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FIREARMS

AN ILLUSTRATED HISTORY

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LONDON, NEW YORK, MELBOURNE, MUNICH, AND DELHI

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First American Edition, 2014
Published in the United States by
DK Publishing
4th floor, 345 Hudson Street, New York, New York 10014

14 15 16 17 18 10 9 8 7 6 5 4 3 2 1
001—187518—04/14

Published in Great Britain by Dorling Kindersley Limited.

A catalog record for this book is available from the Library of Congress.
ISBN: 978-1-4654-1605-6

Printed and bound in China by Leo Paper Products

Includes material previously published in *Gun*, *Weapon*, and *Military History*.

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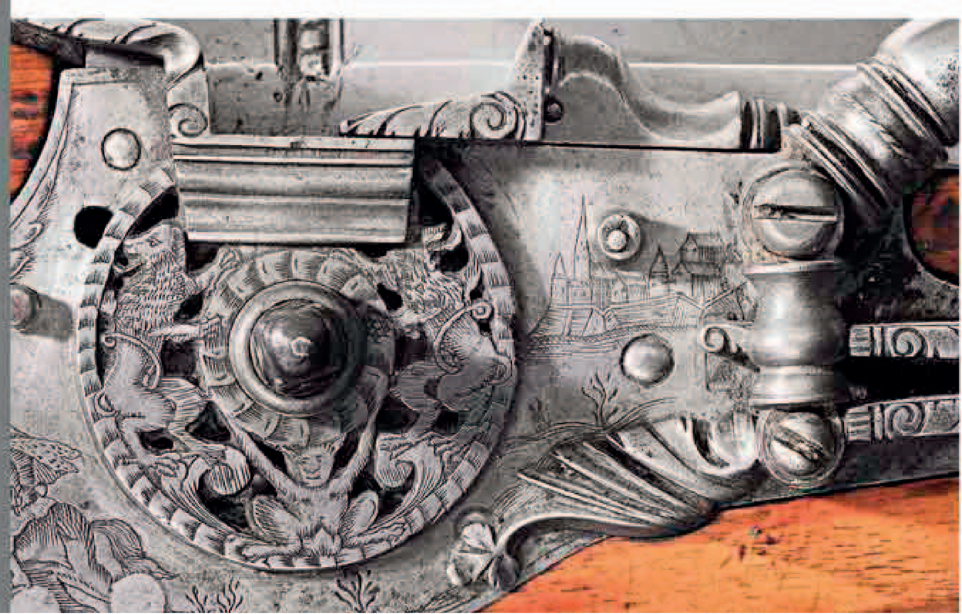

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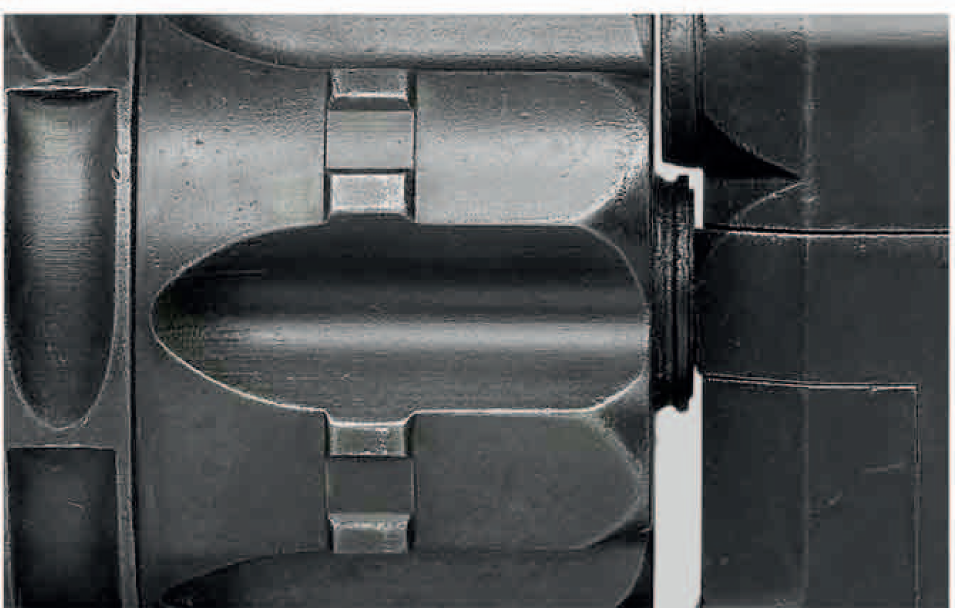


INTRODUCTION

THROUGHOUT THEIR HISTORY, firearms have had a profound effect on human activity. Created to wage war, guns soon provided a means for hunting and defending life and property. They also helped sustain traditions of target shooting that began with bows and arrows.

The first firearms appeared in China in the Middle Ages. At the time, gunpowder was already being used to create explosives. The Chinese discovered that by putting some of this powder, and a projectile, into a metal tube, and then igniting the powder, they could propel the projectile with enormous force. So, as far as we can tell, the first guns were born. While the earliest guns were artillery pieces, portable handguns were not far behind. Personal arms would never be the same again.

For several centuries, guns remained simple metal tubes, loaded at the muzzle and firing spherical balls of lead or stone, propelled by burning gunpowder. At first, they were fired manually by smoldering match-cord, but later, mechanical devices called locks ignited the powder, freeing the hands to concentrate on aiming. Matchlocks, and then wheel-locks and flintlocks, made guns quicker and simpler to fire.

The 19th century saw the greatest advances in the development and manufacture of firearms in their entire history. Muskets developed into rifles, smoothbore artillery evolved into rifled weapons, gunpowder was replaced by smokeless powder, and muzzle-loading gave way to breech-loading. Fulminates—compounds that exploded when struck—were discovered, and for the first time, guns would fire reliably even in the rain. Fulminates would eventually be incorporated into self-contained metal cartridges, loadable in an instant from magazines.

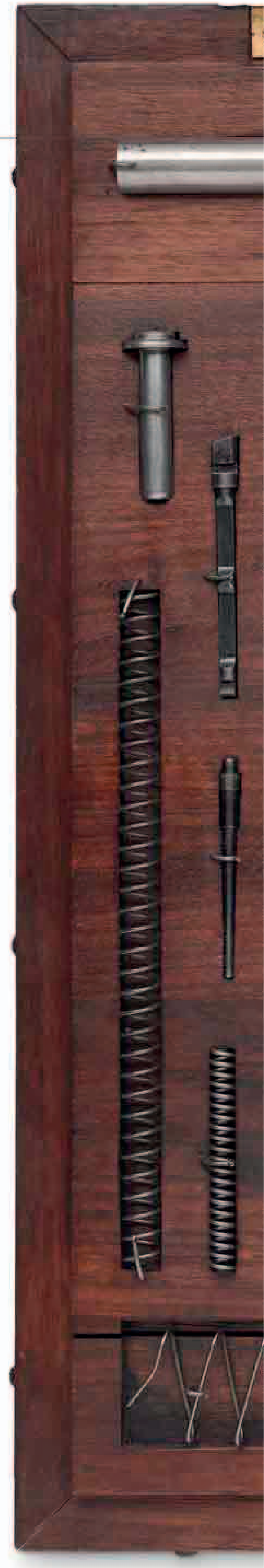
Arms manufacturers such as Samuel Colt pioneered technologies for mass-producing guns with precision-made interchangeable parts, creating a blueprint for how firearms would come to be manufactured. The turn of the 20th century saw the almost universal adoption of repeaters, self-loading pistols, and machine-guns. With evolving firearms technology, military tactics also changed forever.

Firearms development has consistently pushed the limits of available manufacturing technology and spurred the creation of new materials. Modern manufacturers utilize materials such as plastics and pressed steel to build guns using computer-controlled production processes.

Today's designs still owe much to earlier periods. Many modern revolvers, pistols, and rifles are rooted in the genius of their 19th-century designers. This book provides a fascinating visual survey of firearms, from their earliest forms until the present day. It celebrates the inspiration of great firearms designers and also the traditional craftsmanship that is still vital for the creation of fine sporting guns.

GRAEME RIMER

CONSULTANT



COLT MODEL 1911 (TOOLROOM MODEL, DISASSEMBLED VIEW)

GERMAN WHEEL-LOCK RIFLE

BEFORE THE FLINTLOCK

UP TO 1650

A gunlock, or firing mechanism, ignites propellant—gunpowder—to fire a projectile down the barrel of a gun. At first, firearms had no special mechanism for igniting the charge, just a smoldering hemp-cord to light the gunpowder. Then the development of gunlocks such as the matchlock and wheel-lock—and ultimately the flintlock—mechanisms made guns quicker and easier to fire.

EARLY CANNON

The gun was first developed in medieval China. With the invention of gunpowder, blacksmiths there attempted to create a tube strong enough to contain its explosions. In the early 14th century, craftsmen in China, and then in Europe, made cannon by casting them in bronze. Shortly afterward, blacksmiths began to build cannon by assembling them from strips of wrought iron. The strips, or staves, ran lengthwise, and heated iron bands were placed around them. On cooling, the bands shrank, binding the strips tightly to form the bore of the cannon, a little like wooden staves form a wooden barrel. Early cannon were mostly loaded at the muzzle, with gunpowder and balls carved from stone. A vent in the barrel of the cannon allowed the gunpowder to be ignited, usually with a smoldering match-cord.

▲ FLEMISH BOMBARD

Date	Early 15th century
Origin	Flanders
Length	Not known
Caliber	Not known

In the 1400s, large siege guns were known as bombards. The stone balls they hurled were loaded through the muzzle after the gunpowder charge. Flanders, where this bombard was made, had a strong tradition of gunmaking, particularly during the reign of Charles the Bold (1433–77).

▶ BOXTED BOMBARD

Date	c.1450
Origin	England
Length	7¾ft (2.4m)
Caliber	13in (230mm)

As with most types of early gun, bombards had a narrow powder chamber and a wider bore. This helped to concentrate the force of the exploding gunpowder and to focus it behind the center of the ball.

▲ **GREAT TURKISH BOMBARD**

Date	1464
Origin	Turkey
Length	(Barrel) 11½ft (3.5m)
Caliber	25in (635mm)

Cast in bronze, this remarkable weapon was built to defend the Dardanelles, the narrow strait connecting the Sea of Marmara with the Aegean Sea. It was made in two parts, either so the gun could be moved, or perhaps to place the powder charge in the breech, making it an enormous early breech-loader. The barrel of the gun is seen here. Together with its breech section, this bombard would have been more than 16½ft (5m) long.

▲ **CHINESE IRON CANNON**

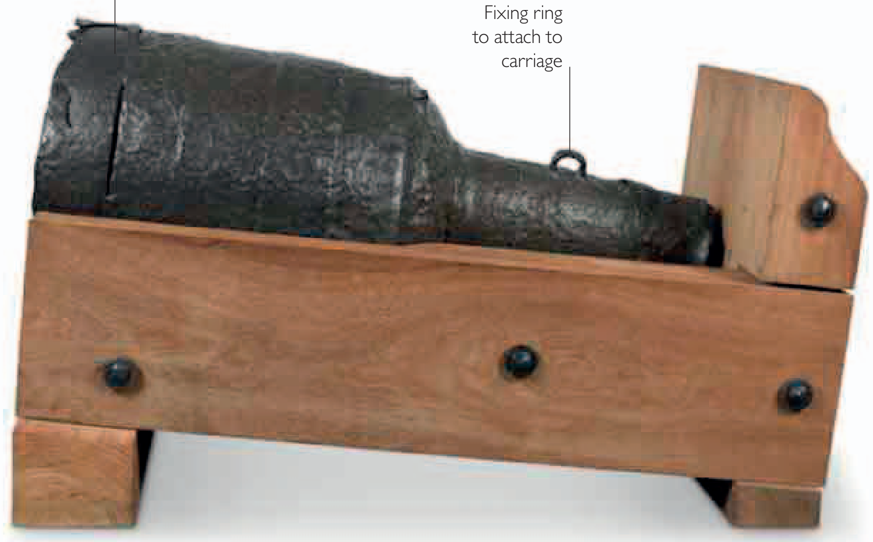
Date	c.1500
Origin	China
Length	1½ft (0.47m)
Caliber	4in (100mm)

This small cannon was fired from a trestlelike stand. It was cast with a bulbous breech region to resist pressure. Rather than firing a single projectile, it was loaded with a number of smaller missiles.

▲ **MONS MEG**

Date	1449
Origin	Flanders
Length	13¼ft (4.04m)
Caliber	19.5in (496mm)

This massive bombard was presented to James II of Scotland in 1457. It fired stone balls that weighed almost 440lb (200kg), but was too cumbersome for regular service because it could only be moved 3 miles (5km) in a day.



▲ **EARLY MORTAR**

Date	15th–16th century
Origin	England
Length	4ft (1.2m)
Caliber	14.2in (360mm)

A mortar was a muzzle-loading siege gun that fired projectiles such as stones or perhaps incendiaries at high angles over the walls of fortifications. This mortar was found in the moat of Bodiam Castle, England. It is pictured here in a resting state at a low angle.

FIELD AND NAVAL ARTILLERY

Artillery—guns that are too big and heavy to be fired by hand—include not only cannon but also smaller weapons such as swivel guns. While the design of early artillery used on land or at sea was similar, guns made for ships had to meet special requirements—space aboard ships is limited and the risk of fire considerable. Guns mounted on a pivot—swivel guns—were developed to increase the maneuverability of artillery. Light versions of swivel guns were created for naval use, and these guns could be fit onto sockets on the sides of ships. This helped to stabilize the guns when firing and to absorb recoil. Although most naval guns were muzzle-loading, loading the charge in the breech of the gun's barrel rather than in the muzzle, or breech-loading, made these guns easier to load. This was a useful feature, because it was impractical to reload a muzzle-loader whose muzzle projected from the side of the ship. Field and naval artillery gradually began to use balls of iron and lead rather than stone.

