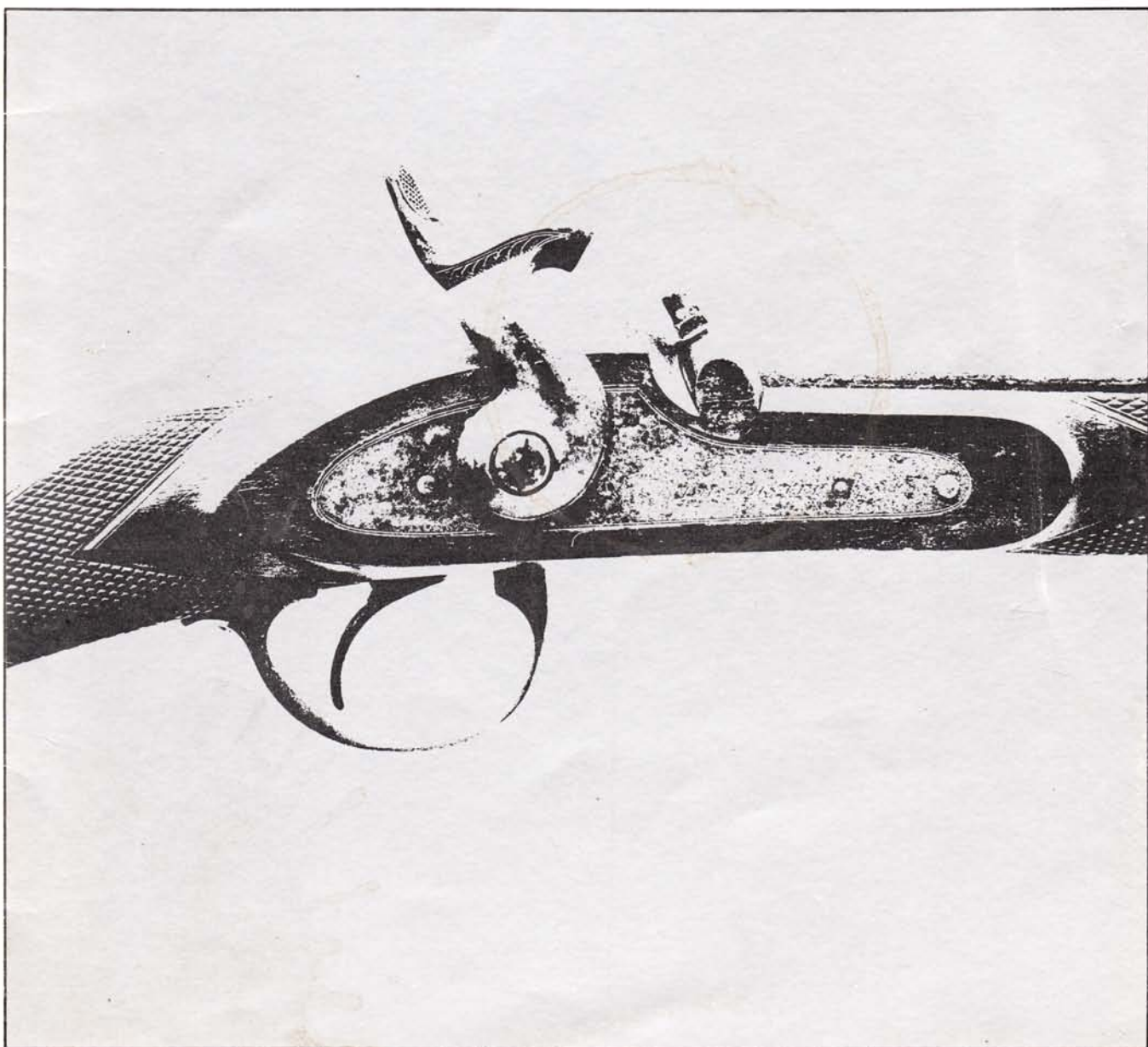


SMALL ARMS PROFILE

14

40p EARLY ENFIELD ARMS THE MUZZLE LOADERS



Glossary of terms



Automatic The common name for a self-loading or semi-automatic pistol. This has been used throughout the Profile Series to denote the above.

Backstrap (18) The part of the frame which forms the rear of the grip.

Barrel (2) The tube down which the bullet is guided.

Bent (13) Notch in hammer.

Breech Rear portion of barrel.

Chamber Part of the gun that receives the charge or cartridge.

Disconnecter (11) A device to prevent multiple shots being fired on a single pull of the trigger.

Ejector A part designed to assist the removal of the empty case.

Extractor (20) Same as ejector but more often applied to automatic weapons.

Firing Pin (19) The pin that detonates the cartridge priming.

Follower (16) Part of the magazine that guides the cartridges upwards.

Frame (6) See Receiver.

Hammer (3) A device to detonate the priming of the cartridge or actuate the firing pin.

Magazine (10) A container for cartridges used to feed a gun automatically.

Magazine Catch (8) The catch that holds the magazine in place in the gun.

Mainspring (12) The spring that actuates the hammer.

Muzzle The open end of the barrel.

Receiver (6) The main housing for the major components.

Recoil Spring (5) The spring that controls the movement of the slide or other moving components upon firing.

Recoil Spring Guide (4) A guide that prevents the recoil spring from becoming damaged.

Safety Catch (9) A device to prevent the gun being fired.

Sear (14) A lever that transmits movement from the trigger to the hammer.

Slide (1) The sliding breech block often containing the extractor and the firing pin, used to close the rear of the barrel.

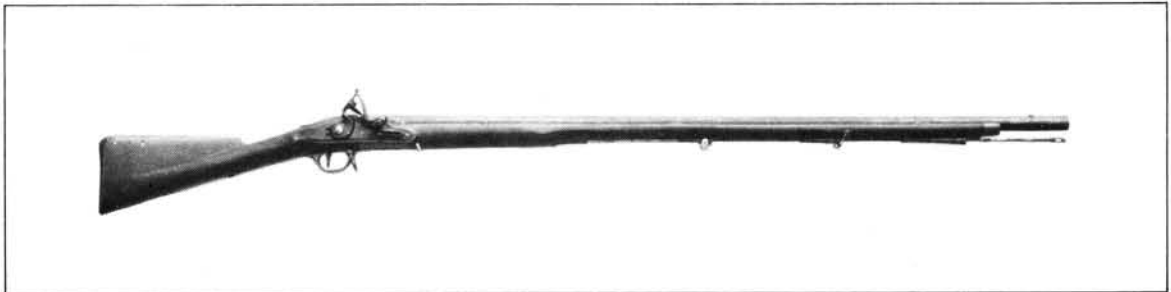
Stocks (Grips) (7) Wooden or plastic pieces used as a handle.

Trigger (15) A lever which is used to release the hammer mechanism.

Trigger Bar (17) A lever connecting the trigger to the sear.



Birthplace of Enfield Rifles—The Royal Small Arms Factory at Enfield Lock. Originally used for transport purposes, the canal in the foreground has since been filled in. *Below: Brown Bess*



Early Enfield Arms The Muzzle Loaders

by E. G. B. Reynolds

A small arms factory was established at Enfield Lock in Middlesex near the Essex border on the canalised part of the River Lea at the beginning of the 19th century, but about 20 years elapsed before it was considered sufficiently well equipped and staffed to deal with a sizeable order for complete military arms.

