showed how he felt an existing musket could be altered by placing a separate tapered tubular piece of metal in the breech and fixing it in place with three screws. This "invention" will be further discussed later.

Several of the remaining sheets of drawings have working sketches which deal with the design of waterproof

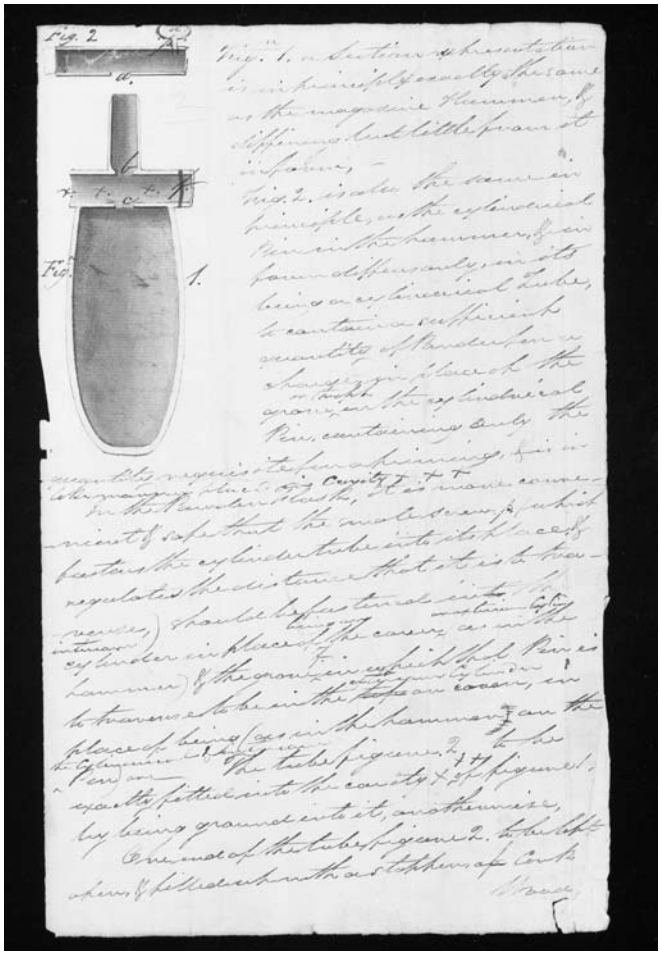


20. Original drawings for Thomson's two designs for constricted breeches to reduce the loading time of service muskets.

and airtight pans and with breech mechanisms which did appear in the final patent specification. There are others however showing various types of breech action and Thomson's ideas for the design of powder flasks which although briefly mentioned in the text of the patent were not illustrated. Interestingly most of these drawings are without any comments from Thomson, suggesting that he had decided he would not pursue them further when applying for his patent.

Efforts to locate the original patent specification roll now almost certainly within the Public Record Office's holdings at Chancery Lane have so far proved unsuccessful. When this is located it is hoped to prove that at least some of these carefully prepared drawings were improved and altered at Thomson's direction and it is these which were enrolled with the patent in 1814. The printed patent published in 1854, is inevitably not an entirely reliable source.

Examination of the four double-sided sheets of manuscript notes which accompany the drawings suggests that they were possibly drafts for part of a patent specification, largely covering the design of powder flasks



21. A page of Thomson's manuscript notes, describing and illustrating a design for a powder flask with a similar tap-valve to that of his priming-magazine frizzle.

using Thomson's various methods of safety cut-off and measuring similar to those in this priming magazine frizzles (see Figure 21). Indeed he makes very brief mention of powder flasks in the preamble to his patent:

> "My Invention consists in constructing fire-arms to be primed, loaded and discharged expeditiously: also in securing the powder of the priming and charge from moisture, and in guarding against accidents, from fire-arms and powder flasks by my improvements on the mode in which the same are to be made, constructed, and effected".

Thomson, however makes no further mention of powder flasks, and none are illustrated in his patent, thus the surviving drawings and notes are a unique insight into what he was proposing.

Lastly, amongst the manuscript notes are two rough ink sketches for two types of breechloading mechanisms, with draft texts for his designs for constricted musket breeches. Sadly no part of these pages of notes contains a draft text as it finally appeared in the published patent.

James Thomson and the Board of Ordnance

Thomson evidently believed that his various designs might find application in British military service. The Public Record Office at Kew now contains the surviving parts of the correspondence which passed between Thomson and the Board of Ordnance; two bundles containing a total of more than forty documents.[5] There is too little space here to reproduce them all but one feels that in fairness to Thomson a number should be quoted as fully as possible in order to properly record the treatment he received at the hands of the Board.

The correspondence begins with the following letter from Thomson to the Earl of Mulgrave, Master General of the Ordnance:

No. 8 Colebrooke Terrace
Islington 26th November 1833

My Lord.

In consequence of a communication from my friend William Hunter. Esq., who has done me the favour to mention to your Lordship the improvements which I have made on Fire-Arms. I beg leave to request your Lordships permission to submit my Plan to the Board of Works at Woolwich—

Conformably to your Lordship's suggestion to Mr Hunter. I have this day applied to the Board stating the objects of my plan and my wishes that it may be inspected & reported upon to the Honourable Board of Ordnance.

My improvements are-

First—A single barrel'd Gun or Pistol (riffled [*sic*] or plain) which with common gunpowder can readily be discharged Nine times in one minute:

Secondly—a Lock for fire Arms, so constructed as to prevent the priming & loading—from being wetted—& can at a small expense, be added to any Lock—

The Articles are ready for inspection, & if your Lordship will condescend to look at them. I will wait upon your Lordship at any time you may do me the honour to appoint—

I have the honour to be
My Lord—
your Lordship's—
most obedient and
very humble servant
James Thomson

As with almost all this correspondence a note was made on the reverse of the original letter recording the action ordered. In this case the Earl "declined to pronounce any opinion" on the inventions and said that the matter should be referred to a Committee of Officers.