▶ SWEDISH SWIVEL GUN

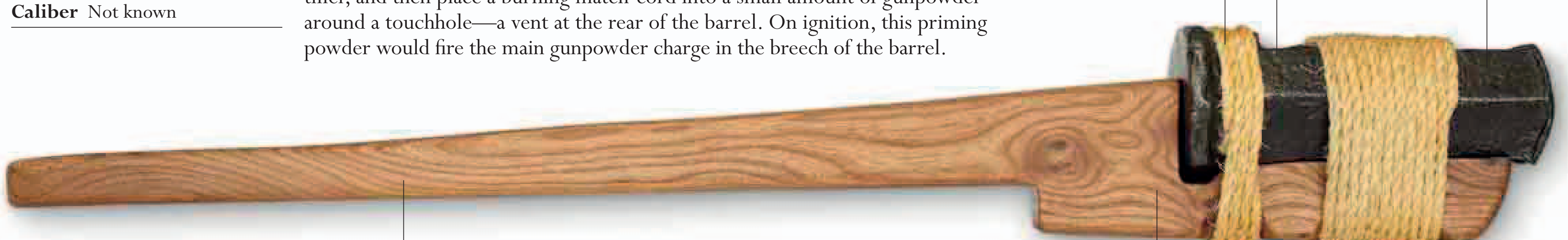
Date	c.1500
Origin	Sweden
Material	Iron
Shot	Round or grapeshot

Swivel guns first appeared in the late 14th century. Unlike fixed cannon, which could only fire in one direction, they provided an arc of fire, and were mainly breech-loading. This model would have been mounted on a boat or a building and would often be loaded with grapeshot—small balls of iron and lead.

▼ ENGLISH HAND-CANNON

Date	1480
Origin	England
Barrel	Not known
Caliber	Not known

Hand-cannon were really small-scale versions of cannon and were deployed in the same way, but unlike true artillery they were small enough to be carried and fired by one user. Their muzzle-loading barrels were attached to wooden tillers. Small hand-cannon were used in naval and land warfare, but they were difficult to aim. The user had to hold the gun, look where he was aiming, direct the gun using a tiller, and then place a burning match-cord into a small amount of gunpowder around a touchhole—a vent at the rear of the barrel. On ignition, this priming powder would fire the main gunpowder charge in the breech of the barrel.



▼ SWEDISH SWIVEL GUN

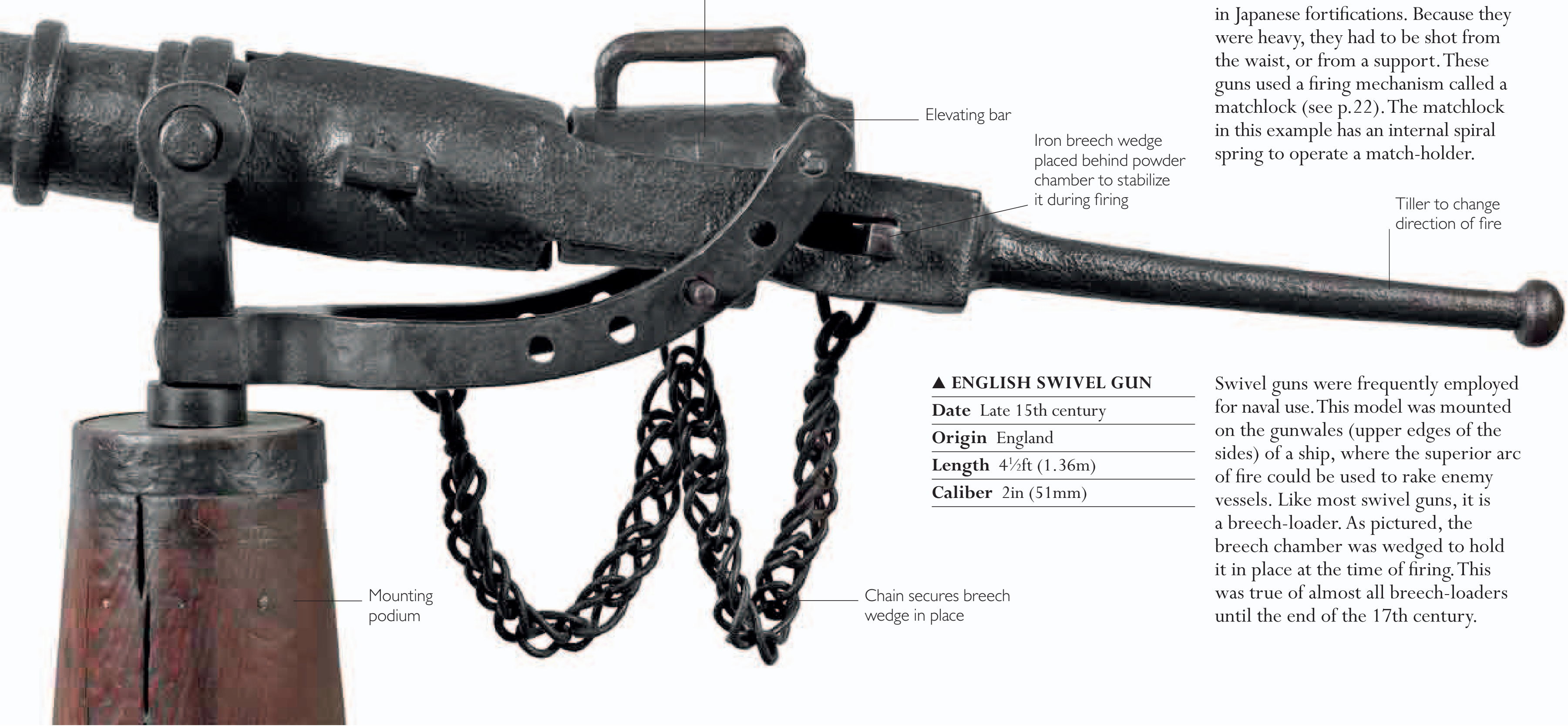
Date	c.1500
Origin	Sweden
Material	Iron
Shot	Round or grapeshot

This is an example of a naval swivel gun. A lead ball would have been placed in the breech of the barrel and a powder chamber, usually made of iron and shaped like a tankard, placed in the trough behind it.

▲ KAKAE ZUTSU

Date	17th–19th century
Origin	Japan
Barrel	2½ft (0.67m)
Caliber	.73in (18.7mm)

Kakae zutsu (hand-cannon), some with bores of up to ¾in (2cm) in diameter, were heavy guns that could be used as light artillery—to provide extra firepower in the battlefield or to batter down the wooden doors used in Japanese fortifications. Because they were heavy, they had to be shot from the waist, or from a support. These guns used a firing mechanism called a matchlock (see p.22). The matchlock in this example has an internal spiral spring to operate a match-holder.



▲ ENGLISH SWIVEL GUN

Date	Late 15th century
Origin	England
Length	4½ft (1.36m)
Caliber	2in (51mm)

Swivel guns were frequently employed for naval use. This model was mounted on the gunwales (upper edges of the sides) of a ship, where the superior arc of fire could be used to rake enemy vessels. Like most swivel guns, it is a breech-loader. As pictured, the breech chamber was wedged to hold it in place at the time of firing. This was true of almost all breech-loaders until the end of the 17th century.

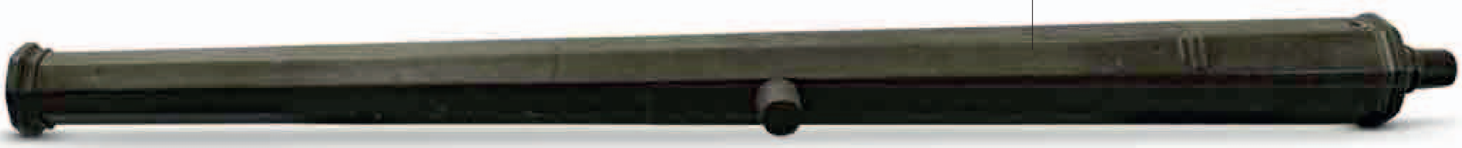
NAVAL CANNON

The barrels of cannon used at sea differed little from those used on land until the 19th century, although carriages for naval service were often more compact. Naval cannon were either cast in bronze or built by forging together pieces of wrought iron (see p.12), until cast iron was perfected in the late 16th century. Bronze was an expensive material, but very durable and impervious to corrosion, unlike iron. Decorative elements could be easily added to the pattern from which a bronze cannon would be cast, and many bronze cannon were decorated ornately. Wrought-iron cannon were relatively plain because wrought iron was a difficult material to embellish.

▲ BRONZE FALCON WITH 10-SIDED BARREL

Date	c.1520
Origin	England or Flanders
Length	9ft (2.78m)
Caliber	2.6in (66mm)

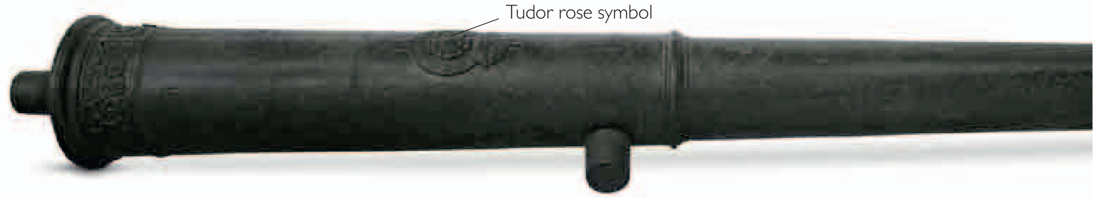
This falcon was cast by a Flemish master gun-founder for King Henry VIII of England as part of a consignment of 28 guns. It fired balls of lead weighing 2¼lb (1kg).



▲ BRONZE FALCON

Date	c.1520
Origin	Flanders or France
Length	8¼ft (2.5m)
Caliber	2.5in (63mm)

The falcon was a light cannon typical of the early 16th century. This model was ordered by Henry VIII, possibly from Flanders, because England did not have an established gun-manufacturing industry at the time.



▲ BRONZE SAKER

Date	1529
Origin	England
Length	7¼ft (2.23m)
Caliber	3.75in (95mm)

Like many early guns, the Saker was named after a bird of prey—in this case, the Saker falcon. This one was acquired from an Italian master craftsman as part of Henry VIII's campaign to supply English forces with artillery of the best quality.

▲ BRONZE ROBINET

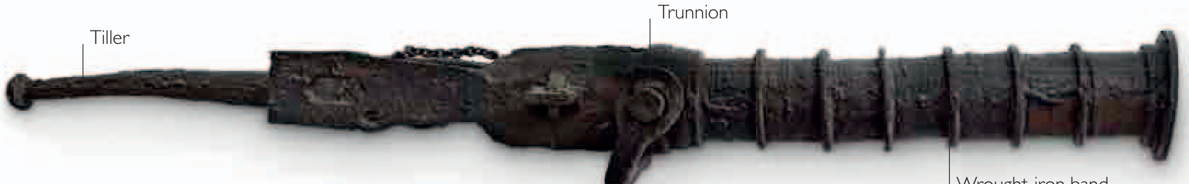
Date	1535
Origin	France
Length	7¾ft (2.39m)
Caliber	1.7in (43mm)

This is an extremely ornate example of the robinet, a light cannon with a small caliber and a barrel weighing a little more than 400lb (181kg). This model was made in Metz, France. It was seized in Paris in 1815 by troops of the Seventh Coalition (Prussia, Russia, Austria, and Great Britain) fighting Napoleon's forces.

▲ BRONZE MINION

Date	c.1550
Origin	Italy
Length	8¼ft (2.5m)
Caliber	3in (76mm)

Minions, light cannon that were particularly well adapted for use at sea, saw service on many English ships during their engagement with the Spanish Armada (1588).



▲ IRON BREECH-LOADING SWIVEL GUN

Date	16th century
Origin	Europe
Length	5¼ft (1.63m)
Caliber	3in (76mm)

Pivots that allowed a gun to fire across a wide arc turned a fixed barrel into a swivel gun (see p.14), especially useful aboard a ship when firing on moving vessels. This type was used in an antipersonnel role, shooting stone ammunition.

▼ BRONZE DEMI-CULVERIN

Date	1636
Origin	France
Length	9½ft (2.92m)
Caliber	4.3in (110mm)

This naval version of a demi-culverin, a medium-sized cannon, was cast for Cardinal Richelieu, chief minister to King Louis XIII of France, who reorganized the French fleet and established a foundry at Le Havre.

▲ BRONZE DEMI-CANNON

Date	1643
Origin	Flanders
Length	10¼ft (3.12m)
Caliber	6in (152mm)

This demi-cannon, a heavy piece designed for naval use, was cast in the famous Flemish gun-foundry at Malines. It was capable of firing heavy shot, which could cause devastating damage at short range.

▼ MALAYSIAN BRONZE SAKER

Date	c.1650
Origin	Malaysia
Length	7½ft (2.29m)
Caliber	3.5in (89mm)

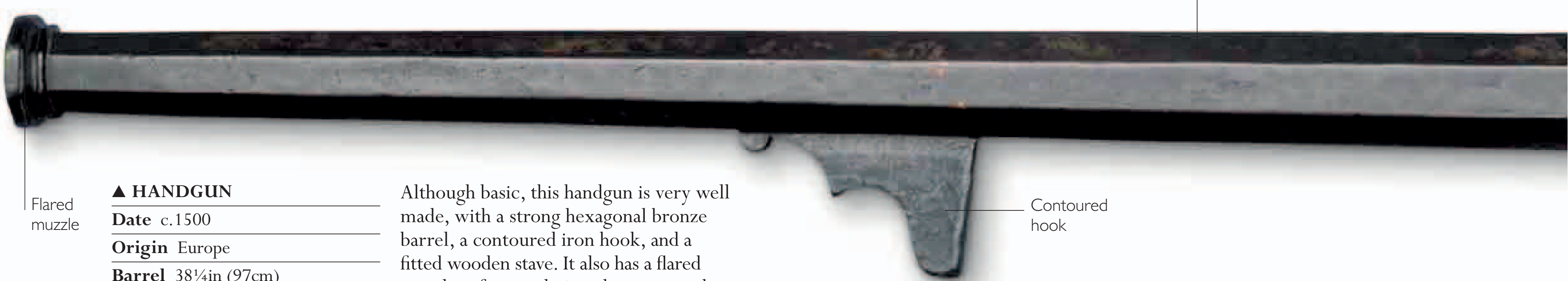
Sakers were light cannon designed for long-range attack. This ornate model was cast in Malacca, Malaysia, by local craftsmen who probably followed a Dutch model.