Known as the Royal Armoury Mills and with less than 50 workmen its early work was largely confined to the assembly of Brown Bess muskets, then the personal arm of the British soldier. When, largely due to water power and transport difficulties

the Lewisham Royal Manufactory was closed down, the work on which it was engaged was largely transferred to Enfield, which was much better placed in respect of water power and transport. This work included the manufacture and proof of barrels and other small arm parts.

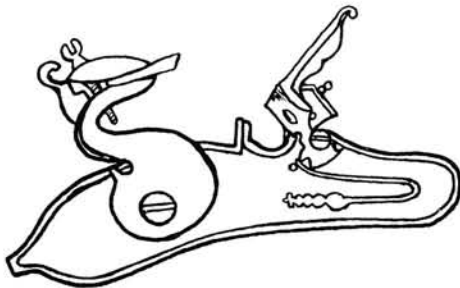
In 1816 a new Storekeeper—a post of considerable importance—was appointed who was destined to become one of the leading designers of military percussion firearms and who undoubtedly exercised much influence on the evolution of the Enfield factory and its products. This was George Lovell

who had started as a clerk at Woolwich Arsenal and soon became well versed in technical matters and the manufacture of arms. He later became Inspector of Small Arms, in which capacity he gave many years of valuable service to the furtherance of British military weapons.

The Baker Rifle

Named after its designer—Ezekiel Baker, a Whitechapel gunsmith—the Baker was the first rifled arm in the British Army and thus provided a challenge, though not a particularly successful one, to the smooth-bore musket. The Baker was a flint-lock weapon weighing about $9\frac{1}{2}$ lb and was 3ft $9\frac{3}{4}$ in in length. It fired a leaden ball one-twentieth of a pound in weight and was therefore known as a 20-bore arm. The barrel was 2ft 6in in length and had seven rifled grooves with a spiral of a quarter-turn in the length of the barrel, and it was sighted up to 200yd.

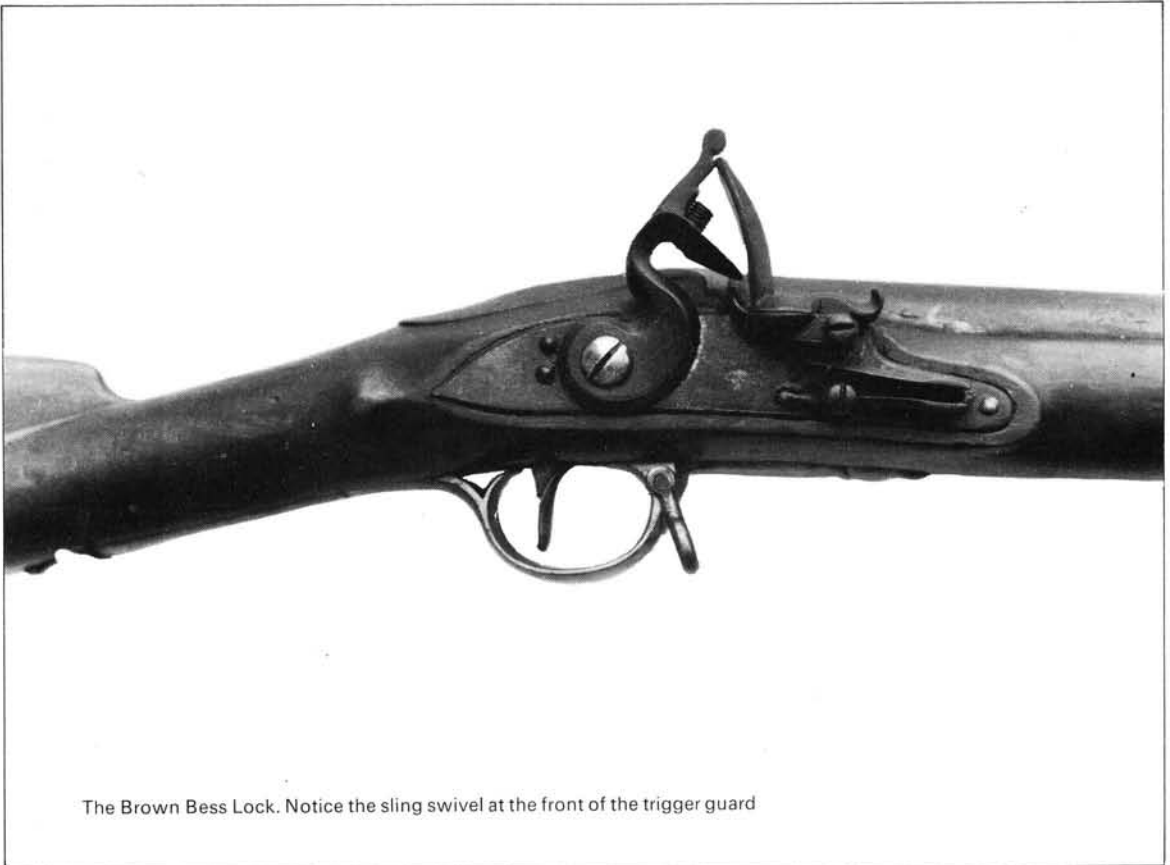
In 1823 an order was placed on Enfield for 5000 Baker Rifles, with which the 95th Regiment (later the Rifle Brigade) had been armed for over 20 years. During its period of service with British Rifle and Colonial Regiments the Baker underwent many changes. Though more accurate than its predecessors, like all muzzle-loading rifled arms it was difficult to load. A small wooden mallet was supplied with each rifle to assist in making the lead ball enter the muzzle but was only issued for a short time as undue force soon distorted the leaden balls. Numerous methods were devised to overcome the loading problem but none proved really successful. The Baker was the last of the British military flint-locks as the percussion system now changed the whole pattern of military firearms.



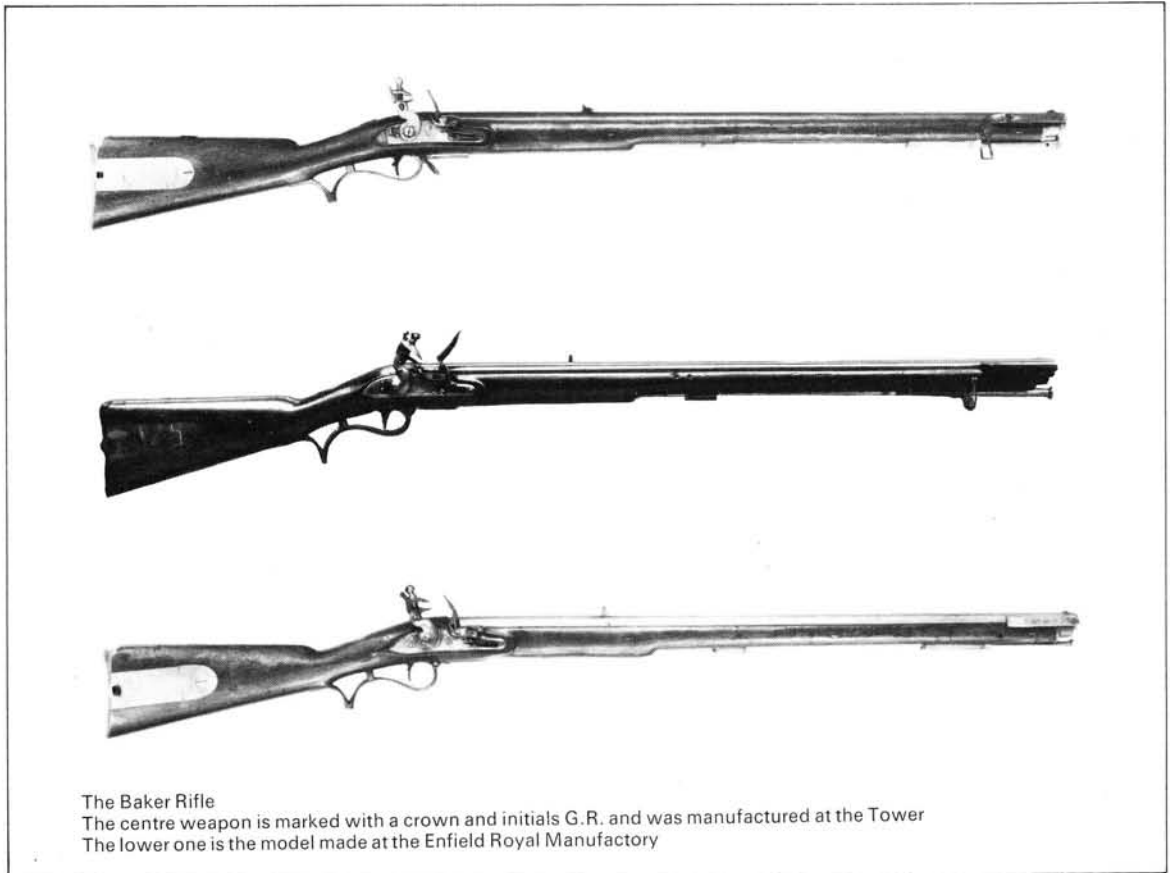
Many flint locks for the Brown Bess musket were made at the Tower of London and the Ordnance Board's Royal Manufactory at Lewisham. Later they were made and assembled at Enfield Lock. This was one of the first jobs entrusted to the factory which many years later produced the famous Lee-Enfield Rifle and became the centre for British military small-arms manufacture