A Committee was duly formed, and its report follows. It is important to note that by the time these officers gathered to consider Thomsons inventions he had added a third item; the priming magazine frizzle.

Present
General Farrington
Lieut. General Lawson
Lieut. General Stephens
Major General Douglas
Major General Wellington — Woolwich
Lieut. Colonel Millar — 21st December 1813

Sirs,

Be pleased to inform His Lordship the Master General that I convened the Committee named in the Margin

[i.e. above] to take into Consideration the inventions of Mr Thompson [*sic*] agreeable to your letter of the 30th Ult.

Mr Thomson attended and stated to the Committee that he had two separate improvements on the Common Musquet to submit to their consideration. The first was an alteration in the hammer of the Musquet Lock by which he proposes that the Soldier should prime at the time he Cocks his peice. This hammer is constructed with a Chamber at the back of it to contain about 20 primings each priming is delivered into the Pan by the turning of a small Cylindrical grooved Pin and so contrived as to prevent the possibility of any communication at the Prime of firing with the Powder in the Chamber—[i.e. that in the priming magazine]

The Second improvement proposed by Mr Thomson is also on the Musquets lock and consists in applying a small slip of Metal which slides up and down in front of the touch hole so as completely to cover it when the peice is at half Cock to prevent any moisture getting into the Charge and removed when discharged this is very ingeniously contrived by the Slip of Metal being attached to the Main Spring which acts upon it by the altering of its relative position without any additional mechanism.

The Committee having formed a very favourable opinion of Mr Thomson's first contrivance from it simplicity and ingenuity had a lock fitted up by him which was repeatedly fired quick by a soldier at the end of 13 Rounds it appeared that the Pin which delivered the priming into the Pan [from expansion) could no longer be turned with the Finger and Thumb: at a Second Trial when 21 Rounds were fired the same objection occurred even in a greater Degree as it then required the Assistance of a Small Wrench to turn the Pin in every other respect the Contrivance answered to the satisfaction of the Committee and altho when the Pin becomes jammed the Lock can still used in the Common Way, yet as the Main Point of the Contrivance is the priming when and as often as required and that with the Rapidity of quick firing the Committee have to report that Mr Thomson entirely failed in the object of his invention.

With respect to the Second Contrivance giving every credit to Mr Thomson for his ingenuity did not think it worthy of a Trial as the closing of the Touch hole appeared a Refinement inapplicable to the Public Service.

Mr Thomson stated to the Committee a third invention of his which consists of a mode of loading a Rifle at the breach by nine Chambers working on a common Centre which when all loaded are brought in succession and attached to the Common Barrel these are primed and fired on the same Principle as in his first invention (before stated) but with more mechanism. This Invention the Committee observe is, although showing much Contrivance much more complicated than several that have been brought before Them for the Same purpose, and as they see many decisive Objections to this Mode of loading fire Arms which have often been expressed in former Reports They do not think Mr Thomson's Contrivance deserving Encouragement.

I have the honour to be
Sir
Your most obedient
humble Servant
(signed) A. Farrington
General

The first improvement, a priming magazine "hammer" or frizzle might well have been of considerable military interest. Britain was still at war with France at this time and any method to increase the speed of loading the service musket could have been an important development. The sliding cover for the touch hole was dismissed without much comment. The third invention seen by the Committee was almost certainly the "poli-chambered" rifle now in the Gunmakers Company and sadly their damning (but it must be said entirely understandable) comments are almost the last we hear of this remarkable weapon.

We do not know the exact date of this first trial, but apparently immediately after it, aware of the views of the Committee and before their report was sent to the Board of Ordnance, Thomson wrote to the Board. He said he had been before the Committee and now asked that; "As it may be necessary to make further experiments on my Invention I have to request that the Board of Ordnance may be pleased to grant me an Order for 200 or 300 rounds of Musquet Ball Cartridges (which I will thankfully Pay for) that my trials may be made with regular Ammunition to meet the recommendations of the Committee".

The Board was clearly not impressed by Thomson's "Contrivance", and late in December 1813 wrote turning down his request, saying that they did "not think it advisable that any further experiments should be made".

Clearly Thomson was not to be so easily put off. In February 1814 he wrote suggesting that the Board's opinion of his inventions was formed "from some misapprehension of the Report, which concludes by stating the Riffle-gun [*sic*, i.e. the "poli-chambered" rifle] "not deserving of encouragement". He suggested that the Board had not fully taken into account the Committee's view on the lock with the priming magazine frizzle, which, after admitting that it jammed badly in the trial "In every other respect the contrivance answered to the satisfaction of the Committee". Perhaps not surprisingly Thomson chose to ignore the Committee's final comment on this device; "that Mr Thomson entirely failed in the object of his invention", a comment the Board would have been bound to act upon.