SIEGE WARFARE

This artist's view of an Ottoman siege in 1529 depicts heavy artillery bombarding Vienna's walls. Such siege guns fired projectiles weighing 18–24lb (8–11kg) over a range of about 1 mile (1.6km). In reality, though, the Ottomans had to abandon their heavy guns and instead used light artillery in their siege, which ultimately failed.

HARQUEBUSES

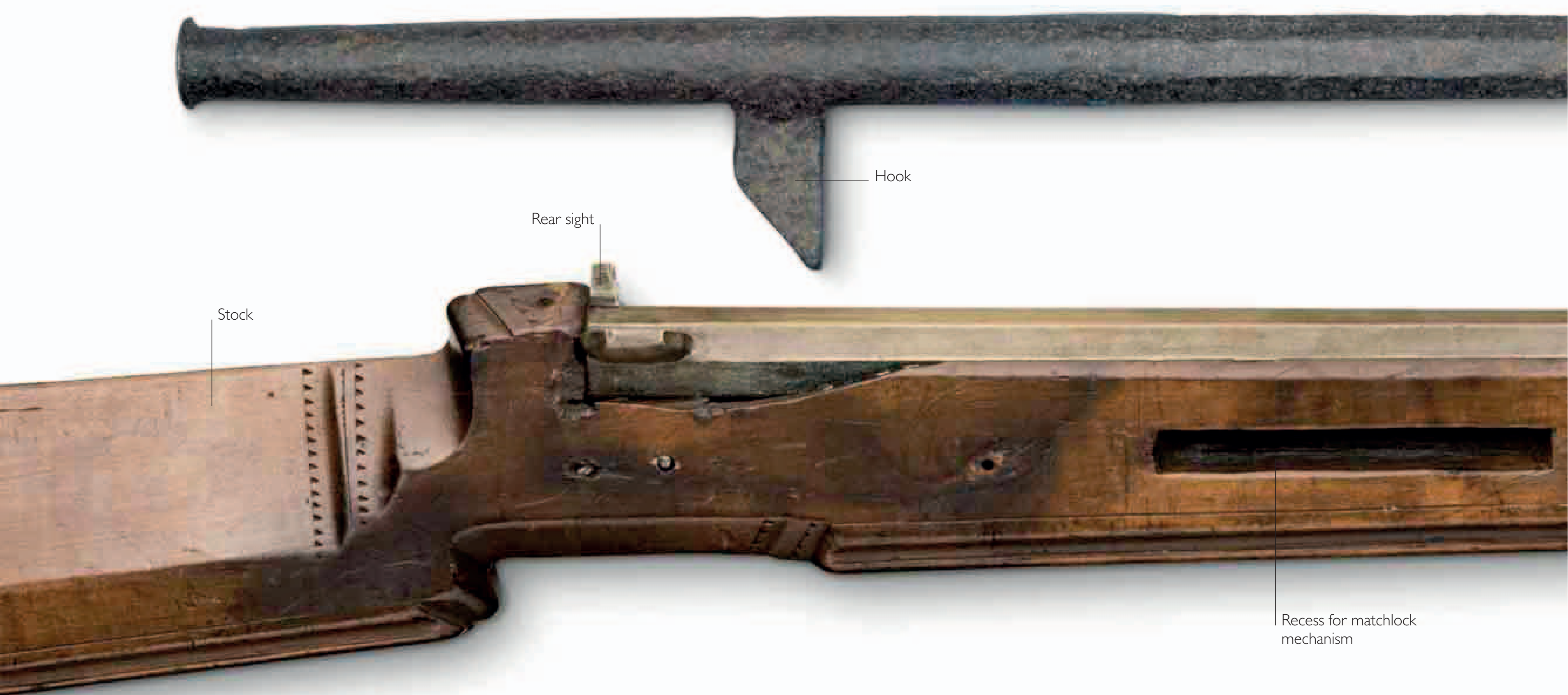
Simple hand-cannon remained in use into the 16th century. These evolved into harquebuses (hook guns)—muzzle-loaders with a recoil-absorbing hook on the underside to place over a wall or portable support for a steadier aim. Key to their development was a wooden shoulder stock that allowed the user to brace the gun with his shoulder, a feature that led to the evolution of the modern gun stock. Harquebuses were fired by a handheld match-cord, and they used lead balls. A harquebus modified by attaching a matchlock (see p.22) gave rise to the first musket.

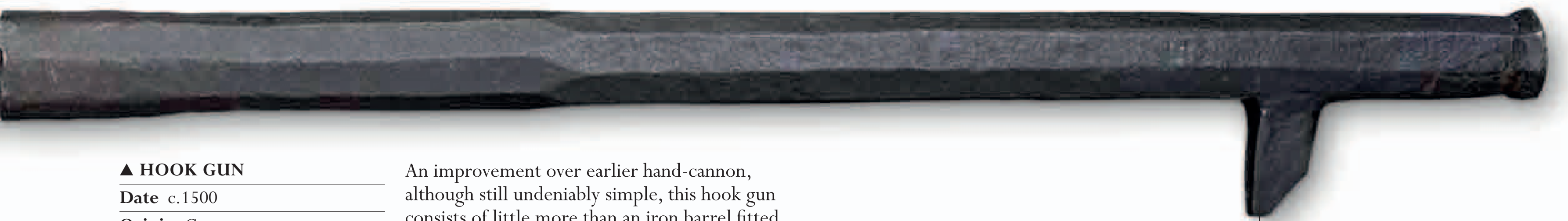


▲ **HANDGUN**

Date	c.1500
Origin	Europe
Barrel	38¼in (97cm)
Caliber	.80in (20mm)

Although basic, this handgun is very well made, with a strong hexagonal bronze barrel, a contoured iron hook, and a fitted wooden stave. It also has a flared muzzle, a feature designed to protect the end of the barrel from potential damage.





▲ HOOK GUN

Date	c.1500
Origin	Germany
Barrel	39in (99cm)
Caliber	.90in (23mm)

An improvement over earlier hand-cannon, although still undeniably simple, this hook gun consists of little more than an iron barrel fitted to a wooden stave, the stave being held under the armpit to stabilize the gun during firing. The wooden stave would evolve into the shoulder stock. The front hook beneath the barrel could be placed on a stable object to improve accuracy.

▲ IRON HANDGUN

Date	c.1500
Origin	Netherlands
Barrel	28in (71cm)
Caliber	.90in (23mm)

This early handgun does not have a wooden stock, but instead features a long iron tiller running out from the rear of the barrel. The weight and awkward shape of the weapon must have made it difficult to handle in the absence of a front support.

▲ EARLY MATCHLOCK HARQUEBUS

Date	c.1560
Origin	Germany
Barrel	29½in (75cm)
Caliber	.59in (15mm)

This match-fired harquebus resembles a more modern firearm because its stock covers most of its body, a trend that would continue in muskets and other firearms. Note also the increased expectations of accuracy indicated by the front and rear sights, although the proportions of the gun (it weighed 50lb/22.7kg) must have affected accurate handling.

FULL VIEW

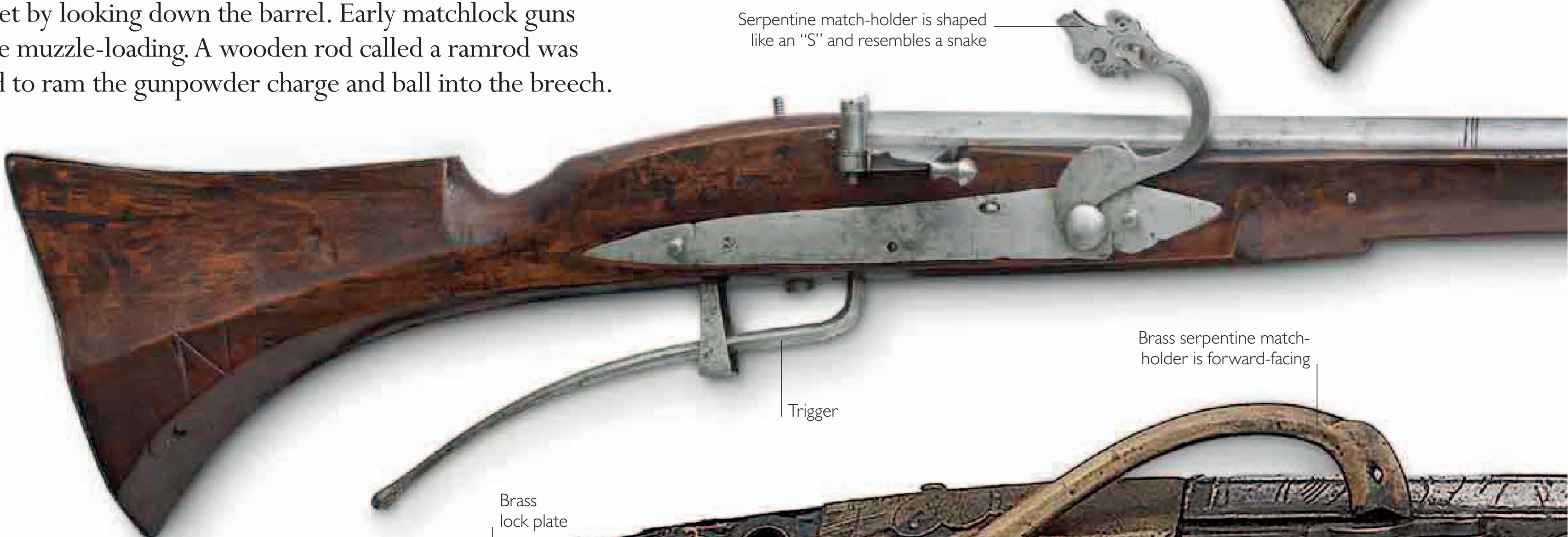
EARLY MATCHLOCK GUNS

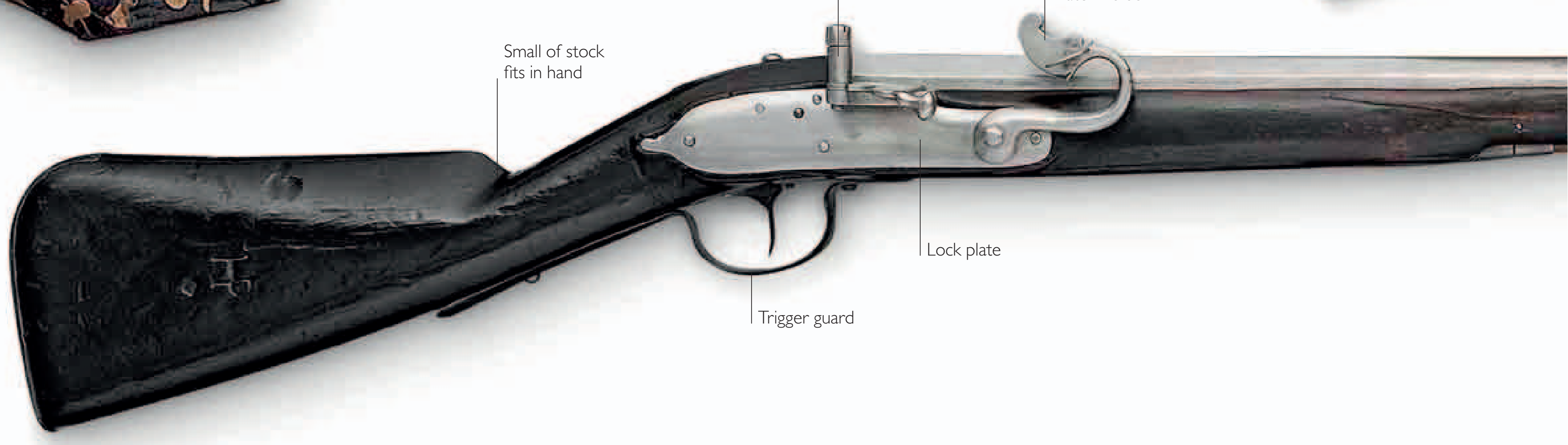
The matchlock was an early firing mechanism for handheld guns. It featured a device—the serpentine—that held a piece of smoldering match-cord. Upon pulling the trigger, the serpentine plunged the match-cord into a pan carrying priming powder. Ignition of the priming powder produced a flash, which ignited the main charge via a vent in the side of the barrel. Firing the gun by just pulling a trigger or squeezing a lever allowed the firer to focus on the target by looking down the barrel. Early matchlock guns were muzzle-loading. A wooden rod called a ramrod was used to ram the gunpowder charge and ball into the breech.

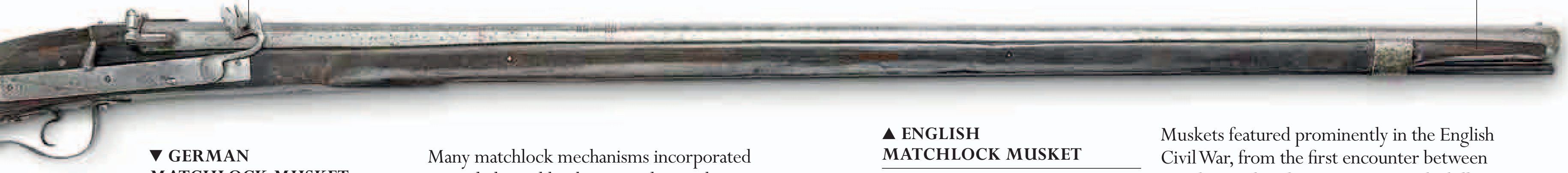
▲ SNAPPING MATCHLOCK

Date	c.1540
Origin	Italy
Barrel	42in (105cm)
Caliber	.47in (12mm)

Henry VIII of England ordered 1,500 of these guns from the Venetian Republic in 1544. A year later, some of them were aboard his flagship, the *Mary Rose*, when it sank. Experiments have shown that their ammunition could penetrate up to ¼in (6mm) of steel at 30 yards (27m).







▼ GERMAN MATCHLOCK MUSKET

Date	c.1580
Origin	Germany
Barrel	46in (116.8cm)
Caliber	Not known

Many matchlock mechanisms incorporated a simple lever, like that on early crossbows. The lever was squeezed to move the serpentine holding the smoldering match-cord into the priming pan. The military musket shown here is typical of those used in Germanic countries in the late 16th century.