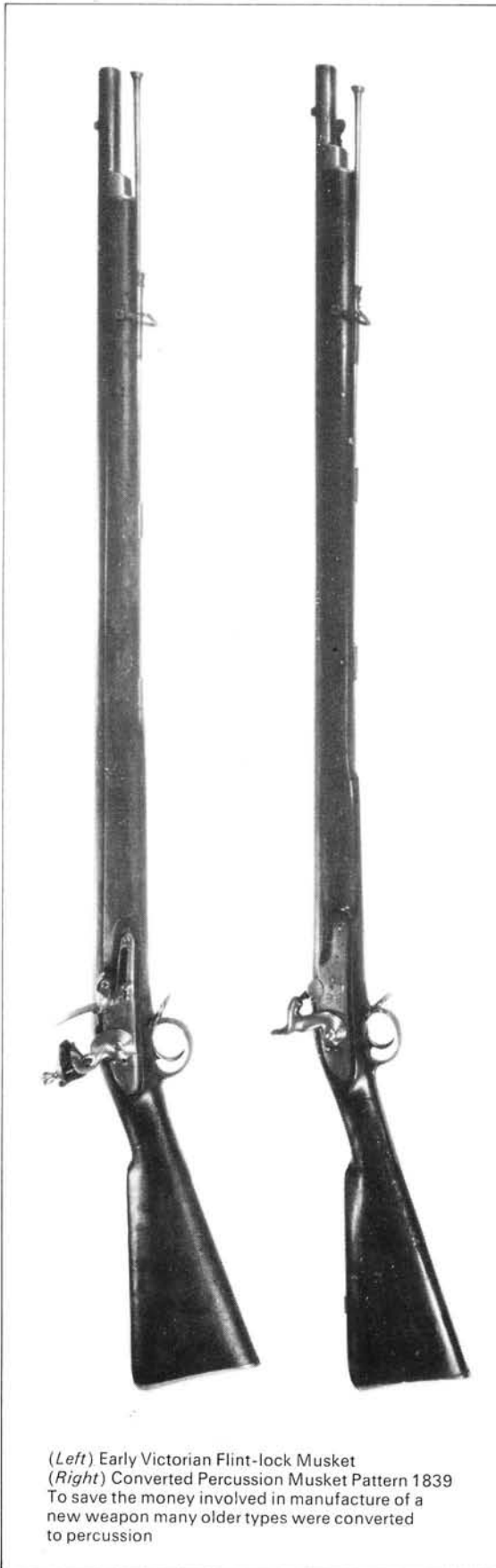
Brown Bess, Smooth bore musket



The Brown Bess Lock. Notice the sling swivel at the front of the trigger guard



The Baker Rifle
The centre weapon is marked with a crown and initials G.R. and was manufactured at the Tower
The lower one is the model made at the Enfield Royal Manufactory



(Left) Early Victorian Flint-lock Musket
 (Right) Converted Percussion Musket Pattern 1839
 To save the money involved in manufacture of a new weapon many older types were converted to percussion

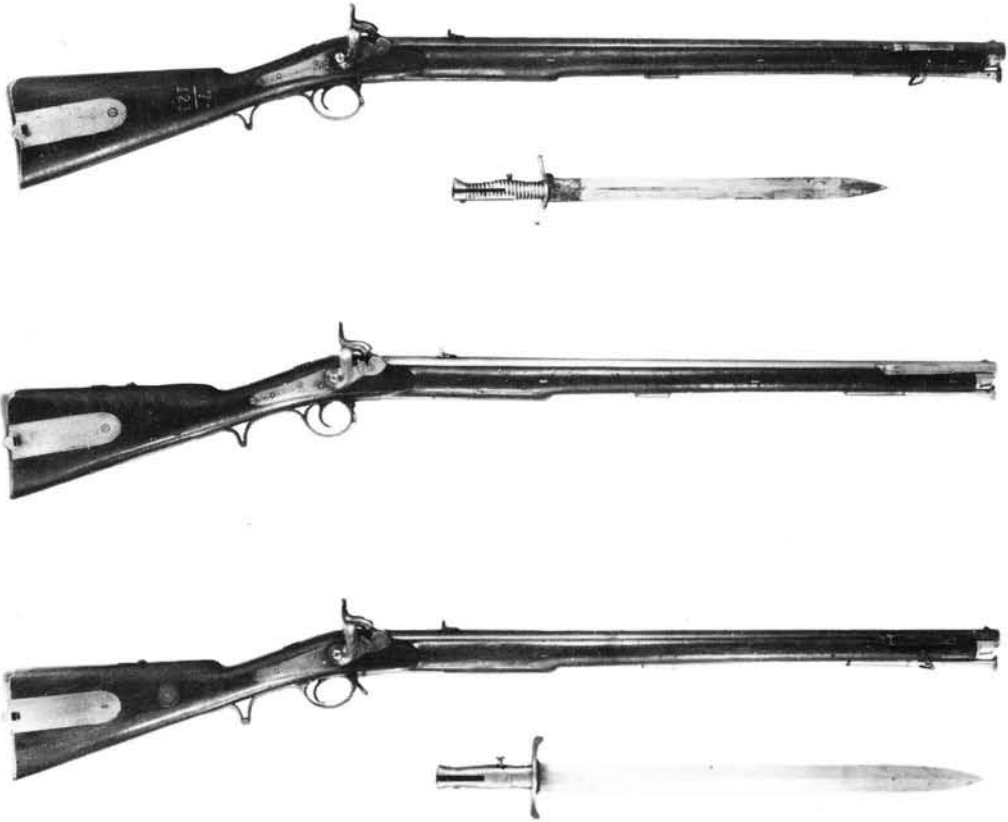
Percussion System supersedes the Flint Lock

The flint lock, invented about 1635, continued in use in the British army until superseded by the percussion system as perfected by the Rev Alexander Forsyth, a Scottish Minister well versed in chemistry and mechanics. One of his hobbies was wildfowling and it is recorded that his experiences with his flint-lock fowling-piece—birds being frightened off by the flash of the priming ignition before the shot took effect—led to his experiments which resulted in the percussion system which he patented in 1807. Like most innovations in the history of military firearms it met with considerable opposition and the principle was not accepted until some 30 years later.