Thomson seems to have accepted the Committee's verdict upon his poli-chambered rifle, and of it no more is heard. For the time being too he did not question further their disinterest in the lock with the touchhole cover, but he assured the Board that he could solve the jamming problem of the priming magazine and asked again for two hundred ball cartridges. He wrote to the Board again on 1st April 1814, having earlier been granted permission to purchase two hundred cartridges, saying that he had made improvements to his "gun hammer" and that "the result is complete success having remedied the impediment experienced at Woolwich, & having fired

a Musquet (quick firing), 44 rounds at the 24th round the Barrel become so much heated that I considered I could not with safety proceed; after an interval of a few minutes I fired 20 more rounds and experienced no inconveniency whatever from the hammer ... I have made a like experiment with a Pistol, of 20 rounds with the like success ...". Thomson offered his improved "hammer" for further trial, and on the 4th of April the Board ordered the original Committee to reconvene, test the device and report as soon as possible. Here is the Committee's report:

Present
General Farrington
Lieut. General Lawson
Lieut. General Stephens
Maj. General Douglas
Maj. General Cuppage
Maj. General Wellington — Woolwich
Lieut Colonel Millar — 18th April 1814

Sir,

I have the honor to acquaint you for the information of His Lordship the Master General, and Hon^{ble} Board, that I assembled the Committee named in the Margin [i.e. above] and resumed the consideration of Mr Thomson's improvements on the Hammer of Musquet locks; agreeable to your letter of the 4th inst.

Mr Thomson attended and explained that the alteration he had made since he last submitted his Invention to the examination of the Committee, consisted in dividing the aperture in the bottom of the Hammer where the powder passes into the pan, into two parts, which division rather projects downwards and prevents to the explosion acting so violently against the pin, and clogging it.

The Committee made a soldier fire this Musquet twenty rounds fast as on service, when it appeared in every way to answer the object proposed, as the priming pin remained perfectly loose and as easily turned, as when the experiment commenced, neither did there appear any tendency in the fire to communicate with the chamber [i.e. the magazine] even when the cap was intentionally left off.

It appearing to the Committee that Mr Thomson has succeeded in the object of his contrivance by the alteration he has now made, and which has done away the objections stated in the former report. The Committee therefore beg to recommend a proportion of these priming Hammers may be prepared and applied to the arms of some Rifle or other Corps for experiment as may be thought advisable.

I have the honor to be
Sir
Yours most obedient
humble Servant
A. Farrington
General

On the strength of this report the Board decided to have twelve muskets fitted with locks with Thomson's magazine frizzle, and on 22nd April they wrote to ask Thomson to produce a pattern. He responded promptly and sent his pattern to the Board on the 27th of April. In his covering letter he said he thought that as the pattern "may be thought rather too small for a musquet Lock, I have also sent one in the forged state, which I am of opinion is about the proper size for a Musquet". Having received his patterns the Board ordered on the 27th April "that Twelve Locks ... be set up into Musquets in the Royal Manufactory for Experiments".

In the Royal Armouries collections is what is almost certainly one of these twelve muskets (Inventory number XII.685, see Figure 22). It is an India Pattern musket fitted with a lock of New Land Pattern type although larger than standard in order to fit the original India Pattern lock aperture. It has a ring-necked cock and engraving, however, of India Pattern type. The magazine frizzle is very well made, with a simple screw plug at the top for filling and a robust tap valve which rotates only half a turn. It has the improvements made by Thomson; of having two diverging holes to deliver the powder into the pan, and a small semi-circular fence between them to deflect vent gas away from the tap valve (see Figure 23), which are referred patent illustrations and on the priming magazine of the poli-chambered rifle.

22. A military trial musket with Thomson's patent priming magazine "hammer". (Royal Armouries, H.M. Tower of London, No. XII.685.)

On the 14th of June 1814 Thomson wrote to the Board saying that he understood that the twelve muskets were "in great forwardness and will probably be completed in a few days". He then asked if he might have either his original musket, which was left with the Committee of Officers at Woolwich at their request or one of the twelve in preparation, in order that he might add to it "for the inspection of the Board (his) improvements on the Barrels of Musquets, whereby they are to be loaded in half the time requisite on their present construction". This was almost certainly a reference to the constricted-breech design Thomson included in his patent As Mr H. L. Blackmore has stated,[6] the Board had already considered a variety of similar ideas and only in 1813 had finally rejected after extensive trial a virtually identical method put forward by Major V. Gardner. In fact an order was made "that Mr Thomson's Request be complied with, and that the Musquet be delivered accordingly". Later correspondence will show, however, that the musket was probably not returned, and certainly we hear no more of Thomson's musket barrel "improvement". Thomson's letter of the 14th June also contains his first reference to the costs incurred by him in preparing his inventions. In asking the Board for either his original or one of the new muskets he says that he had "been induced to make this application from acconomy

23. The underside of the priming magazine "hammer" of the musket in Figure 22, showing the two powder holes divided by a semicircular fence.

[*sic*]— having already been at a very heavy expense ..." We will discover more later of Thomson's financial problems in dealing with the Board.

On the 5th of August Thomson wrote again to the Board asking to attend the proposed military trial of the twelve muskets. The Board, however, did not reply to Thomson but ordered that the Commander in Chief (the Duke of York) should be "acquainted that there are Twelve Musquets in the Tower set up with Musquet Locks invented by Mr Thomson; in case His Royal Highness should wish any trial to be made with them by the Guards or any other Regt."

Between August and October 1814 there is polite exchange of correspondence between the Board of Ordnance and Horse Guards (the office of the Commander in Chief) seeking the C. in C.'s view on whether or not a troop trial would be sanctioned.[7] Requests made by Thomson to be kept informed of progress and asking to be present at any trial apparently went unheeded. On the 22nd of October a letter from Horse Guards to the Board stated "that the Commander in Chief has been pleased to approve of the Twelve Musquets... being issued for trial to Certain Regiments in the Kent District and I am accordingly to request that these Musquets may be forwarded to Canterbury, addressed to the care of Maj. General Pack, Commanding the Kent District who will receive the necessary instructions in regard to their distribution".