▲ ENGLISH MATCHLOCK MUSKET

Date	c.1640
Origin	England
Barrel	45½in (115cm)
Caliber	.73in (18.7mm)

Muskets featured prominently in the English Civil War, from the first encounter between Royalists and Parliamentarians at Edgehill in 1642 to the war's conclusion at Worcester in 1651. Because matchlocks took so long to load, musketeers were vulnerable, particularly to cavalry, and had to be protected by pikemen.

▼ HI NAWA JYU

Date	17th–19th century
Origin	Japan
Barrel	36¾in (93.7cm)
Caliber	.59in (15mm)

The *hi nawa jyu* was introduced to Japan by the Portuguese from their base in India in 1543. Within 25 years, manufacturing centers were producing thousands of these guns for arming foot soldiers, and the matchlock had become a decisive weapon in battle.

FULL VIEW

▲ DUTCH COMBINATION LONG GUN

Date	17th century
Origin	Netherlands
Barrel	46in (117cm)
Caliber	.90in (23mm)

This unusual musket is equipped with both a flintlock (see pp.38–39) and a matchlock mechanism. The matchlock pan is part of the top of the frizzen (pan cover combined with a striking steel). The matchlock is operated by the trigger guard, while the operation of the flintlock is by means of the trigger.

▲ BRITISH MATCHLOCK

Date	17th century
Origin	England
Barrel	46in (117.2cm)
Caliber	.70in (18mm)

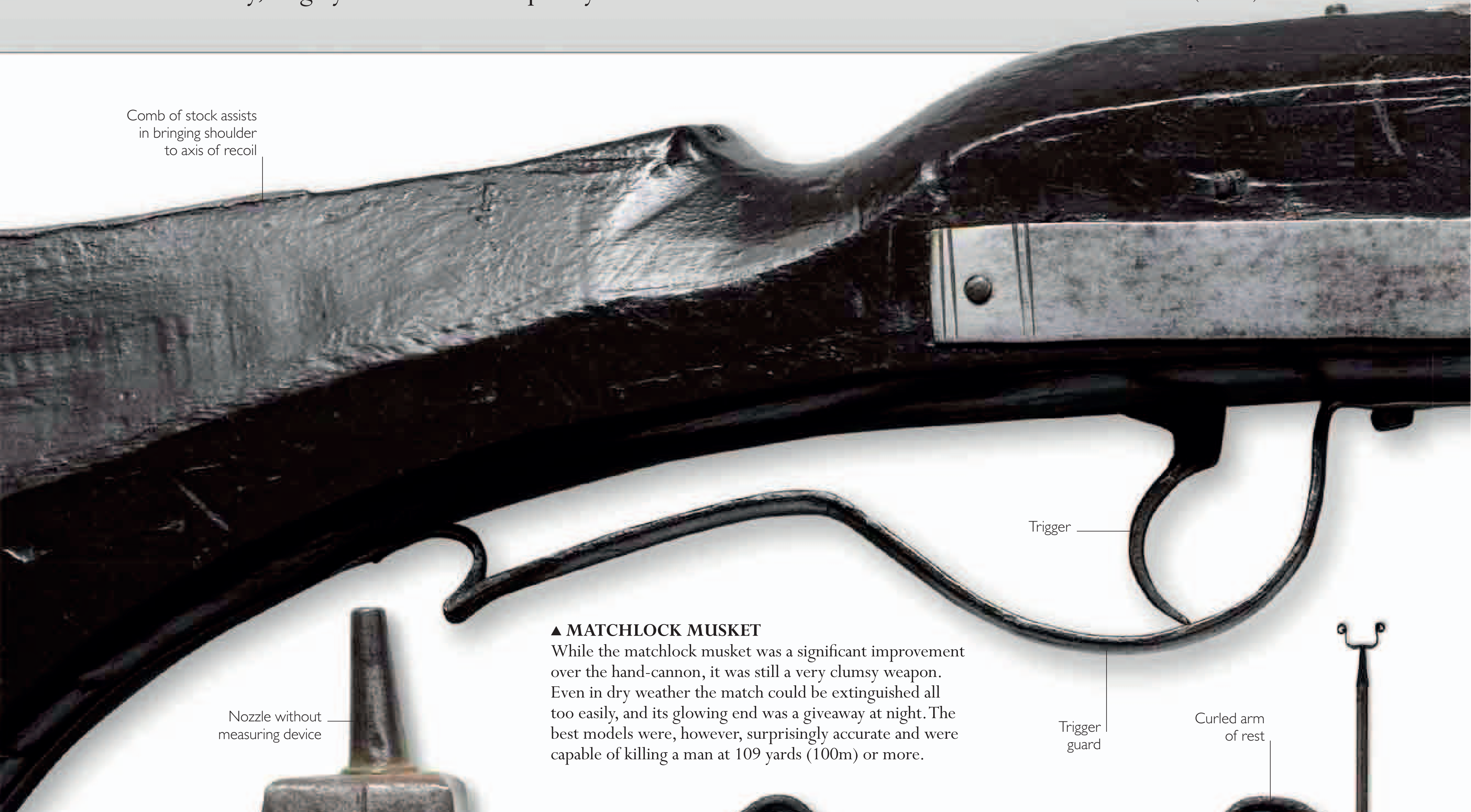
By the end of their period of dominance, the best matchlocks had acquired a degree of sophistication, at least in their finish. They had also become much lighter, and thus were considerably easier to handle. A high-quality piece such as this would have been a prime contender for conversion into a snaphance (see p.38) or flintlock (see pp.38–39), had it not been preserved in a collection.

SHOWCASE

MATCHLOCK MUSKET

In the late 16th century, the harquebus (see p.20) developed into a type of matchlock musket that was widely adopted in western Europe. Matchlocks were more unwieldy and unreliable than the wheel-lock guns invented soon afterward (see p.27), but they continued to be popular until the end of the 17th century, largely due to their simplicity.

MATCHLOCK MUSKET	
Date	c. mid-17th century
Origin	Britain
Barrel	49½in (126cm)
Caliber	.75in (19mm)

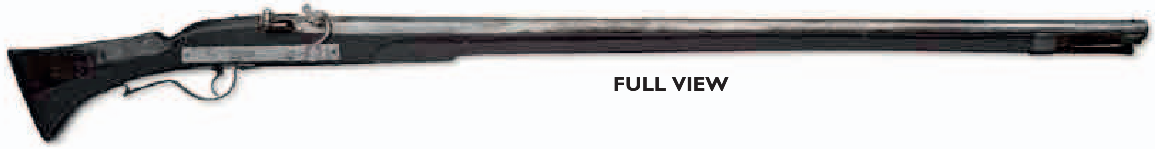


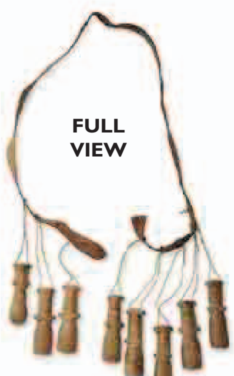
▲ **MATCHLOCK MUSKET**
While the matchlock musket was a significant improvement over the hand-cannon, it was still a very clumsy weapon. Even in dry weather the match could be extinguished all too easily, and its glowing end was a giveaway at night. The best models were, however, surprisingly accurate and were capable of killing a man at 109 yards (100m) or more.

◀ **POWDER FLASK**
This flask is made of wood, covered in fabric, and has an outer iron frame. Originally its nozzle would have had a thumb-operated shutter at its base, which was used to measure the individual charges of gunpowder for a musket.

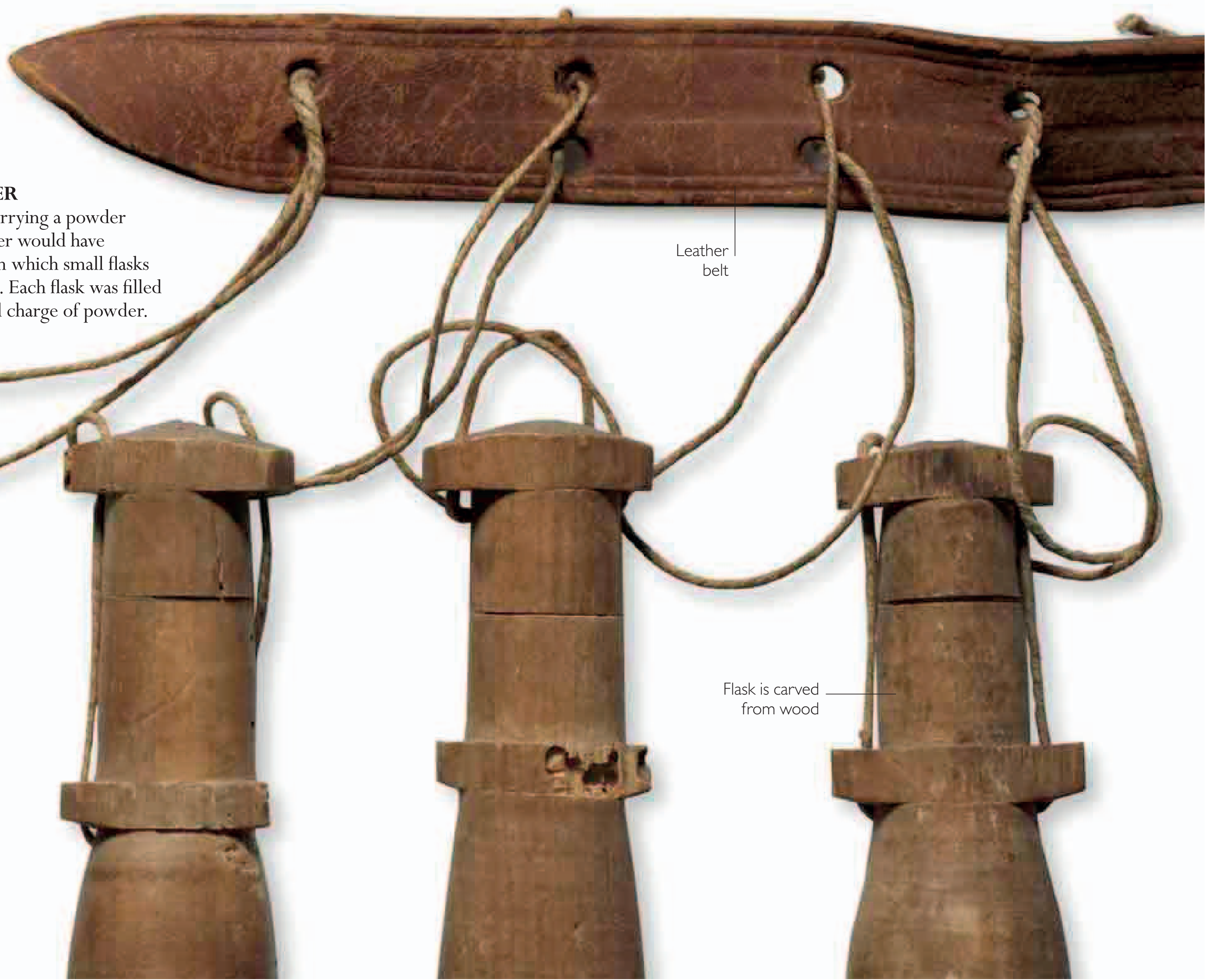
▼ **MUSKET REST**
The earliest military matchlocks were very heavy and required the use of a rest. The rest itself had to be of sturdy design, and this increased the gunner's load. By about 1650, guns had become light enough that rests were no longer needed.

FULL VIEW





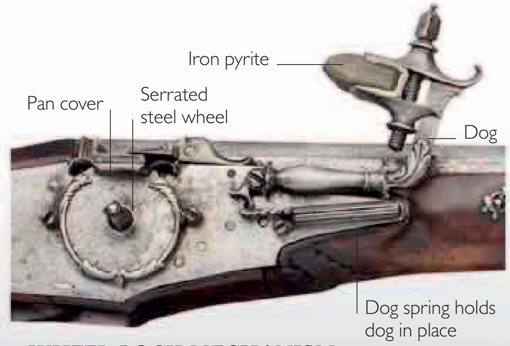
▶ BANDOLEER
In addition to carrying a powder flask, a musketeer would have worn a belt from which small flasks were suspended. Each flask was filled with a measured charge of powder.



TURNING POINT

READY-TO-FIRE GUNS

Before 1500, all firearms had to be fired using a piece of smoldering match-cord. The device to hold this match-cord—the matchlock—was vulnerable to the effects of wind and rain, and the match-cord could potentially burn the user. The wheel-lock was the first mechanism to provide an internal system for igniting a firearm, allowing guns to be carried loaded and ready to fire in an instant. It made the development of an entirely new weapon—the pistol—possible, and revolutionized the use of firearms by cavalry.



▲ **WHEEL-LOCK MECHANISM**
A spring-loaded steel wheel sits under a pan. A piece of iron pyrite is held in jaws on a spring-loaded arm called a dog. Before firing, the dog is placed onto the pan cover. Pulling the trigger causes the wheel to spin as the pan cover opens, bringing the iron pyrite in contact with the wheel.

From their first appearance in Europe in the 14th century, firearms had to be lit and fired with the help of direct heat. The only practical source of this heat was hemp- or match-cord, impregnated with saltpeter, or potassium nitrate, which smoldered when lit. Early handguns were fired by match-cord held in the hand, which made supporting and aiming the gun difficult. Matchlocks were then devised to help place the lit match-cord into a priming pan. Burning match-cord, however, posed a constant risk to the shooter. Plus, it could be extinguished in bad weather.

» BEFORE

The match-cord and priming powder of matchlock guns could be rendered damp and useless in windy or rainy weather. The smoldering match-cord was also a source of danger to its user.

- **LARGE QUANTITIES OF MATCH-CORD** had to be supplied to armies since soldiers had to keep it burning in readiness, even if no gun was fired.

MATCHLOCK MUSKET

- **THE MATCH-CORD POSED A RISK** to a soldier because he kept it smoldering if his musket was likely to be fired. The match-cord could either burn him or set off his supply of gunpowder.