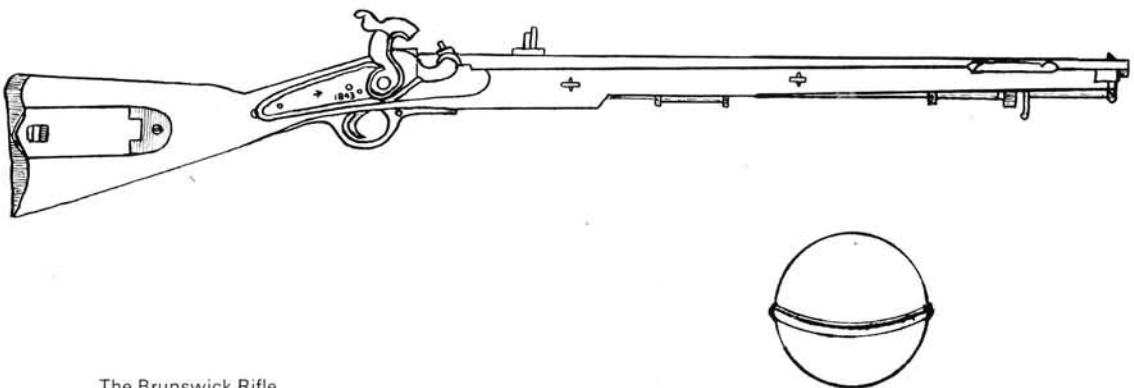
In 1831 a number of muskets were converted to the percussion system and three years later were pitted in trials against flint-lock muskets. They were found to be more accurate, gave less recoil and a higher rate of fire, and some 30,000 muskets were eventually converted. This was effected by removing the hammer with the spring and pan, and replacing the cock by a percussion hammer. The nipple was a small pillar screwed into the side of the barrel to hold the detonating cap. Meanwhile new percussion muskets were under development, in which George Lovell at Enfield played a leading part.

The Brunswick

When it was decided to arm a second battalion of the Rifle Brigade—raised in 1805—with an improved weapon, after trials extending over several weeks at Woolwich the choice fell on the Brunswick Rifle, which was officially approved the following year. It embodied the percussion system of ignition, and its weight with sword and scabbard being 11lb 5½oz. The barrel was 2ft 6in long and was rifled with two deep rounded grooves with a spiral of one turn in 30in. The bore was .704in not a great deal smaller than that of the old 'Brown Bess' and it fired a spherical lead ball with a raised belt projecting around it which fitted the two grooves in the barrel. To assist in this fitting a notch was cut across the muzzle to guide the belt into the grooves. Like the Baker, loading and accumulation of fouling frequently presented a problem, and there was often considerable delay in accurately placing the belted ball in the rifling and ramming it down the bore. An advantage claimed for the two-grooved rifling was that the more rapid degree of twist—four times greater than the Baker—could be given to the bullet without it stripping. In 1841, under Lovell's guidance, it was changed to a side-lock action and four years later about 2000 were made at Enfield. Although the Brunswick apparently made a good impression when it was adopted and was reasonably accurate up to about 300yd, 15 years later a Select Committee on Small Arms reported: 'The Brunswick rifle has shown itself to be much inferior in point of range to every other arm hitherto noticed. The loading of this rifle is so difficult that it is a wonder how the rifle regiments have continued to use it so long, the force required to ram down the ball being so great as to render any man's hand unsteady for accurate shooting.'



The Brunswick Rifle. A number of each of these models were made at Enfield ; all have back-action locks.
 (Top) Model 1836 embodying eleven-grooved rifling.
 (Centre) Another of Lovell's models' with two-grooved rifling.
 (Lower) Sealed pattern of January 1837.



The Brunswick Rifle.
 (and it's belted bullet)

During the Brunswick's limited service in the English army numerous attempts were made to overcome the loading and fouling problems but without a great deal of success, and it was eventually largely superseded by the English Minie which fired an expanding bullet.

The Percussion Musket 1842

Besides the conversions to the percussion system already referred to, a considerable amount of experimentation took place with new muskets and carbines, largely under the direction of George Lovell.

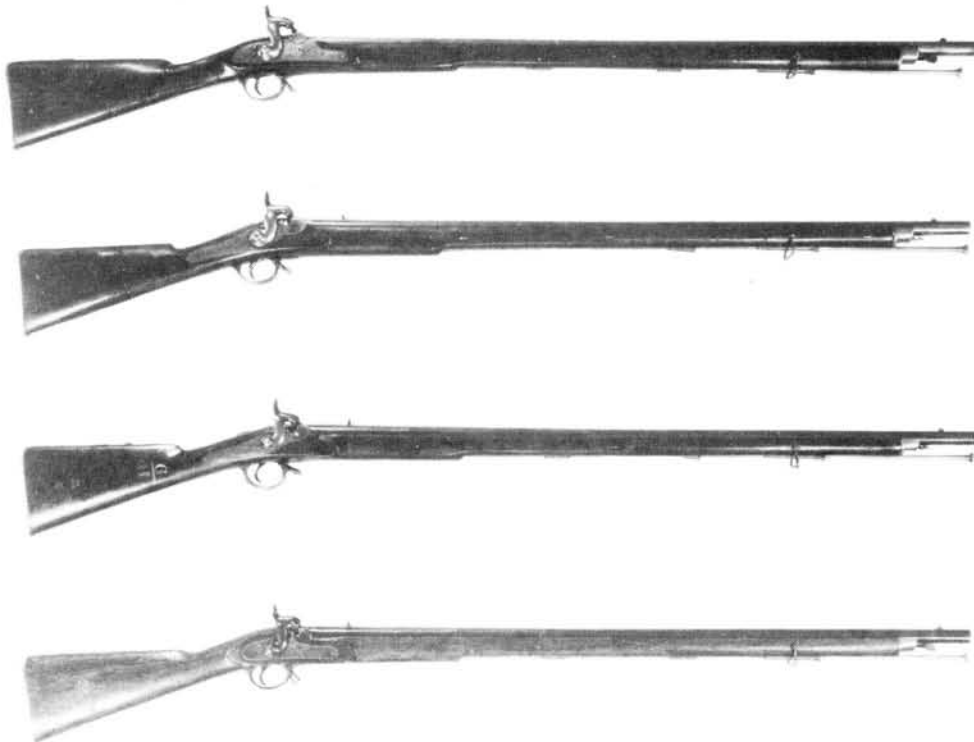
In 1841 a new musket was approved and ultimately went into production as 'The Percussion Musket 1842'. It weighed 9lb 14oz, was 4ft 6 $\frac{1}{2}$ in in length and had a bore diameter of .753in. It was a smooth-bore weapon and was sighted up to 150yd. The barrel was 3ft 3in in length, 9in longer than that of the Baker and Brunswick. A shorter pattern for Sea Service had a barrel 2ft 6in in length. They continued in use in the English army until partially superseded by the Minie in 1851 and by the Enfield rifle four years later.