The trial of the twelve muskets took place during November 1814, and on the 30th of that month a further letter, enclosing the trial report, was sent from Horse Guards to the Board. In it the writer, Lt. Gen. Calvert was commanded by the C. in C. "to observe that under the Circumstances, therein stated. His Royal Highness does not consider the Alteration proposed by Mr Thompson [*sic*] expedient—". The report of this trial was endorsed by Major General Pack, who said in a covering letter that the "remarks I think are very judicious.... I was present at the trial... and fully concur in the justness of the Observations".

Remarks arising from the Trial with twelve stand of Arms M^{r} James Thompson's new invented Musquet Lock by the 2^{d} Batt^{n} 9th Foot.

Canterbury 27th Nov 1814

The following are the advantages that present themselves.
1st That priming in the dark, and in wet weather it possesses advantages over the Lock now in use.
2nd That in firing twenty rounds it will exceed the common mode by two rounds.* [Presumably meaning it could fire off two more rounds in a given time.]
*[MARGIN NOTE] not certainly unless the priming chamber was filled previous to the Soldiers receiving the Order to prime & load.
D. Pack
M. General

The following are among the principle objections which far outweigh the advantages.

1st It is presumed that a Powder Horn would be necessary to be added to the Accoutrements of the Soldier to prevent the Destruction of a Cartridge at each Charge of the priming Chamber. The Cork intended to protect the Powder in the Chamber frequently falls out in going through the Motions of the Firelock, and of course on numerous occasions upon Service could not be replaced.

2nd The Priming is not well delivered unless the Musquet is held in a Horizontal Position at the turning of the priming key, and with common blank Cartridge Powder seldom or never deposits sufficient priming, and even with ball Cartridge Powder which is of finer grain soon clogs the Passage leading to the Pan and impeded the revolution of the priming key.

3rd The face of the Hammer, which from constant use must often require repair, is not of sufficient substance to be refaced. In one Instance the first fifteen rounds that were ever fired from the firelock, the flint penetrated through the hammer laying the chamber open and the lock consequently became useless.

4th The destruction of Flints from the Force necessary to throwback the Hammer is found to be in the Proportion of Six rendered useless for one in the old lock.

5th The Cock is too short consequently does not strike the Hammer so as to throw open the Pan with effect

6th Mr James Thompson's Lock rendered the already heavy firelock three Ounces and one Quarter heavier than the one now in use, the lock of which from its Simplicity compared to Mr Thompsons is far preferable in the hands of a Soldier.

(signed) W. Gordon Macgregor
L^{t} Col 2^{d} Batt^{n} 9th Foot

In an attempt to assess the validity of some of the comments made in this report the author was fortunate in being able to carefully examine the Thomson trial musket in the Royal Armouries. Objection 1 of the report is not easily understood since on the surviving trial musket there is no safety hole as on the poli-chambered rifle's frizzle. Objection 2 was fully sustained; firstly that inevitably priming powder will not be delivered to the pan except when the musket is held horizontally, and secondly that the amount delivered is very small. It was found after several tests, too, using fairly fine grained black powder, that in fact the magazine contained only enough powder for about twelve primings. Objection 4. the destruction of flints at a great rate, may well have been due to the mass of the magazine frizzle: It was found that the Thomson frizzle weighed 5 ounces (145g) empty, and 5¼ ounces (150g) when filled with powder. The weight of a standard New Land Pattern frizzle is 2 ounces (60g). It seems likely

that the extra force upon the flint in having to propel such a heavy frizzle may well have accounted for the high rate of flint consumption.

For reasons of their own, not recorded, the Board had not invited Thomson to the trial. Having received the report above, however, they ordered that he should be informed of the result. A short and rather abrupt note to Thomson told him officially of the trial and that "the alteration which [he] proposed in the lock is not considered expedient".

Sometime after the end of 1814 Thomson became ill, and the next piece of correspondence, bearing the address of his brother Samuel Thomson, at 57 Red Cross Street. Cripplegate, is a "Memorial"—a statement of Thomson's case so far. lt is dated the 17th of March, 1817. and addressed to the Master General and the Board of Ordnance. This document is too long to be quoted in full here, but its substance was to remind the Board of the amount of time, effort and financial expense Thomson had incurred, he believed at the Board's wish. Having been encouraged by the successful second trial Thomson furnished the requested patterns and then attended the Royal Manufactory at Lewisham to superintend the production of the twelve trial locks. He said that the Board's interest in his inventions had encouraged him to apply for and obtain his patent, and regretted that not only had he not been invited to attend the troop trials but that he had heard nothing further on the matter from the Board. He ended by saying that his expenditures had totalled over five hundred pounds and asked that "if his said inventions is [*sic*] deemed not to be advisable for his Majesty's service that his case may be taken into consideration and such compensation granted as your honourable Board may deem to be meet".

On the 13th of June the Board replied asking Thomson to "state the particulars and amount the Expenses" which he had incurred, which must have offered him a ray of hope. No copy of the account Thomson sent survives, unfortunately, but we know from later correspondence that it was in excess of four hundred pounds. The Board's response was brief and uncompromising. The Secretary of the Board was "directed in reply to acquaint you, the board not having authorised you to incur any Expense on the above objects and your Inventions not being judged applicable to the King's Service, the board cannot afford you any remuneration or relief. Thomson's reply, sent from Brighton on the 5th of July 1817, expressed his "disappointment and surprise". It appeared to him "most extraordinary" that the Board should ask for an account if it had no intention of making any payment. He reminded the Board again of this work on the twelve trial locks and asked for them to be given over to him, even if he had to cover the cost of materials and labour they had required "for undoubtedly the Board can have no right to avail itself of [his] time and talents or Invention secured to [him] by his Majesty's Letters Patent".