- **IMPOSSIBLE TO CONCEAL**, a matchlock weapon with a smoldering match-cord would easily give away the soldier's position at night.

- **ON HORSEBACK, IT WAS UNWIELDY AND IMPRACTICAL** to load and fire a matchlock weapon, and so cavalry, other than dragoons (mounted infantry), were not equipped with firearms.

> "… **gun** that **men carry**… fires of its own action … they are **small**… nobody **sees** them…"

DUCAL EDICT, **BRESCIA, NORTHERN ITALY (1532)**

THE WHEEL-LOCK MECHANISM

The first gunlock to overcome these problems was based on a tinder-lighter—a simple device used to kindle fire. This "wheel-lock" demanded great skill to build. It consisted of a steel wheel that rotated against a piece of iron pyrite, a natural mineral, to produce sparks. One end of the lock's V-shaped mainspring was attached to a chain. By using a key to turn the wheel, the shooter wound this chain around the mechanism's axle, compressing the spring ("spanning" the lock). He then locked the spanned wheel in position, preventing it from spinning. At this point, the upper edge of the wheel entered the pan through a slot. Next, he placed gunpowder in the priming pan and closed the cover. When the gun was to be fired, the shooter moved the dog (the part of the lock that held the iron pyrite), bringing it over by hand, and placing it onto the pan cover. Pulling the trigger released the wheel, which automatically opened the pan cover. The iron pyrite hit the rotating wheel, producing sparks, which flashed through a touchhole on the side of the barrel to light the main gunpowder charge in the barrel's breech.

NEW WEAPONS

The wheel-lock design enabled the manufacture of firearms that could be carried primed and ready to fire. Because they did not require live fire, firearms could now be carried concealed. It made a brand new kind of small firearm—the pistol—a practical proposition by the 1520s. Single-handed operation of firearms became possible. The thought of a firearm small enough to be concealed under clothing alarmed European authorities, who considered it a threat to public safety. By the early 16th century, many European countries had introduced legislation against these new, portable firearms.

Thanks to the wheel-lock's portability, the cavalry at last had firearms that they could use effectively on horseback, without the need to dismount. Wheel-lock firearms, such as pistols and carbines (see p. 32), could be stowed away for use at a moment's notice. Each weapon could be fired only once during an engagement, which was why cavalry were issued with pairs of pistols, and sometimes carbines too. This, however, gave them the advantage of two or indeed three shots from the saddle, when previously none had been possible. This offered the cavalry firepower like never before.

◂ **SHOOTING ON HORSEBACK**
During the Thirty Years' War, at the Battle of Lützen (November 16, 1632), the Protestant Swedish king, Gustavus Adolphus, led his cavalry against Catholic Imperial forces. Shot by Imperial cavalrymen wielding wheel-lock pistols, he succumbed to his injuries.

KEY **FIGURE**

Leonardo da Vinci
(1452–1519)

The earliest images of a mechanism resembling a wheel-lock appeared in the notes of Leonardo da Vinci's *Codex Atlanticus* in around 1495. It seems Leonardo was inspired by a tinder-lighter when he made drawings of a fire-striking device to attach to the side of a gun barrel.

AFTER »

Although the invention of the wheel-lock enabled the development of new handheld arms that could be portable, concealed, and used on horseback, there were still drawbacks. The wheel-lock was costly, easily put out of order, and hard to repair—problems in both military and hunting situations. A simpler, more reliable gunlock was still needed.

- **RARE LEVELS OF EXPERTISE** were needed to manufacture wheel-lock pistols, which made them expensive guns to buy.

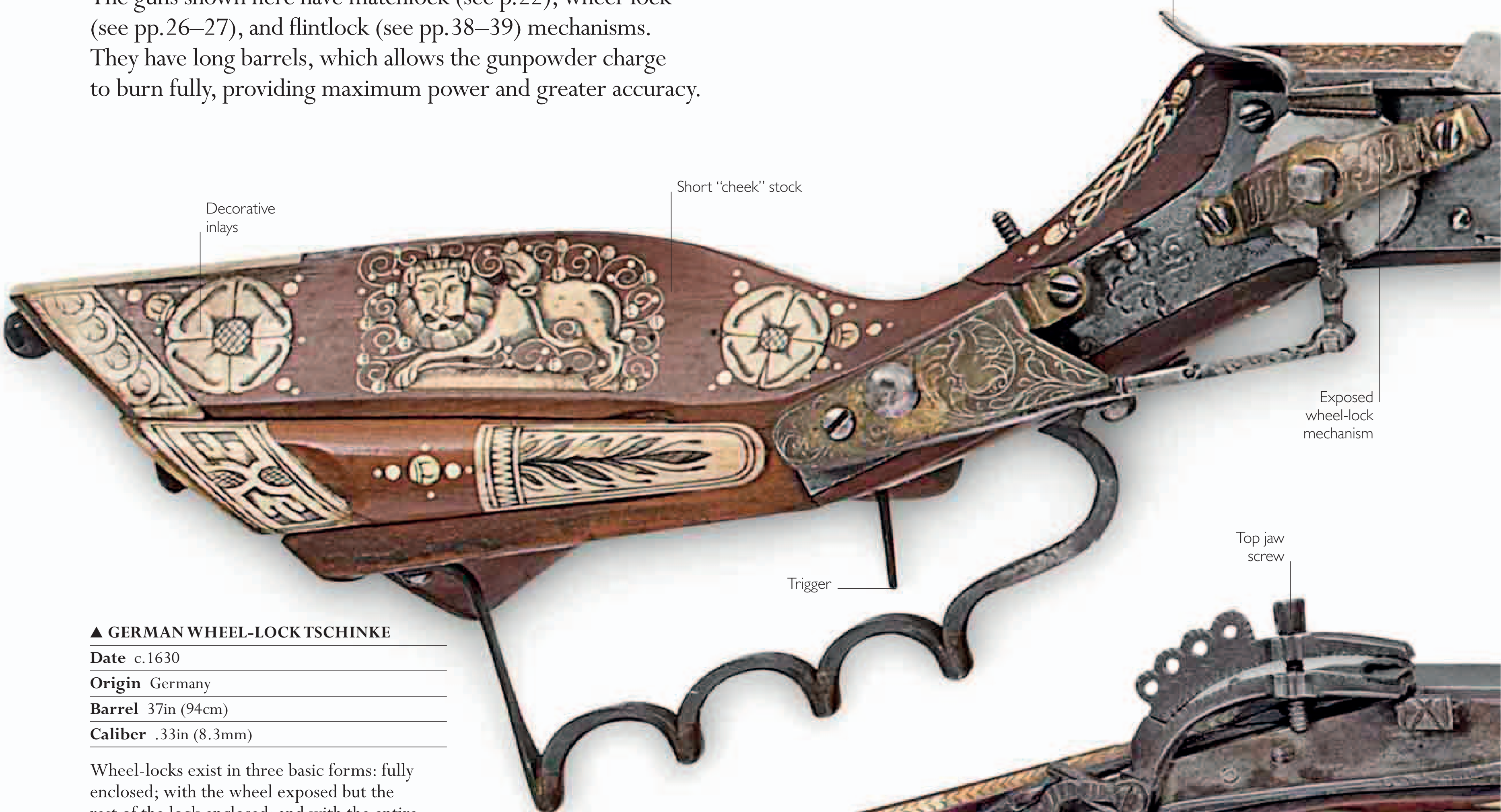
- **THE SNAPHANCE LOCK** (see p. 38), a precursor to the flintlock, evolved in the 1560s.

FLEMISH FLINTLOCK PISTOL

- **THE FLINTLOCK** appeared during the 1570s (see pp. 38–39). It was cheaper, simpler, and more reliable than the wheel-lock or the matchlock.

SPORTING LONG GUNS

By the middle of the 16th century, some sporting guns had developed "rifled barrels" in which parallel spiral grooves were cut along the bore of the barrel. Firing these "rifles" imparted a spin to the round lead balls used as ammunition. This rotation made the balls fly straighter than those fired from a smoothbore (non-rifled) barrel. Smoothbore sporting guns could fire a solid lead ball or, for shooting at birds, a measured quantity of small lead pellets, or "shot." In almost all cases, early muskets and rifles were muzzle-loaders, but they used a variety of ignition systems to fire the main charge. The guns shown here have matchlock (see p.22), wheel-lock (see pp.26–27), and flintlock (see pp.38–39) mechanisms. They have long barrels, which allows the gunpowder charge to burn fully, providing maximum power and greater accuracy.



▲ GERMAN WHEEL-LOCK TSCHINKE

Date c.1630

Origin Germany

Barrel 37in (94cm)

Caliber .33in (8.3mm)

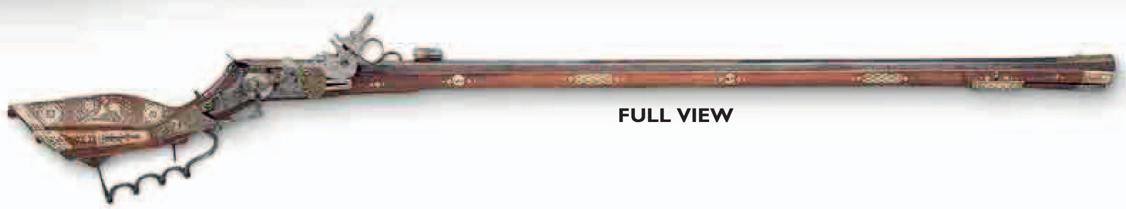
Wheel-locks exist in three basic forms: fully enclosed; with the wheel exposed but the rest of the lock enclosed; and with the entire mechanism exposed. The last form, known as a "Tschinke," a German wheel-lock, is more easily damaged but easier to clean and maintain. This example was made in Silesia (a region spanning areas of present-day Germany, Poland, and the Czech Republic), and its stock is inlaid with horn and mother-of-pearl. It has a short butt forming a "cheek" stock which is braced against the face instead of the shoulder when firing. The gun has a heavy barrel to help absorb much of the recoil when it fires.

FULL VIEW

▲ COMBINATION WHEEL-LOCK/ MATCHLOCK MUSKET

Date	1650 (mechanism)
Origin	Germany
Barrel	46½in (118cm)
Caliber	.70in (17.7mm)

In this gun, wheel-lock and matchlock systems are set beside each other on the same lock plate. The wheel-lock mechanism and stock are typical of those made in the Netherlands and in parts of what is modern-day Belgium and Germany around 1650.

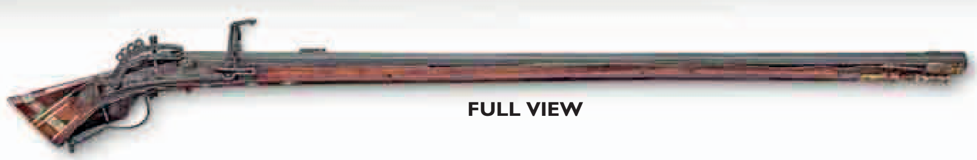


FULL VIEW

▼ SWEDISH BALTIC FLINTLOCK

Date	c.1650
Origin	Sweden
Barrel	38½in (98cm)
Caliber	.4in (10mm)

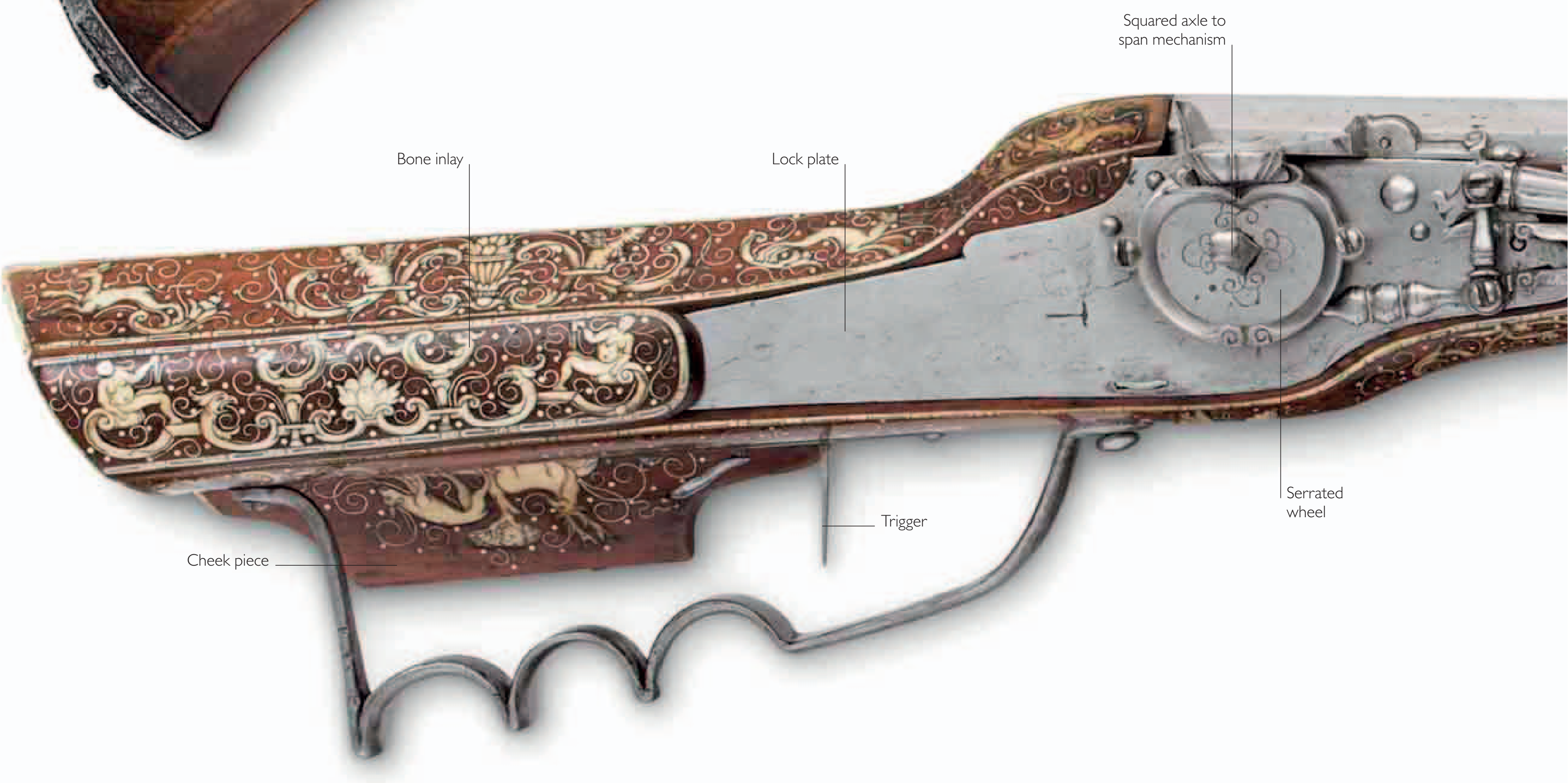
This early flintlock rifle, with a characteristic "Baltic" lock from the south of Sweden, has the distinctive "Goinge" type short butt stock reminiscent of weapons of a still earlier date. Compared with later examples, its simple lock is crudely made, but it features the frizzen common to all flintlocks (see pp.38–39).