It was considered an advantage to have a bore larger than that of certain Continental armies because,



(Top) Brunswick Sea Service

(Bottom) Brunswick Rifle Corps. (Birmingham Museum and Art Gallery)



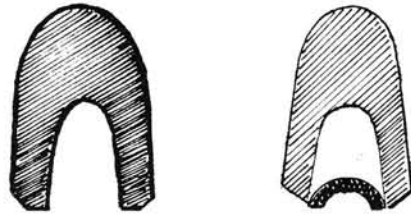
Some of the last of the Smooth-bore Percussion Muskets. The top three are Lovell's Pattern 1838 with back action lock ; the lower one is his Pattern 1843 with side lock action

whereas captured ammunition could be fired from English muskets, English leaden balls could not be fired out of theirs.

A large number of these percussion muskets were eventually converted into rifles and were issued to the Royal Marines and the Royal Navy and became known as 'Sea service rifles'. The bore diameter was .731 in and they fired an expanding bullet of the Minie pattern.

The English Minie

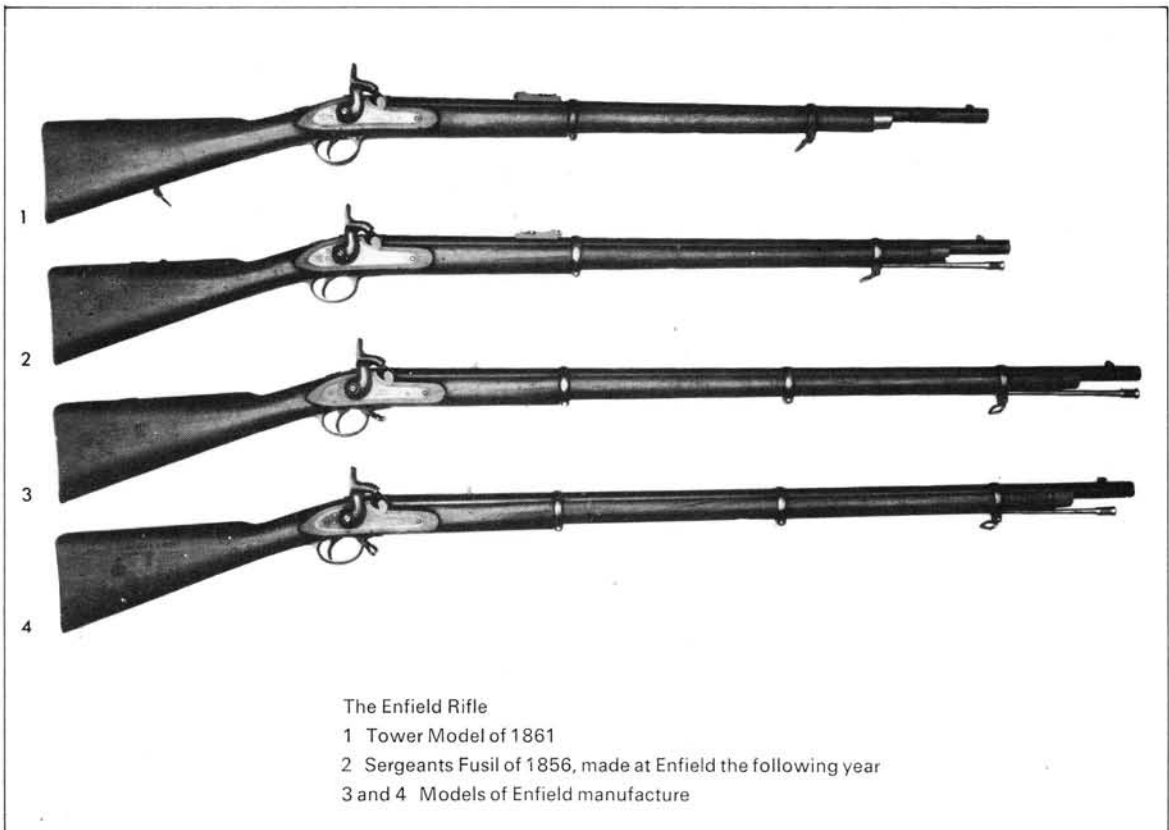
In 1847, after a great deal of experimental work had been carried out in trying to develop a really satisfactory bullet for the rifled arm, a French officer named Capt Minie introduced a hollow-based pointed bullet with an iron cup in the base. This gave greater expansion and consequently much better engagement with the rifling. The rifled musket in which this bullet was used became known as the Minie rifle and was adopted for the Imperial Guard and other troops of the line in the French army. The apparent success of this new arm led to a rifled musket of the Minie pattern being introduced into the English army in 1851. As improved by Lovell at Enfield it weighed 10lb 8 $\frac{3}{4}$ oz and had a bore diameter of .702 in. The barrel was 3ft 3in in length and embodied four-grooved rifling with a spiral of one turn in 78in. It was the first English military rifle to be sighted up to 1000yd, a somewhat optimistic view having obviously been taken of its long range capabilities. It was a rather clumsy weapon and, due largely to the development of a new rifled musket, its life in the English army was limited.



Left The first bullet used in the English Minie rifle was conoidal in form and, with little chance of the axis of the bullet coinciding with that of barrel when fired, it was soon changed to one of cylindro-conoidal form

Right with an iron cup in the base. The base and cylindrical parts of the bullets were covered by paper lubricated with five parts of tallow and one part of beeswax.

The difficulties in loading the rifled musket due to fouling appear to have been largely overcome in the Minie because the bullets expanded sufficiently well into the rifling to remove the fouling left by the previous shot. The bullet first used with the English Minie was conoidal in shape. This proved unsatisfactory as the axis of the bullet seldom coincided with the axis of the bore during its passage up the barrel. It was therefore changed to one of cylindro-conoidal shape with an iron cup in the base of nearly hemispherical form.