Thomson seems to have received no favourable response from the Board, and thus takes up the matter again in March 1818, on return from a sojourn on the continent for the benefit of his and Mrs Thomson's health, with a note to the Board reminding them of his previous correspondence. Again this apparently had no effect, and in an attempt to obtain some satisfaction he wrote a second 'Memorial', on the 27th of November, addressed to the Duke of Wellington, then Master General of the Ordnance. Thomson explained in detail the story of his invention and his dealings with the Board up to that time, recognising that the Duke "was not in Office at the date of the transactions alluded to". Thomson begged "that this case may be reconsidered" and explained that the "excuse of so long a space of time having elapsed without renewed applications to your honourable Board is that your Memorialist has ever since been on the Continent for the benefit of his health, and in so precarious a situation as to have been advised not to harass or perplex his mind by any pecuniary pursuits—"

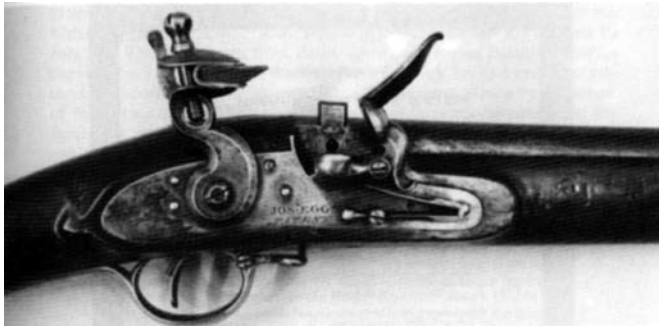
Apparently an unsuccessful attempt was made by the Board in May 1818 to locate the twelve trial muskets, presumably with the intention of sending the locks to Thomson. They wrote to Lt Col. William Macgregor, who had commanded the 9th Foot at the time of the trial, but received no answer. The surviving documents then leap a full six years, to November 1824. They reopen with what is apparently an internal Board of Ordnance report; an account of the "Case of Mr Thomson J., 27 Nov 1824-226". The document number 226 is significant; it is the received letter code of the 1818 "Memorial" by Thomson to the Duke of Wellington, which strongly suggests that in fact no action on this matter had been taken in the intervening years. In response to this report however, on the 3rd of December 1824 the Board wrote again to Lt. Col. Macgregor, asking for a reply to their letter to him of the 11th May 1818.

By this time it was over ten years since the troop trial had taken place, and Lt. Col. Macgregor had retired on half pay. He made two replies, however, to the Board's second request for information on the possible whereabouts of the twelve trial muskets. Macgregor's first letter, dated the 2nd of January, 1825, explained that he could only speak from memory, not having access to the regimental records, but that he remembered that the trials findings were unfavourable, and that when the 2nd Battalion 9th Foot, (which carried out the trial) was reduced in December 1815 the muskets were deposited in the depot of the 1st Battalion. On the 25th of March he wrote again to the Board, suggesting then that the muskets might have been lodged in the depot of the 1st Battalion, or perhaps deposited in the Ordnance stores at Chatham. Contacting the 1st Battalion 9th Foot, and consulting the storekeepers records at Chatham for the relevant period should, he said, "ascertain how they were disposed of.

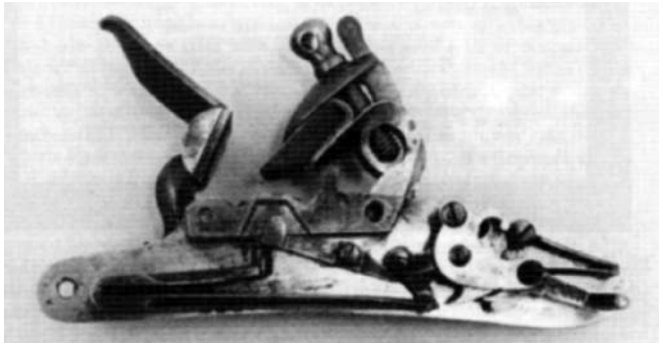
The Board duly wrote to the Officer Commanding the 9th Foot on the 28th March and after some delay, caused by the fact that the regiment was then stationed in Grenada, Lt. Col. David Campbell replied, on the 28th of May. He sent endorsed copies, extracted from the regimental records, of two pages from the Chatham storekeepers accounts, which confirmed that on the 15th of November 1815 the twelve Thomson muskets were received into store at Chatham from Mr Samuel Reeves, Quarter Master of the 2nd Battalion, 9th Foot. On contacting the stores at Chatham the Board were told in a reply by the Storekeeper and Deputy Storekeeper that "upon examination into the Armouries at this Depot, we find that the twelve Muskets, in question, as described, remain here in good Condition".

While the Board was conducting these investigations, and probably in response to the report on the "Case of Mr Thomson" of November 1824, it instructed the Hon. Fitzroy Somerset, military' secretary to the Duke of Wellington, to write to him in December. This letter stated again that the Committee which originally considered his inventions could not recommend their adoption for British service. This letter, however, went on to say that the "Committee having observed that the hope of obtaining remuneration (for the expenses of the apparatus which you submitted for their examination and trial in 1813 and 1814) was the motive of your sending the description of your Invention on the present occasion I am directed by the Master General to acquaint you that he cannot order any remunerants of your Expenses incurred on the Account".