FULL VIEW

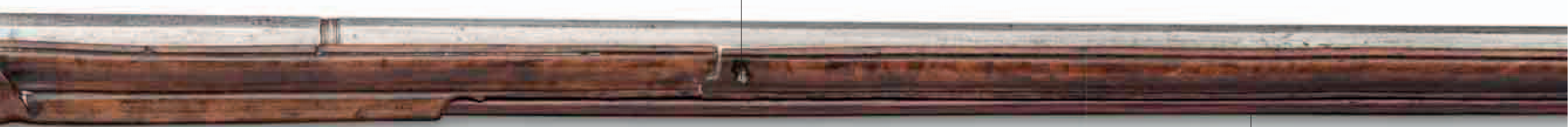
EUROPEAN HUNTING GUNS

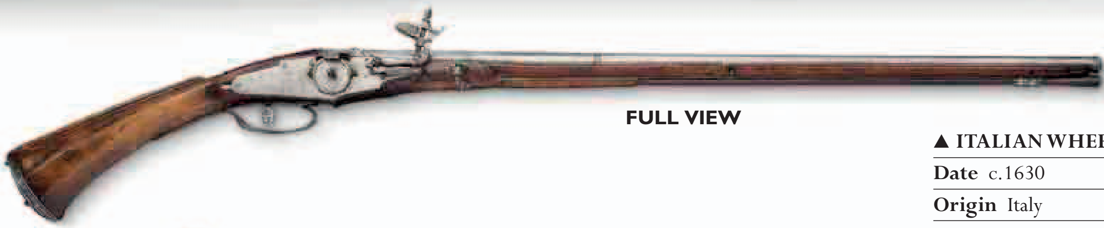
Hunting guns were often built to popular regional styles that were in fashion at the time. Specific types of firing mechanism were preferred from place to place. The snaphance lock (see p. 38), for instance, was preferred in Scotland and the wheel-lock (see pp. 26–27) in German lands and in Italy. Hunting guns were often decorated with engraved and chiseled metalwork and inlaid stocks, to demonstrate the taste and wealth of their owner. In some regions of Europe where large game was hunted, hunters preferred rifles over smoothbore shotguns. Rifles had greater power and accuracy and were more capable of killing large animals.



▲ SCOTTISH SNAPHANCE	
Date	1614
Origin	Scotland
Barrel	38in (96.5cm)
Caliber	.45in (11.5mm)

The name snaphance derives from the Dutch *schnapp-hahn*, meaning "pecking hen," which the mechanism was thought to resemble. It was the first attempt to simplify the wheel-lock's method of striking sparks from a piece of iron pyrite. This example is attributed to gunsmith Alison of Dundee, Scotland. It was a gift from King James VI of Scotland (and eventually of England) to Louis XIII of France.





▲ ITALIAN WHEEL-LOCK	
Date	c.1630
Origin	Italy
Barrel	31½in (80cm)
Caliber	.45in (11.5mm)

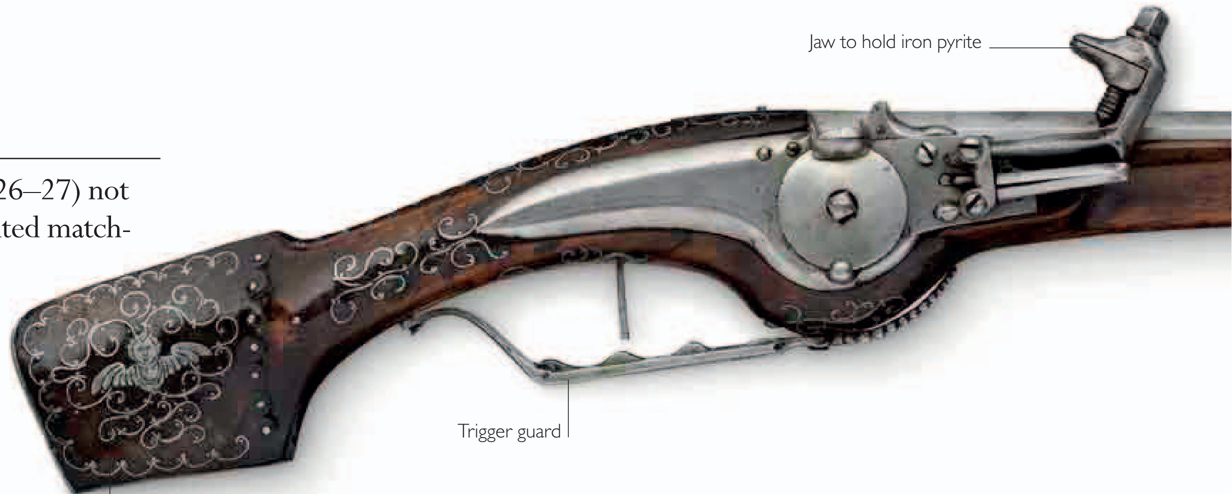
By the 17th century, the northern cities of Brescia and Bologna had long been the centers for the fabrication of wheel-lock guns in Italy. This example is by Lazarino Cominazzo of Brescia, who was better known for his pistols.

▲ GERMAN WHEEL-LOCK	
Date	c.1640
Origin	Germany
Barrel	34in (86.4cm)
Caliber	.65in (16.5mm)

The wheel-lock mechanism appeared in both Italy and Germany in around 1500, and soon firearms using this revolutionary new ignition system were being made and used throughout much of Europe. This example has its serrated wheel mounted externally, to make it easier to clean, although the rest of the lock-work is protected within the stock behind the lock plate.

EARLY PISTOLS AND CARBINES

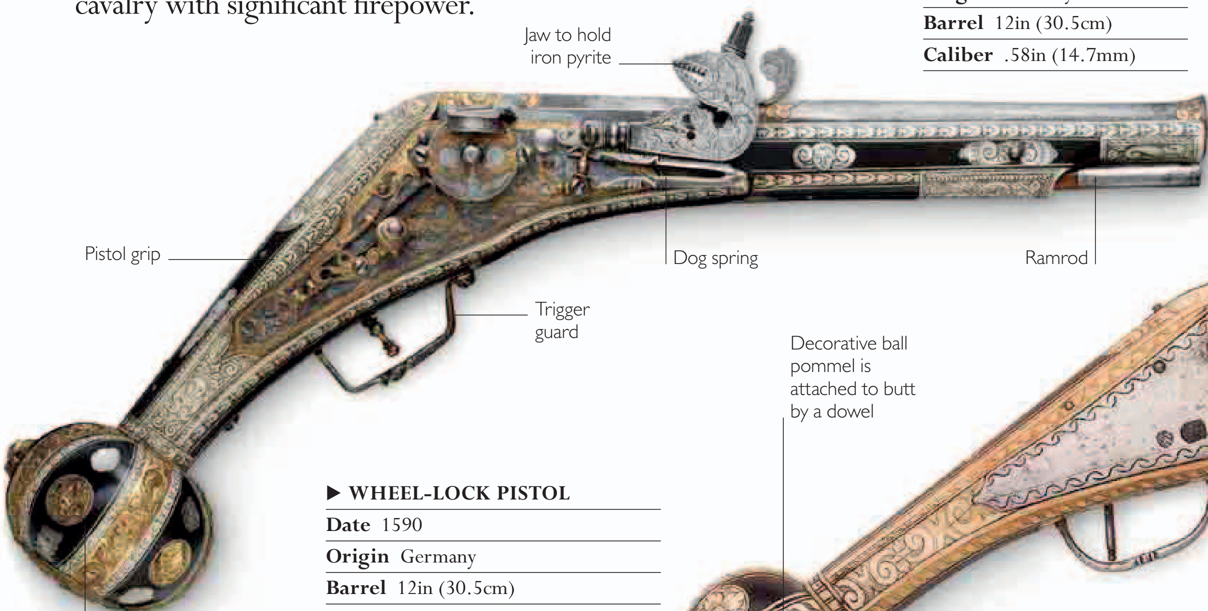
The advent of the wheel-lock (see pp.26–27) not only made it possible to dispense with a lighted match-cord, but now firearms could also be made smaller, be fired with one hand, and carried around, instantly ready to fire. This gunlock made new types of firearms practical. Pistols and carbines appeared. These were lighter than cumbersome muskets and easier to handle. Carbines were shorter than muskets, but larger than pistols, and they provided cavalry with significant firepower.



▼ HOLSTER PISTOL

Date	c.1580
Origin	Germany
Barrel	12in (30.5cm)
Caliber	.58in (14.7mm)

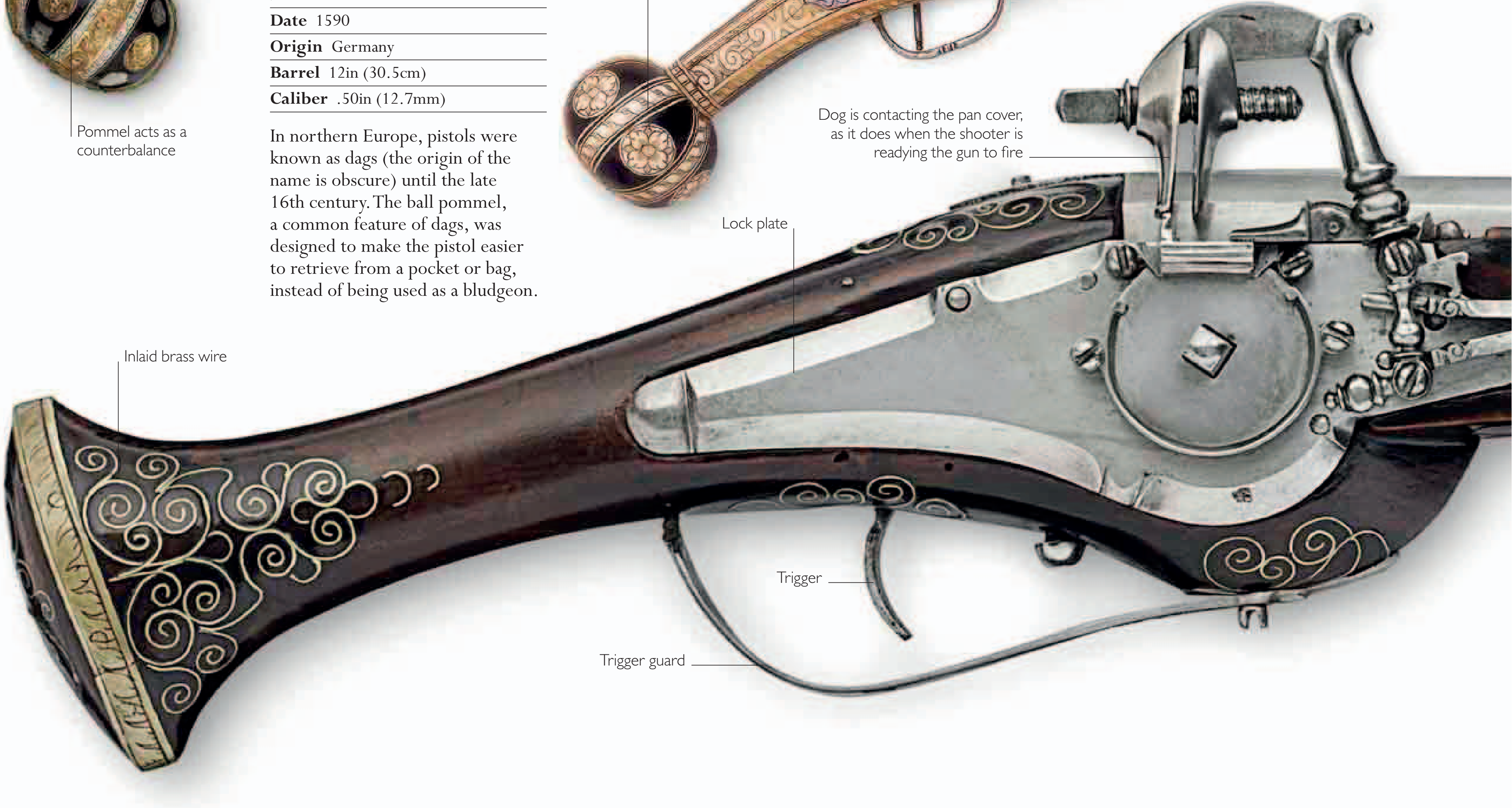
This holster pistol has a recognizably angular handgun layout, which meant it could be stored in a holster while on horseback. Every aspect of the gun is highly decorated, including a large pommel at the end of the grip.