Advance of Enfield

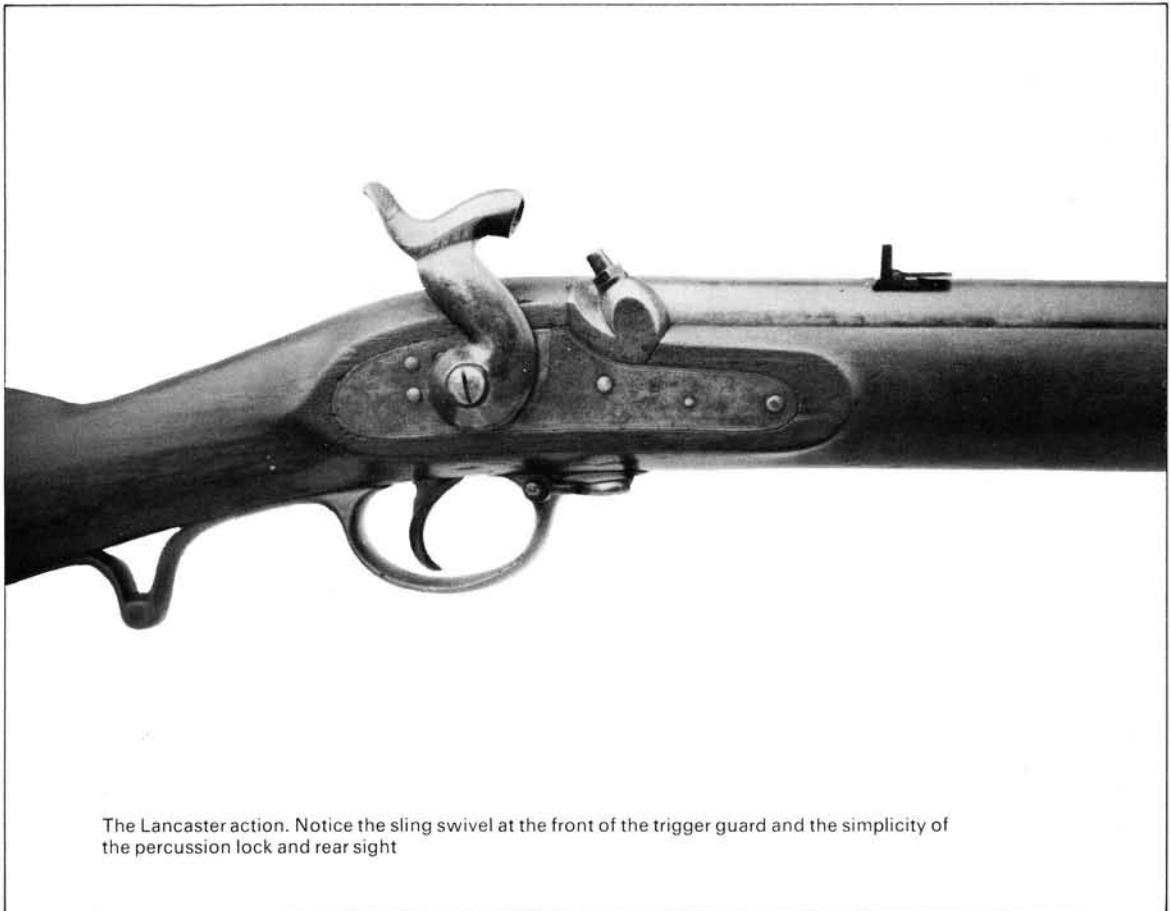
When in 1841 a disastrous fire destroyed the Grand Storehouse at the Tower of London with some 280,000 arms including many new percussion muskets, the Enfield factory increased in stature. Manufacture of Government small arms became more concentrated on Enfield which was becoming better equipped and producing work of a higher standard, particularly in the manufacture of rifle barrels. In the early 1850s there was much dissatisfaction in Government circles regarding the supply of small arms to the armed forces and the failure of private manufacturers to fulfil their contracts. Weapons made in this country were considered to be much inferior to those made in America and serious trouble was caused by exorbitant demands from contractors and workmen. In 1854 a Select Committee was set up in the House of Commons to consider 'the cheapest, most expeditious, and most efficient mode of providing small arms for Her Majesty's Service'. The outcome of all this was the establishment of Enfield as the home of British military small arms and a considerable amount of machinery was purchased in the United States and installed in the factory. By 1860, 1700 men were employed at Enfield and nearly 2000 rifles were being made each week. It seems likely that the needs of the Crimean campaign also had some influence on the modernisation of Enfield.

The Enfield Rifle, and the Pritchett Bullet

Early in 1852, by order of the Master-General of Ordnance, Lord Hardinge, experiments were carried out at Enfield with the object of finding the best military fire-arm, combining lightness with general efficiency. Some of the leading gunmakers submitted their weapons for trial, against two rifled muskets made at Enfield which embodied improvements suggested by experience. Those which were considered the most successful to compete against the Enfield were rifles made by Lancaster, Wilkinson and Purdy.

The Lancaster, which later became the arm of the Corps of Sappers and Miners (Royal Engineers) was rifled on the oval bore principle of two grooves rounded off into the line of the bore and with an increasing spiral. The Purdy, a four-grooved rifle also had an increasing spiral and the Wilkinson barrel had five-grooves with a regular spiral of one turn in 6ft 6in.

In 1855, what became known as the 'Enfield three-grooved Rifle' or 'Rifle, musket pattern 1853'—the first English service arm to bear the name Enfield—performed very favourably in further trials against the Lancaster and the Minie and, after a few small improvements had been effected, was introduced into the English army and saw early active service in the Crimean campaign, replacing the Minie and the rifled musket in several regiments. Its performance was noteworthy and a prominent



The Lancaster action. Notice the sling swivel at the front of the trigger guard and the simplicity of the percussion lock and rear sight

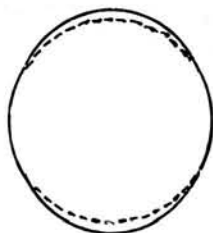
writer of the day expressed the view that : 'The Enfield Rifle turned the tide of war in our favour at Inkerman.'

The early rifles were fitted with barrels grooved to a uniform depth but a form of progressive rifling was embodied in 1858. Details of this rifle were :

Weight, with bayonet	9 lb 3oz
Weight of barrel	4lb 1½oz
Length of rifle	4ft 7in
Length of barrel	3ft 3in
Rifling	
Bore diameter	·577in
No of grooves	3
Depth of grooves at breech	·015in
Depth of grooves at muzzle	·005in
Width of lands (equi-distant)	·262in
Twist of rifling (spiral)	right-hand, one turn in 78in

The barrel was secured to the stock by three steel bands fastened by screws and a breech nail. The backsight was of Westley-Richards pattern with a hinged leaf which could be folded either backward or forward.

In his book 'The Rifle', published by J. B. Nicholls and Sons in 1864, Arthur Walker (79th Highlanders and Hythe and Fleetwood School of Musketry) states : 'By means of a beautiful system of machinery a thousand complete rifles are turned out each week



The oval bored Lancaster rifling. The difference between the major and minor axes was ·012". It had an increasing twist from breech to muzzle

with a degree of accuracy and finish such as the hand of the most skilful mechanic could never impart. All the various parts of the lock stock and barrel are made with such a nice degree of accuracy, with reference to each other and the standard pattern employed, that a rifle and bayonet, and every other part complete, may be put together in five minutes from a heap of the same kind.' This was indeed a high tribute to the Enfield factory and marked a great advance in arms manufacturing technique ; such interchangeability was certainly not obtained in war-time manufactured rifles nearly a hundred years later.



The oval bore Lancaster Rifle. For a time it was a serious rival to the more famous Enfield. During 1853 4 it competed with the Enfield and other rifles at Hythe and was found to exceed all others in accuracy and ease of loading. Its eventual rejection was largely due to a tendency to strip the bullets.



Left side of Enfield Percussion
Musket dated 1855 and marked 'Tower'



The lock of the Brown Bess



Right side of Enfield Percussion Musket



The lock of the Enfield Percussion Musket



Bayonet and ramrod of the Enfield Musket





(a)



(b)

Due principally to large manufacturing tolerances and consequent inability to maintain close relationship of barrel bore and bullet, the first Pritchett bullet (a) was not a great success in the Enfield Rifle. The bullet's form was altered and the cavity in the base enlarged to house a Minie type iron cup. Further experiments took place in 1855 resulting in the replacement of the iron cup by a boxwood plug (b). This bullet was adopted



.577" Cavalry Carbine of 1856 made for the Royal Irish Constabulary

Amongst the advantages claimed for the Enfield over its predecessors was a saving in weight each soldier had to carry and probably most important of all it was capable of being manufactured quickly in large quantities. This was of vital importance for the Crimean campaign, which commenced about the same time as the rifle went into full production. A year before the rifle experiments began at Enfield, a Small Arms Committee was formed with the object of procuring an improved form of bullet. Various forms of cavities and plugs in the base of bullets had been tried with varying degrees of success and a bullet designed by Mr Pritchett of St James Street, London, came nearest to fulfilling the requirement. It was cylindro-conoidal in shape, weighed 530 grains and had a small cavity in the base. Later a boxwood plug was inserted in the base to improve expansion and the bullet was adopted in 1855. Providing the bullet and bore diameters were closely maintained in manufacture, the bullet performed well in the new Enfield Rifle. For his design Mr Pritchett was awarded £1000 by the British Government.