We know that for some years by this time Thomson had been in poor health. Two and a half years, however, were to elapse before he apparently felt able to take up the challenge of his case again. In July 1827 he had gathered sufficient strength to send from his home at "aux Batignolles, Rue St Louis, Paris" a seven-page counterblast upon the Board and its conduct, in which he almost crackled with rage. He began by copying in full the Fitzroy Somerset letter above, to which he had apparently made a reply which unfortunately does not survive. He refers the Board to this reply in which he apparently said in no uncertain terms what he thought of their conduct as officers which was "so different from that which [he] had experienced from the Committee under General Farrington, [whose] demeanour was respectful affable and polite . . ." He continues by then challenging the Board on the matter of a trial carried out in 1816 of a sliding touch-hole cover for muskets offered by Joseph Egg. What is probably the trial musket concerned survives in the Royal Armouries collection (Inventory number XII.693, see Figures 24 and 25). There is no record

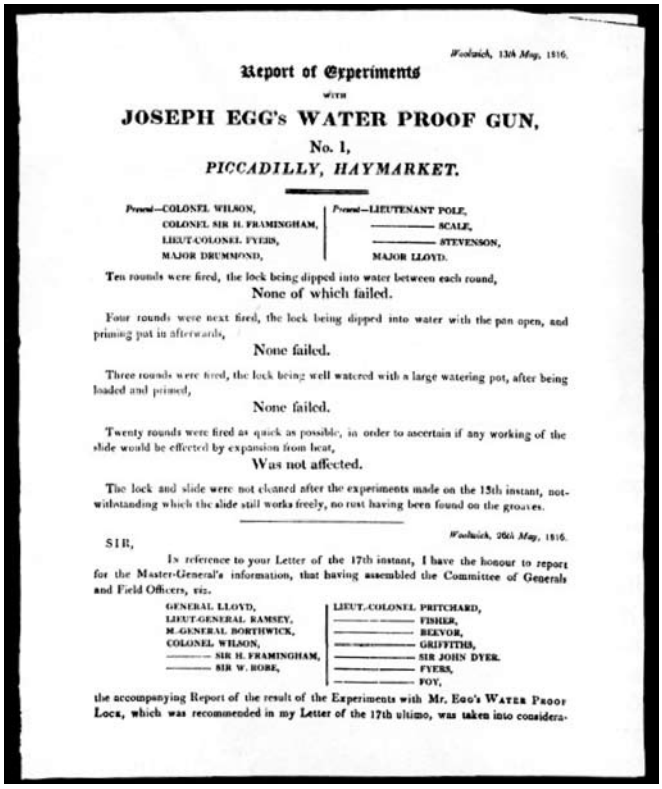


24. The lock of Joseph Egg's "Patent" musket, with a sliding vent cover. (Royal Armouries, H.M. Tower of London, No. XII.693.)



25. Interior of the Egg "Patent" musket, showing the rocking lever which moved the touch hole cover.

of a patent by Egg to protect this design, which, as is evident from these illustrations, was a clear infringement of Thomson's rocking-lever design (although he in fact submitted the simpler mainspring-operated cover at the 1813 trial). Thomson was clearly incensed not only that the Committee of Field Officers which had rejected his sliding touch-hole cover as a "refinement inapplicable to the Public Service" should only three years later recommend the military trial of an identical feature, but also that Egg should have the effrontery to publish the results of the Committee's deliberations (Figure 26). In fact twenty-five India Pattern and twenty-five New Land Pattern muskets were altered to this design, but because this necessitated a dovetailed groove being cut vertically through the barrel by the touch-hole the resultant weakness caused several trial muskets to burst at the breech and the tests were abandoned.[8]



Woolwich, 13th May, 1816.

Report of Experiments

WITH

JOSEPH EGG's WATER PROOF GUN,

No. 1,

PICCADILLY, HAYMARKET.

Present—COLONEL WILSON, COLONEL SIR H. FRAMINGHAM, LIEUT-COLONEL FYERS, MAJOR DRUMMOND, | Present—LIEUTENANT POLE, ——— SCALE, ——— STEVENSON, MAJOR LLOYD.

Ten rounds were fired, the lock being dipped into water between each round,

None of which failed.

Four rounds were next fired, the lock being dipped into water with the pan open, and priming put in afterwards,

None failed.

Three rounds were fired, the lock being well watered with a large watering pot, after being loaded and primed,

None failed.

Twenty rounds were fired as quick as possible, in order to ascertain if any working of the slide would be effected by expansion from heat,

Was not affected.

The lock and slide were not cleaned after the experiments made on the 13th instant, notwithstanding which the slide still works freely, no rust having been found on the grooves.

Woolwich, 26th May, 1816.

SIR,

In reference to your Letter of the 17th instant, I have the honour to report for the Master-General's information, that having assembled the Committee of Generals and Field Officers, viz.

GENERAL LLOYD, LIEUT-GENERAL RAMSEY, M.-GENERAL BORTHWICK, COLONEL WILSON, ——— SIR H. FRAMINGHAM, ——— SIR W. ROBE, | LIEUT.-COLONEL PRITCHARD, ——— FISHER, ——— BEEVOR, ——— GRIFFITHS, ——— SIR JOHN DYER, ——— FYERS, ——— FOY,

the accompanying Report of the result of the Experiments with Mr. Egg's WATER PROOF LOCK, which was recommended in my Letter of the 17th ultimo, was taken into considera-

26. Front page of the copy published by Joseph Egg of the report by the Committee of Field Officers in 1816, endorsing his "Waterproof Gun". (PRO. W044/635.)

In his attack upon the Board, however, Thomson evidently took no satisfaction from this. More than ten years after the event it still rankled. He said that he was sure that the Board would recognise the "piracy" of his patent and he thought it extraordinary that they had apparently chosen to ignore "the trick which had been practised upon them and fraud upon [himself] by Mr Egg". In not considering his invention at the earlier trial but showing considerable enthusiasm at Egg's version of the same idea he asks if this is not perhaps due to negligence, a blunder, or even vested interest within the membership of the Committee. "If so", he asks "is it either candid or honourable", or is it surprising that he "should be indignant at the subject being quashed by a side-wind—or that [I] should not be satisfied at your Committee charging me with practising a manoeuvre such as I despise [i.e. in asking for coverage of some of his expenses] — whereas

my conduct was open and irreproachable". He closes the broadside; "I am Gentlemen, (tho considering that I have not been handsomely used). Respectfully, Your most obedient and very humble Servant".