▶ WHEEL-LOCK PISTOL

Date	1590
Origin	Germany
Barrel	12in (30.5cm)
Caliber	.50in (12.7mm)

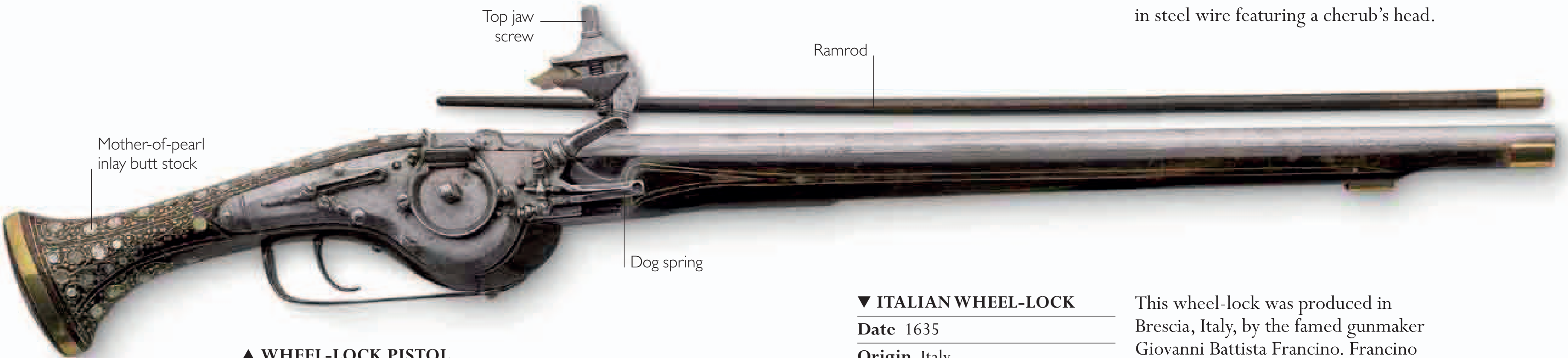
In northern Europe, pistols were known as dags (the origin of the name is obscure) until the late 16th century. The ball pommel, a common feature of dags, was designed to make the pistol easier to retrieve from a pocket or bag, instead of being used as a bludgeon.



◀ WHEEL-LOCK CARBINE

Date	1650
Origin	Germany
Barrel	20½in (52cm)
Caliber	.50in (12.7mm)

Made by German gunmaker Hans Ruhr, this wheel-lock features a short, flattened butt. The steel butt plate is drilled with a cavity—possibly to contain a cartridge or powder measure. The stock is inlaid with scroll-work in steel wire featuring a cherub's head.



▲ WHEEL-LOCK PISTOL

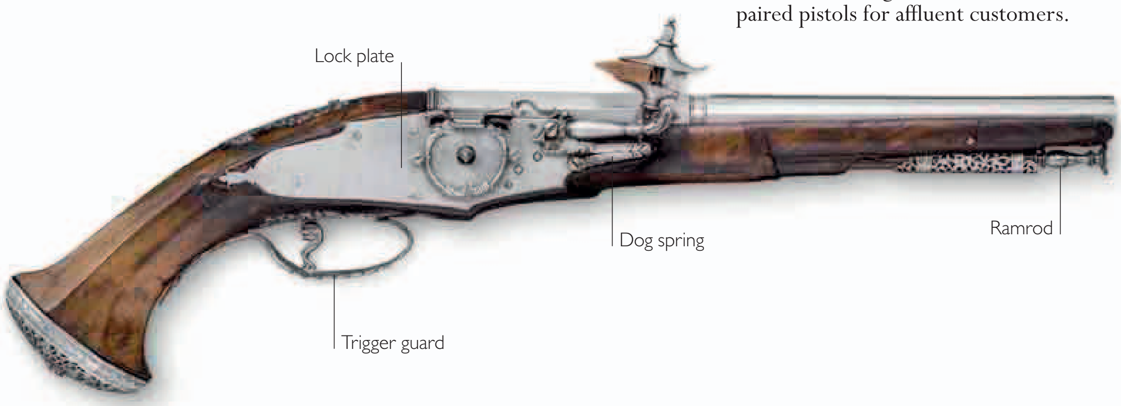
Date	17th century
Origin	Germany
Barrel	20in (50.8cm)
Caliber	.50in (12.7mm)

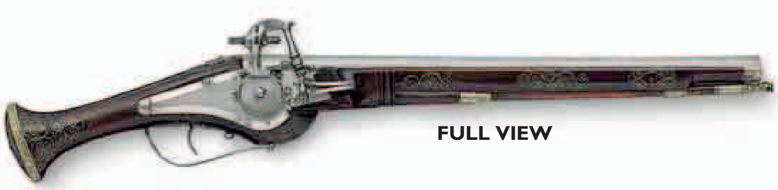
Military wheel-lock pistols were expensive (see p.27) and used only by cavalry. Pairs of these pistols were carried in holsters in front of the saddle. This example is more decorative than most, having mother-of-pearl inlay in the stock.

▼ ITALIAN WHEEL-LOCK

Date	1635
Origin	Italy
Barrel	10¼in (26cm)
Caliber	.52in (13.3mm)

This wheel-lock was produced in Brescia, Italy, by the famed gunmaker Giovanni Battista Francino. Francino built his reputation on the high quality of finish, fine balance, and superb lockwork of his guns, and he often made paired pistols for affluent customers.





FULL VIEW

▲ GERMAN WHEEL-LOCK

Date	1620
Origin	Germany
Barrel	17in (43cm)
Caliber	.57in (14.5mm)

This pistol was made by Lorenz Herold, who is recorded as working in Nuremburg from 1572 until his death in 1622. This model is, however, stamped with the Augsburg control mark. Herold was, therefore, either working in both regions or buying in Augsburg-made barrels.

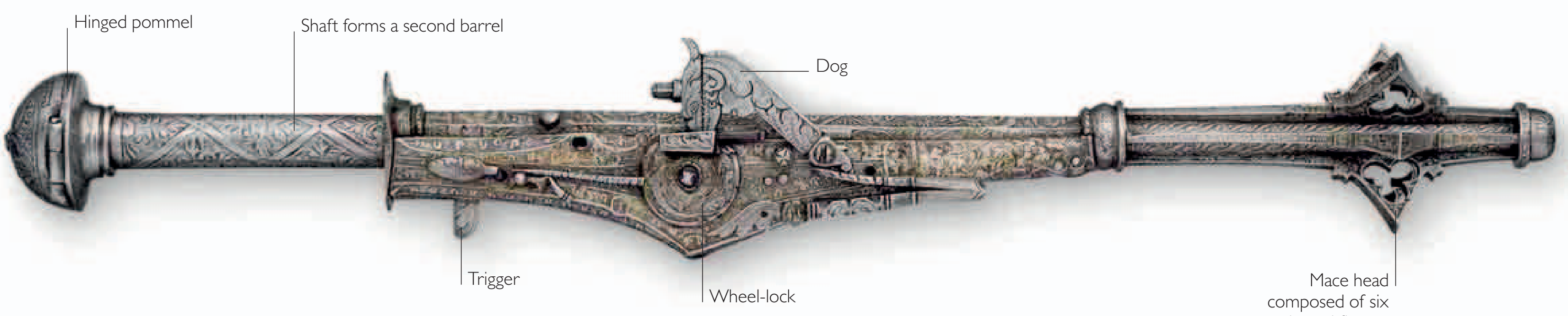
COMBINATION WEAPONS

Throughout history, arms-makers have tried to combine the benefits of more than one weapon. Sometimes these were attempts to produce practical military weapons, but often these hybrid weapons were made as objects of interest and technical curiosity. Combining two weapons would often compromise the effectiveness of both, but they could be splendidly decorative, even if they were not very practical. Firearms were frequently attached to other kinds of weapon, with the idea that a staff weapon, shield, or sword might gain additional potency.

▼ HALBERD WITH TWO WHEEL-LOCK MECHANISMS

Date	c.1590
Origin	Germany
Length	27¼in (69.1cm)
Caliber	.33in (.83cm)

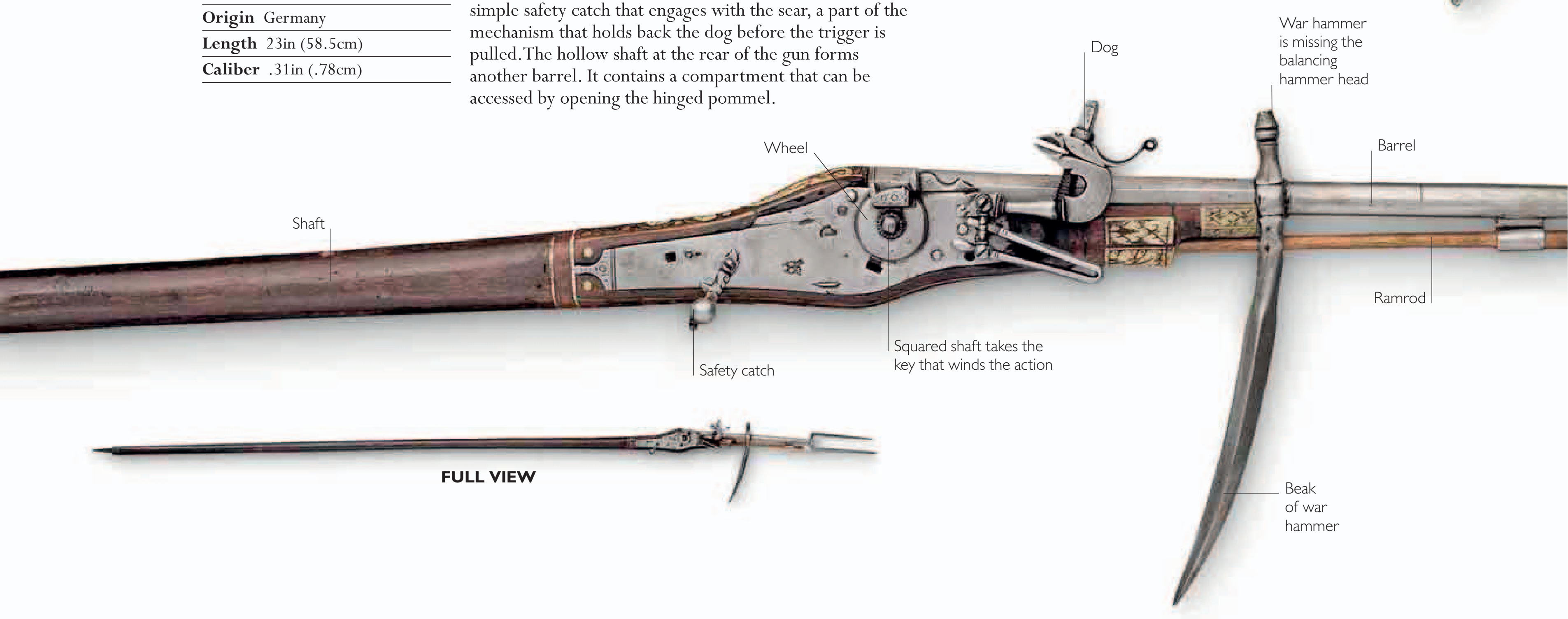
This is a ceremonial halberd equipped with a double-barreled wheel-lock pistol. The pistol barrels are octagonal and mounted on either side of the leaf-shaped blade. The whole gun is etched and partly gilt with strap and scroll-work, the ax and fluke of the head having additional trophies of arms.

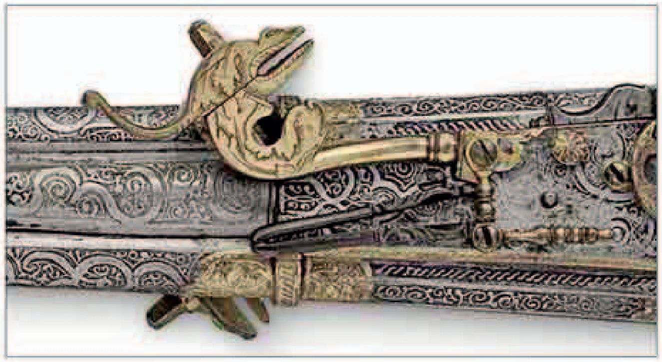


▲ MACE WHEEL-LOCK

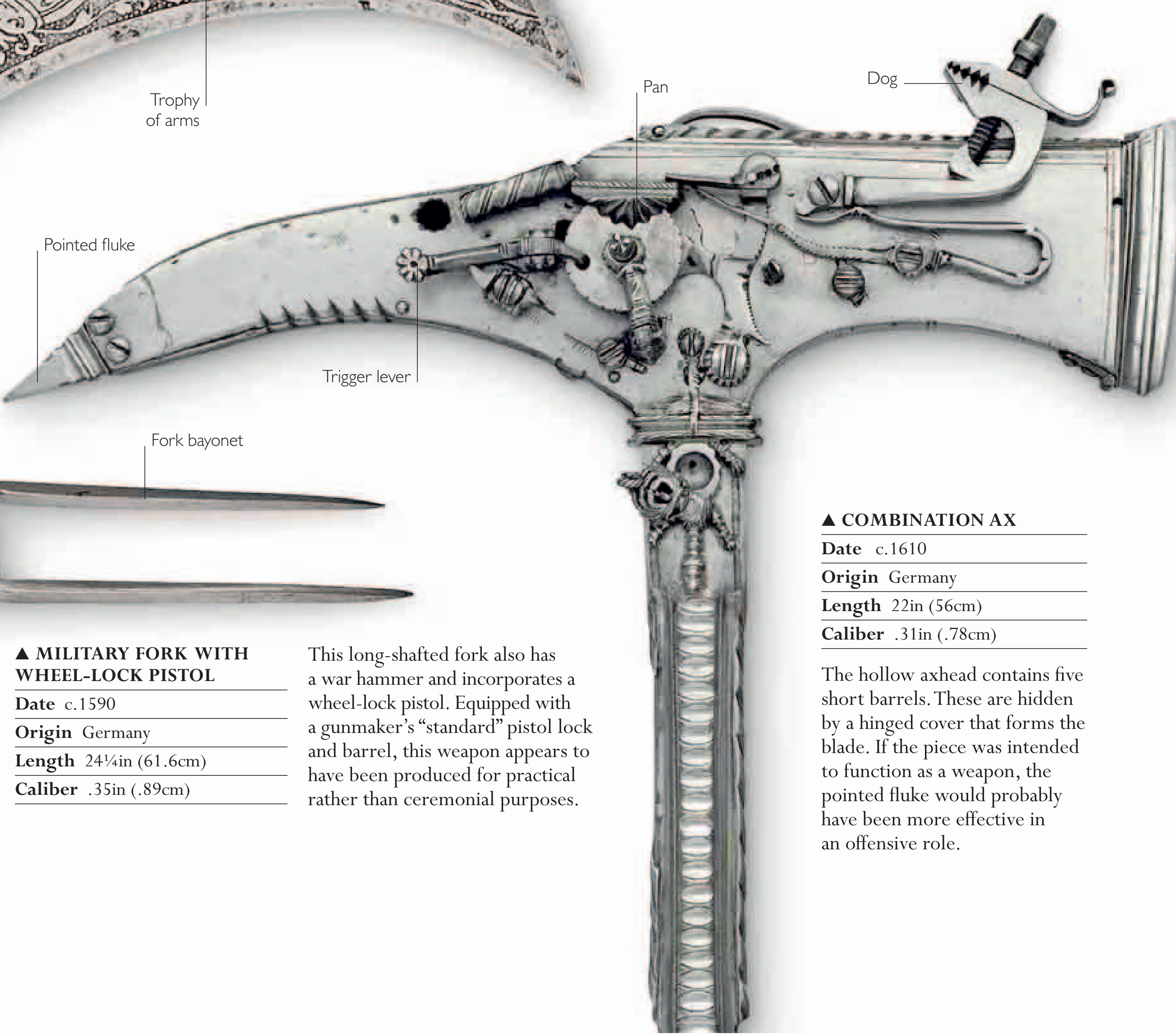
Date	c.1560
Origin	Germany
Length	23in (58.5cm)
Caliber	.31in (.78cm)

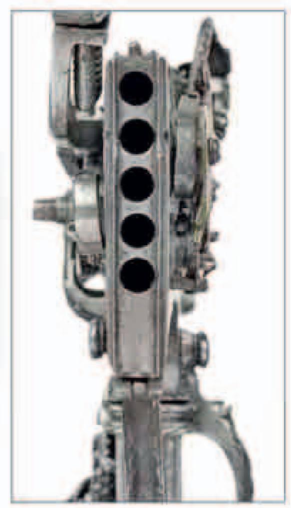
The head of this wheel-lock pistol has six pointed flanges, each pierced with a trefoil shape. The lock incorporates a simple safety catch that engages with the sear, a part of the mechanism that holds back the dog before the trigger is pulled. The hollow shaft at the rear of the gun forms another barrel. It contains a compartment that can be accessed by opening the hinged pommel.