In 1858 a shorter rifle, with the same bore diameter but having five progressive grooves with a spiral of one turn in 4ft was made at Enfield for the Royal Navy and was also issued to rifle regiments and sergeants of infantry of the line. It was considered to be more accurate than previous patterns of the Enfield rifle. Carbines on the same principle were made for the cavalry, artillery, and Corps of Sappers and Miners.



Artillery Muzzle-loading Percussion Carbine 1858. .577 calibre, it had Enfield 3-grooved rifling



.577" Muzzle-loading Percussion Carbines, made for the Corps of Sappers and Miners (Royal Engineers). They were similar to those made for the Artillery.



.577 Muzzle-loading Percussion Carbine issued to the Artillery in 1858. It embodied the Enfield 3-grooved barrel



Muzzle-loading Enfield Rifle of 1858
Notice the rear sight in its upright position



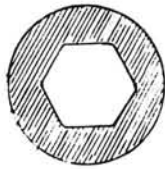
Muzzle-loading Percussion Carbine 1858. This
was a weapon made at Enfield for the Royal
Artillery. The barrel (.577in) was a shortened
version of that of the Enfield Rifle



Muzzle-loading Enfield Rifle of 1858 equipped
with sling.



1860 Military Pattern
Whitworth Rifles made at
Enfield
Notice the different
placing of the rear sling
swivel



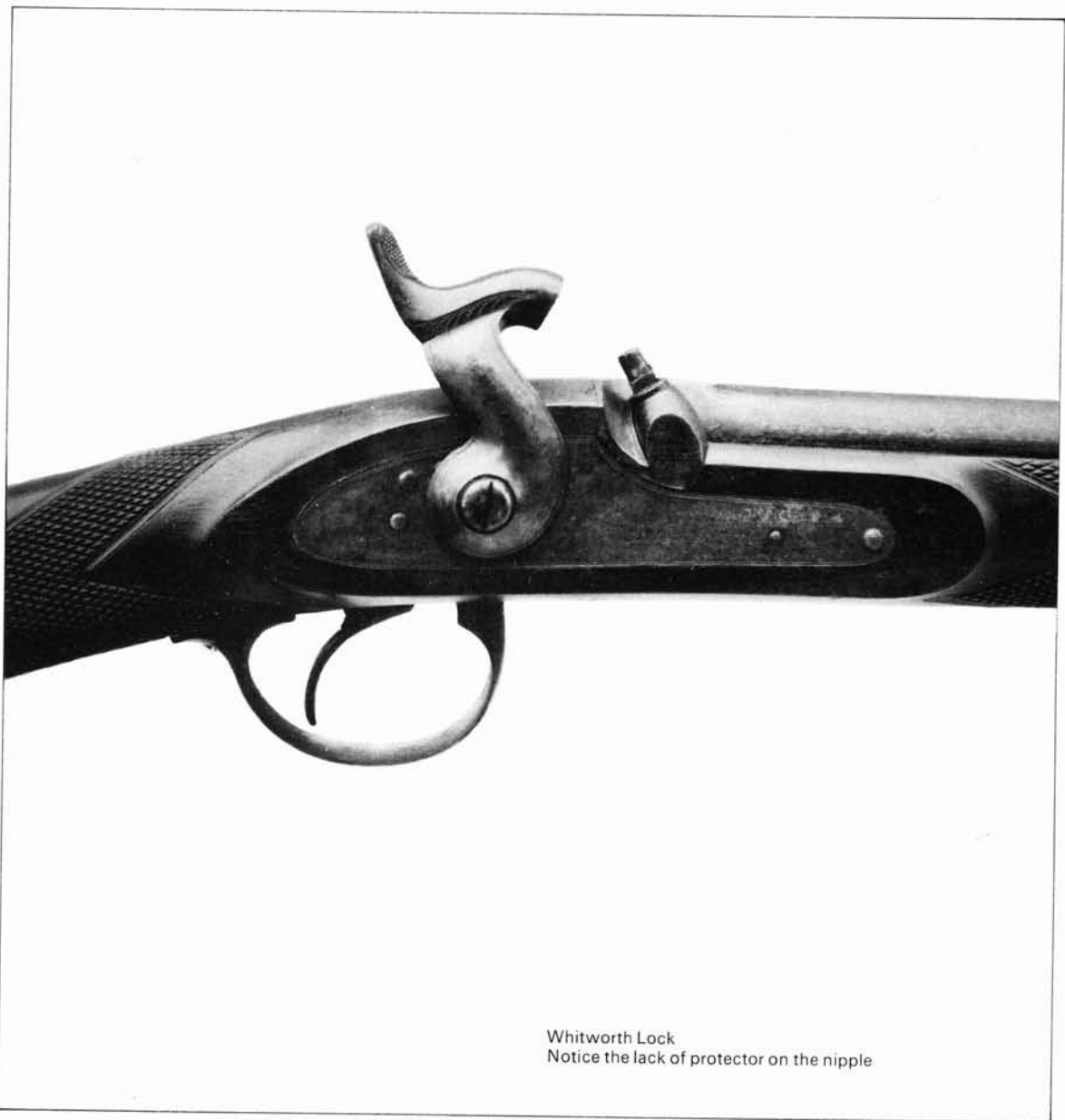
The Whitworth bullet and rifling marked a great improvement in accuracy. Of smaller calibre than the Enfield bullet but similar in weight it was about a $\frac{1}{2}$ -inch longer and made of harder metal. The Whitworth bullet was shaped to exactly fit the rifling