Thomson's correspondence with the Board is not entirely complete, and we cannot at this distance in time from the events be sure exactly why Tomson took so long to make his last efforts to extract a satisfactory solution from the Board. It seems, however, that very shortly after his vitriolic letter to the Board he sent a second even longer but more concilatory statement of his case. He had received a letter from the Board saying that they had located the twelve trial muskets at Chatham, and had ordered that the locks be removed and given to him. He only, they said, had to apply to the Ordnance Storekeeper at Chatham. The letter was dated the 17th of August 1825, but for some reason its delivery was greatly delayed. In July 1827 Thomson wrote from Paris, again as in earlier communications copying back to the Board their last letter, which he had only recently received from them. What followed was a full account, as seen by Thomson, of the events surrounding his submission of firearms inventions to the Board. Because it contains a number of pieces of information not fully explained in the other surviving documents, and because it is the last significant communication from Thomson it follows in full:

Rue St Louis N° 1. aux Batignolles
pres Paris July 1827

Sir

The Letter of which the above is a copy has lately been transmitted to me, & I presume came from your honble Board in consequence of my letter to R. H. Crew Esq^{r} [i.e. Secretary to the Board] dated 16th March 1818 (a Copy of that application is herewith No. 7) when offering to pay for the materials & workmanship, but till now never got any answer; at that period when there was eleven years of my Patent unexpired they were of infinite value to me in comparison of what they are at present when one year only of it remains; It is a long period to have been suspense [*sic*] & I had given up all hopes of a reply thereto—also had abandoned my expectations of compensation, though considering myself justly intitled remuneration, & which I trust your honble Board will yet grant. On reconsidering my Case, which I am about to state with all possible brevity—& to occasion no trouble w^{ch} it is in my power to avoid I shall herewith send Copies of the Documents to which I refer—Viz. No. 1 is a Copy of a Report from the Committee of Colonels & Field Officers at Woolwich dated the 23^{d} December 1813, stating their active approbation of my inventions on the musquets Hammer—with one objection thereto—No. 2 is a Copy of a Letter from R. H. Crew Esq^{r} dated the 22nd April stating that I had done away the objection made by the 1814, Committee Decem^{r} that the Board had decided upon submitting to trial twelve priming Hammers on the principle suggested by me and desiring me to produce a Pattern thereof, which I did accordingly & was instructed to superintend the manufacturing to be done at Lewisham. I did from time to time attend there, for that purpose & the Locks having my priming-magazine Hammer being finished attached to Musquets. I accidentally heard that it was intended that there should be a trial by Soldiers, & I applied to H. R. H. the Commander in Chief for permission to be present & begging to be informed of the time & place to which I received no answer or heard anything further on the Subject untill I received R. H. Crew's Letter dated 2nd Decem^{r} 1814 stating that the alteration which I had prepared was not considered expedient: soon after this I got into a bad state of health which disqualified me from attending to business, & continued so till at length in 1817 I determined on going the Continent, & previously to my setting off under date 17th March 1817 Memorialised your Board (Vide No. 4.) stating that my expenses had exceeded Five Hundred Pounds &c &c in answer thereto is R. H. Crew's Letter date 13th June 1817 (No. 5.) desiring that I would state the particulars & amount of Expences incurred which I accordingly did amounting to £410.2.1 exclusive of my personal Expences on various journies to at & returning from Woolwich Lewisham &c &c &c. The answer thereto is R. H. Crew's Letter date 27 June 1817 (No. 6.) at which I was more astonished than can find Words to express my feelings. Whereon with that defference which is due to your honble Board, yet I hope that I may without trespassing, suggest that after what had occurred, having claimed remuneration being desired to furnish the particulars of my expences which doubtless is an admission of there being something due to me, what must I think of the observation that "the Board had not authorised me to incur any expence". Is it possible that I could perform what was required of me without expence—I entrust the honble Board to attend to dates, of the period of my inventions being submitted Dec^{r} 1813, an improvement on the musquet Lock was of no small importance mine was sanctioned approved of and even deemed meritious. the most effectual mode of securing its use from the enemy was by his Majesty's Patent prohibiting the Article from being manufactured by any other than His Majesty's establishments; for I am not or ever was a Gunmaker: I do not mean to infer that I had not a view to being rewarded. I avow on the contrary that I expected it—Such being the Case a Patent was applied for & obtained at a great expence having been opposed by a gunmaker at Birmingham who it was proved had no pretensions—My Patent is enrolled in His Majesty's high Court of Chancery 4th July 1814 where it can be referred to.

In the interval of my experiments at Woolwich of my inventions & their being tried by Troops of the line (Viz. from Decem^{r} 1813 to Decem^{r} 1814), the War had ceased & "the alterations which I had prepared in the musket Lock was not considered expedient" notwithstanding that it had been approved of as is reported 21st Dec^{r} 1813 & 22^{d} April 1814-

Without meaning any disrespect I have no hesitation in asserting that I do believe that my improvements will yet be adopted tho I hope there may not be occasion for them in my time being 64 years of age & infirm, nevertheless I would purposely

visit England to be present at a trial of them & would be highly gratified by it being ordered to take place and permission granted to me to attend—

I will not dispair of being yet deemed entitled to some compensation of my Case being reconsidered—

I am respectfully
Sir. Your most obedient
humble Servant
James Thomson

Among the points of special interest is Thomson's reference to the eleven remaining years of the patent. When the patent was granted on the 9th of March 1814 its protection was to last for the then standard period of fourteen years.[9] Thomson later refers to the fact that he was "not or ever was a Gunmaker", the only positive proof we have that he did not himself made the rifle now in the Gunmakers Company, but that he had a now sadly unrecorded gunmaker produce it for him. The same craftsman may have produced the patterns for the priming magazine "hammer' Thomson supplied to the Board in 1814. When applying for his patent Thomson says he was opposed by a "Birmingham gunmaker". Unfortunately despite extensive searches through the records for this period of cases heard in the High Court of Chancery in London no trace of this case has yet been found, and we therefore do not know the identity of his opponent.[10] Finally it is remarkable to find that even in 1827 Thomson was still hoping either that his invention might yet be adopted for service, or that he might receive some form of compensation.