The Whitworth Lock. Notice the nipple protector



The Whitworth Rifle



Whitworth Lock
Notice the lack of protector on the nipple

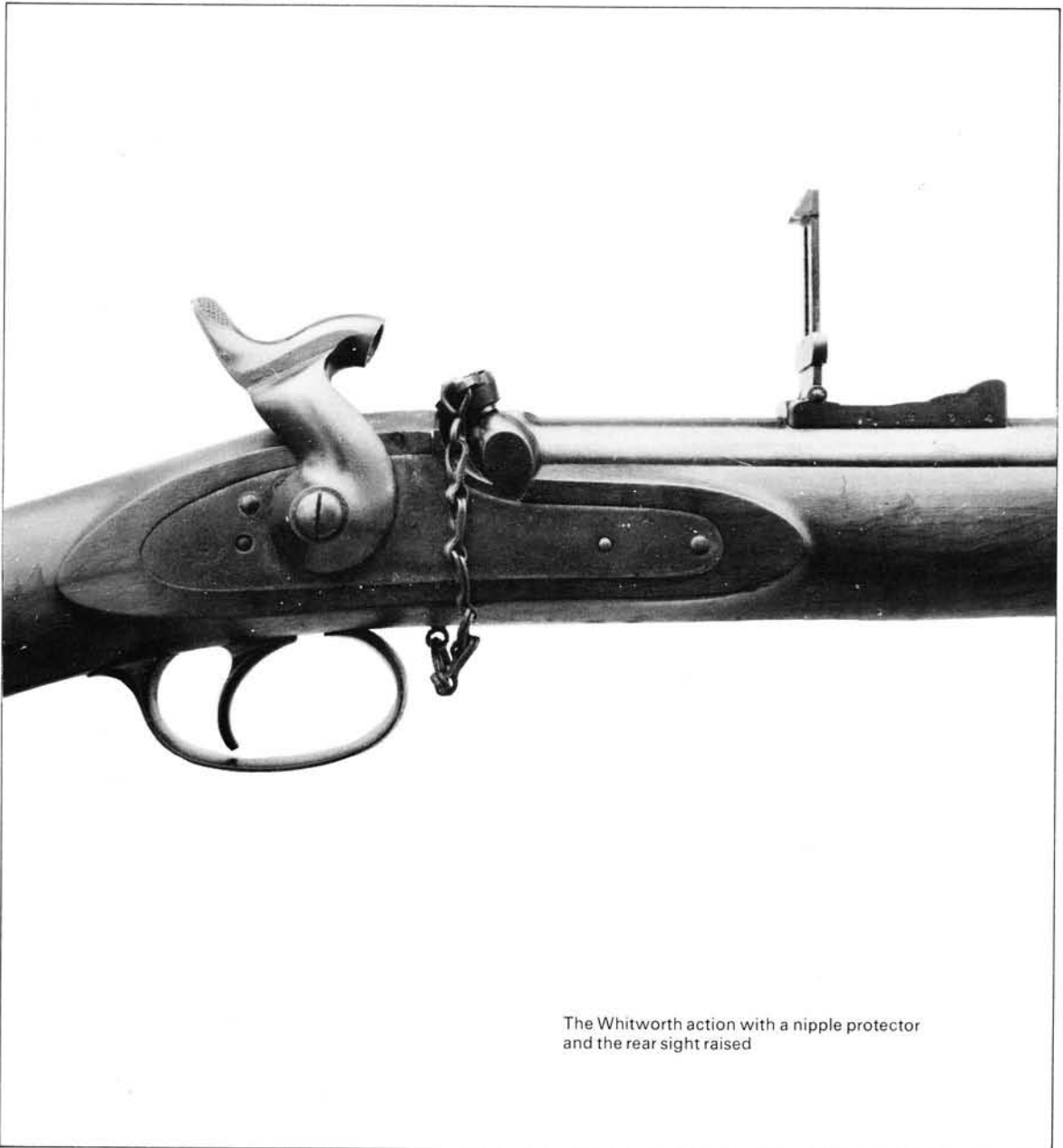
The Whitworth Rifle

The trend in rifling had been towards deep grooving and this was encouraged by the tendency for the lead bullets to drive across the lands when being forced into the rifling. And largely owing to the lack of accurate measuring instruments, variations in the bore size of individual weapons mitigated against consistent shooting. It was largely Sir Joseph Whitworth's experiments that led to a general appreciation of the importance of extreme accuracy in measurements in the manufacture of small arms, and in 1854 he was approached by Lord Hardinge—now the Commander-in-Chief of the British Army—to apply his considerable experience to the subject of rifling. After many experiments he produced a rifle with a particularly novel form of rifling. Its form was hexagonal and, although it was considered that a cylindrical bullet would give satisfactory shooting

from it, it was decided to use a bullet of the same shape as the rifling, which had a spiral of one turn in 20in. The bore was $\cdot450$ in but the bullet was the same weight—530 grains—as that used in the $\cdot577$ in Enfield. This gave a projectile far more efficient ballistically than its predecessors and the accuracy obtained with the Whitworth was a great advance on that of the Enfield, particularly at long distances. In fact the Whitworth was considered to be superior to all other rifles of similar calibre. In 1860, when the newly formed National Rifle Association held its first Imperial Prize Meeting at Wimbledon largely to encourage the Volunteer movement, the Whitworth Rifle was chosen for the long range shooting for HM The Queen's Prize as the Enfield, with which the Volunteers were armed, was not considered sufficiently accurate for target shooting beyond 600yd.



Whitworth Rifle
At the left a Macht Rifle of 1862
(Birmingham Museum and Art Gallery)



The Whitworth action with a nipple protector and the rear sight raised

The Whitworth dominated the long range prize lists at Wimbledon for several years. At one time it looked as though it might replace the Enfield in the armed forces but, largely owing to breech-loading developments, the Enfield survived to the end of the muzzle-loading era. In fact it took on a new lease of life when, following the lead of the Prussian and other Continental armies, its conversion to breech loading as a temporary expedient became a matter of considerable urgency.

The next important development which not only led to the Whitworth being outclassed for accuracy but was destined to play a leading role in the future of British service rifles, stemmed from the work of William Ellis Metford, a civil engineer of considerable repute.

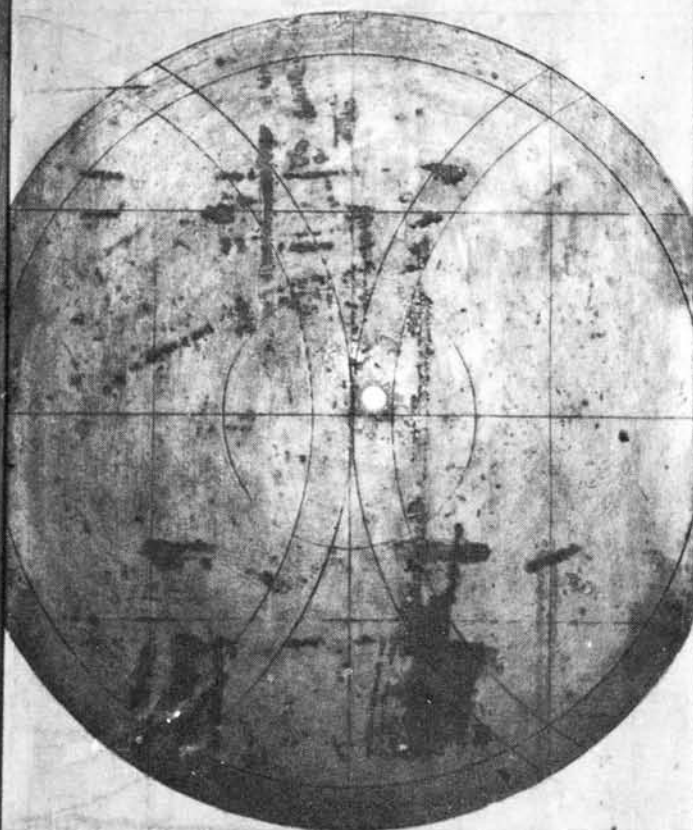
Metford's numerous interests included all matters

connected with the rifle and rifle shooting and, in the 1850s, he carried out many important experiments with bullets made of alloys of lead and tin to find whether flat-based bullets of this nature would 'rifle up' in a satisfactory manner. Eventually he came to the conclusion that flat-based hardened bullets would do this in shallow grooved rifling. Thus the whole pattern of rifling was changed and the use of mechanically fitting soft lead bullets with deep grooving, as in the Whitworth and certain other arms, eventually disappeared. With bullets hardened with tin and antimony and rifle barrels with shallow grooving and made to an exactitude formerly unknown, results were achieved in this country and America which had never previously been equalled.

QUEEN'S TARGET.

The First Shot fired on Wimbledon Common
at the Opening Meeting of the National
Rifle Association, 2nd July, 1860.

Fired by Her Majesty Queen Victoria at 400
yards with a Whitworth Rifle fixed on a rest.



Evidence of the great advance in accuracy shown by the Whitworth Rifle was provided at the National Rifle Association's first Prize Meeting at Wimbledon, and in the next few Meetings until it was superseded by the breech-loading Martini-Henry. Firing the first shot at this memorable Meeting in July, 1860 from a Whitworth Rifle carefully 'laid' in a Whitworth mechanical rest, Her Majesty Queen Victoria hit within $1\frac{1}{2}$ inches from the centre of the iron target at a distance of 400 yards. The impact of the shot is clearly visible on the target which is now in the main office of the NRA at Bisley Camp

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Small Arms Editor: A. J. R. Cormack