Thomson was to be disappointed again. The Board replied to this submission that they had nothing to add to their letter of the 17th of August 1825 (in which he was told that he might have the locks from Chatham). A last recorded letter from Thomson, of the 13th of August 1827. begging the Board to take up the offer of a trial with him present, was again predictably abruptly answered—that "the Board do not consider it necessary to make any further trial of the Musquet Locks of [his] invention".

It seems that after this Thomson may have felt unable to carry on the struggle himself. Instead his brother Samuel, who was still living in Red Cross Street Cripplegate, wrote to the Board in October 1827 to ask for the name of the Storekeeper at Chatham in order that he might apply for the twelve musket locks on his brother's behalf. The Board however ordered that the locks should be sent from Chatham to the Tower, where Robert Porrett, Chief Clerk under the Principal Storekeeper, was to deliver them to Samuel Thomson.

After about six weeks, during which time Samuel wrote again asking what was happening, Porrett wrote to the Board to explain the delay. His letter, dated the 15th of November, explained that the locks had not been received at the Tower from Chatham until the 10th of that month, and that they would have been delivered to Samuel Thomson that day "had it not been for very strong objections made by the Master Furbisher who requested that it might not take place until he had reported to the Board certain reasons for their retention".

On the same date the Master Furbisher, Jonathan Bellis, sent his report from the Tower to the Secretary of the Board:

Small Gun Office Tower
15th Novr 1827

Sir

Adverting to the Minutes of the Board dated the 8th of October 1827 on the Application of Mr Samuel Thomson Brother of Mr James Thomson requesting that Twelve Musquets and Locks which were in Store at Chatham might be delivered unto him (which paper I did not see until this Morning). In answer thereto permit me to state for the Information of the Honble Board that on the 27th of April 1814, The Board were pleased to direct that Twelve Musquets of the India Pattern should be made in the Royal Manufactory with Magazine Hammers, the Pattern of which Hammers was proposed by Mr James Thomson, that these Musquets were completed entirely at the expense of the Office, and forwarded to Canterbury to the care of Major General Pack, (I believe for Experiment) and were sent from Canterbury to the Stores at Chatham, where they have ever since remained until a few Days back when they arrived at the Tower and that the Locks have been taken off the Arms, and delivered to Mr Thomson; Permit me further to state that as these Locks were made entirely at the expense of the Office and are marked with the King's Marks, and are the entire property of His Majesty, that they ought not to remain as private Property in the Hands of an Individual, but that they should be again returned into Store with the exception of the Hammers *only*, which he might be permitted to retain, they being of no value, though made at the expense of the Office.

I have the Honor to be
Sir
Your most obedient
humble Servant
Jonathan Bellis

Bellis's submission was duly considered at a meeting of the Board on the 21st of November 1827. The full account of their deliberations appears in the minutes of this meeting,[11] but the substance is more succinctly given in a cramped margin note written on Bellis's report:

21 November 1827

Inform Mr Saml Thomson in answer to his letter of the 9th Instant that, on further consideration of the question and on a review of the correspondence respecting these Locks, it is found they were made at the expence of this Department (the pattern of the Hammer having been proposed by Mr James Thomson) & that, as they are marked with the Kings Marks, any Individual in whose possession they might be found would be liable to prosecution.

Under these circumstance therefore the Board have thought proper to cancell their order for the delivery of these Locks to his Brother But they will order the Hammers to be given up should be think proper to require them, or will direct payment to be made to him of the Sum of £5 which they consider to be a sufficient remuneration for his trouble—.

No response by either Samuel or James Thomson survives. This is perhaps fortunate; one suspects that it might well have been unprintable.

Acknowledgements

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Notes

1. The patent was granted by George III on the 9th of March 1814, the specification, with coloured drawings, was submitted on the 1st of July, and the patent was finally enrolled on the 11th of July, 1814.
2. Guildhall Library, MS 5220/24. p. 112.
3. Guildhall Library, MS 5220/24. p. 119.
4. Guildhall Library, MS 5220/24. p. 126.
5. PRO, Kew, W044/635, bundles 870 and 871.
6. H. L. Blackmore, *British Military Firearms 1650-1850*. London, 1961, pp. 247-8, and "Gardner's Musket 1811". *JAAS*. Vol. I, No. 3, September 1953, pp. 35-33.
7. Copies of letters out from the Commander in Chief are contained in WO3/210 (PRO, Kew) under the dates quoted.
8. For an account of this trial see H. L. Blackmore, op. cit., pp. 155-156.
9. For the original patent roll. (i.e. the Royal Letters Patent from George III), see PRO. Chancery Lane: C66/447.
10. Extensive searches have been made in the indexes in the PRO Chancery Lane, and of the legal Decrees and Orders relating to cases heard in the High Court of Chancery from mid 1813 to mid 1814. So far no case with James Thomson (regardless of spelling variations) as either the plaintiff or the defendant has been found.
11. The Minutes of the Board of Ordnance for this meeting may be found in W047/1395. p. 11. 610 (PRO. Kew).