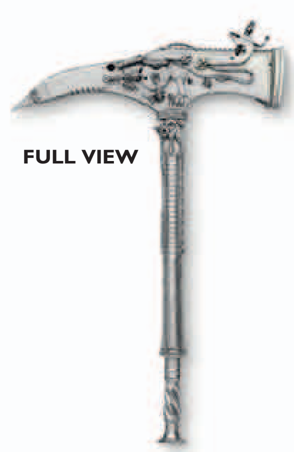



SIDE VIEW OF DOG





BARREL DETAIL



FULL VIEW

▲ MILITARY FORK WITH WHEEL-LOCK PISTOL

Date	c.1590
Origin	Germany
Length	24¼in (61.6cm)
Caliber	.35in (.89cm)

This long-shafted fork also has a war hammer and incorporates a wheel-lock pistol. Equipped with a gunmaker's "standard" pistol lock and barrel, this weapon appears to have been produced for practical rather than ceremonial purposes.

▲ COMBINATION AX

Date	c.1610
Origin	Germany
Length	22in (56cm)
Caliber	.31in (.78cm)

The hollow axhead contains five short barrels. These are hidden by a hinged cover that forms the blade. If the piece was intended to function as a weapon, the pointed fluke would probably have been more effective in an offensive role.

GERMAN FLINTLOCK SPORTING GUN

THE FLINTLOCK YEARS

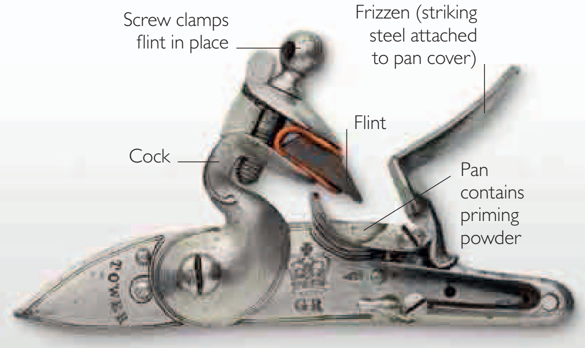
1650–1830

The flintlock mechanism appeared in the late 16th century. It was cheaper and simpler than the wheel-lock, and produced sparks by striking a piece of flint onto a piece of hardened steel. By around 1650, it was being used widely in Europe and North America, although matchlock and wheel-lock guns remained in use. Employed on firearms ranging from pistols to artillery, the flintlock would continue to be the principal firing mechanism for more than 200 years.

TURNING POINT

GUNS FOR ALL

While the wheel-lock (see pp.26–27) brought new opportunities for the creation of smaller, more portable firearms, it was a complex design and expensive to build. By the end of the 16th century, efforts to find a reliable but simpler and cheaper mechanism yielded a new lock. This "flintlock" utilized a piece of natural flint to strike hardened steel, generating sparks that ignited the priming powder. Due to their simple, robust working parts, flintlock guns were cheaper and more reliable than earlier arms and became the principal weapons for sporting and military purposes for the next two centuries.



▲ **THE FLINTLOCK MECHANISM**
In this mechanism, the jaws of a spring-loaded cock hold a piece of flint. The cover of the priming pan and a striking steel are united to form a frizzen. A touchhole to the side of the pan connects to the barrel's breech.

The problems faced by users of matchlock weapons (see p.26) were well-known—wind and rain could extinguish the match-cord or blow exposed priming powder away. As a result, matchlock guns were prone to misfire in bad weather. The smoldering match-cord was also unsafe and inconvenient for the user. An improvement on the matchlock, the wheel-lock, provided an internal system for igniting the priming powder, but it was expensive to manufacture, prone to jam if left spanned (see p.27) for any length of time, and difficult to maintain in the field. The iron pyrite used in the wheel-lock was soft, and wore out quickly. Soon after the wheel-lock evolved, it became clear that a less costly mechanism for firing a gun was needed. By the 1560s, new gunlocks began to appear. They worked on the principle of striking flint on hardened steel to create sparks.

THE FLINTLOCK MECHANISM

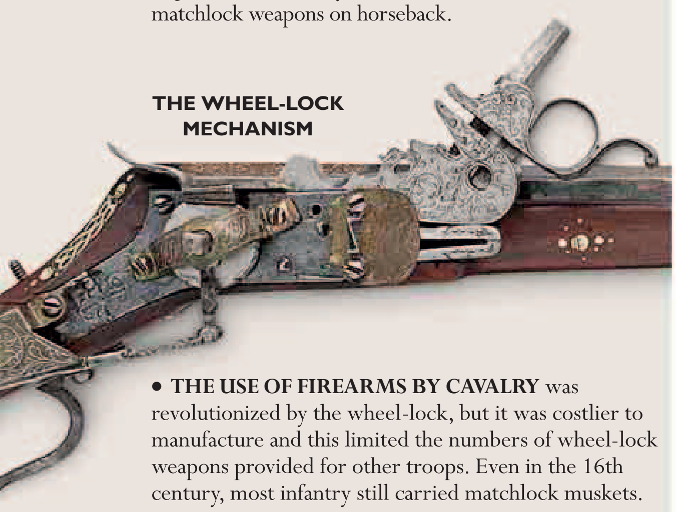
The snaphance, a precursor to the flintlock, was simpler than the wheel-lock. The snaphance's cock held a piece of flint. Pulling the trigger made the cock fall, pushing open the pan cover via an internal link. Simultaneously, the flint scraped against a steel held on a pivoting arm, which produced sparks. These sparks fell into the pan, igniting the priming powder inside. The

» BEFORE

Matchlock and wheel-lock firearms coexisted for a long time, despite the obvious advantages presented by the wheel-lock ignition system. Matchlock weapons were inexpensive and durable and so remained in military service until the latter part of the 17th century.

- **SINGLE-HANDED USE OF FIREARMS** was not possible using the matchlock. It was impractical for cavalry units to load and fire matchlock weapons on horseback.

THE WHEEL-LOCK MECHANISM



- **THE USE OF FIREARMS BY CAVALRY** was revolutionized by the wheel-lock, but it was costlier to manufacture and this limited the numbers of wheel-lock weapons provided for other troops. Even in the 16th century, most infantry still carried matchlock muskets.

- **PORTABLE, HANDHELD GUNS** became a reality in the early 16th century. The wheel-lock enabled guns to be carried primed and ready to fire. As a gun no longer required live fire, it was possible to carry a small weapon in a pocket, spurring the development of the pistol.

> "… **easier** to use, **quicker** and of **less hindrance** to the user… as well as **cheaper**…"
>
> *FROM A LETTER MENTIONING SNAPHANCES TO THE VENETIAN AMBASSADOR IN ENGLAND*
> **WRITTEN BY THE DOGE AND SENATE OF VENICE, NOVEMBER 6, 1613**

touchhole relayed the ignition flash to the breech of the barrel, firing the main gunpowder charge.

The snaphance remained popular in parts of Europe until the 19th century but, while regional styles existed, the greatest influence on its design came from France. In the late 1600s, French gunmakers published design books depicting fashionable shapes for components and their decoration. Many gunmakers in western Europe adopted these enthusiastically.

The design of the snaphance was simplified to create the first true flintlock, in which the separate pan cover and steel were combined to create a part called the frizzen. This opened when struck by the flint (see p.303). Uniting these parts into a single piece made the flintlock cheaper to manufacture and far more reliable. The flintlock had far fewer parts than the wheel-lock—a late 17th-century flintlock might have just 16 parts compared to a wheel-lock's 40. This simplicity of design allowed flintlocks to be built more quickly.

THE FLINTLOCK IN USE

All three gunlocks—the matchlock, wheel-lock, and flintlock—remained in use throughout the 17th century, but the advantages of the flintlock were obvious. By the early 18th century, it had been adopted widely. For the armies, it was cost-effective technology that could be applied toward manufacturing firearms in large numbers to standardized patterns. Gunmakers could fit a flintlock to all kinds of firearms, from a cavalry pistol to an artillery piece. Guns now became affordable for the civilian population, too. The flintlock provided travelers with useful firearms for self-defense, sportsmen with guns which were both efficient and fashionable, and duelists with weapons of deadly reliability.

Refinement of the flintlock technology continued into the 19th century, but even in its most efficient form, it had its drawbacks. Smoke produced by flintlock weapons could alert game to the presence of a hunter. The flint needed to be kept in precisely the right shape and place, and the touchhole needed to be kept clear of residue. The mechanism's exposed priming made it susceptible to bad weather. Gunmakers tried to keep the mechanism waterproof by designing a raised rib around the pan to keep out moisture, but this did not work completely. The solution to these problems came in the form of gunlocks using chemicals called fulminates (see p.80) as primers. Chemical ignition systems heralded a new era for firearms development.

▼ **FLINTLOCKS IN WAR**
By the 18th century, the flintlock musket was the main infantry weapon in Europe and North America, and featured prominently in the American Revolutionary War. At the Battle of Brandywine in 1777, American troops put up a stiff resistance before being defeated by British forces. Seen here are American soldiers firing their flintlock muskets in volleys.

AFTER »

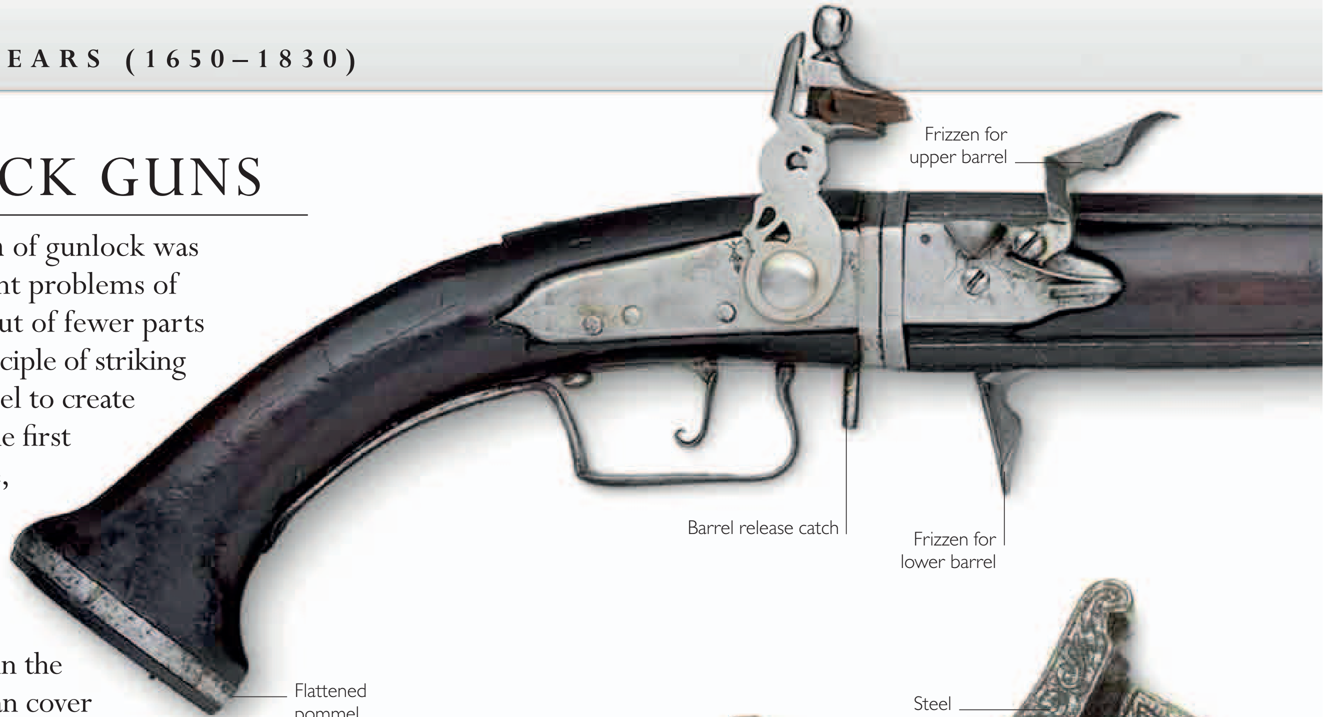
The flintlock mechanism continued to be used into the 1850s, but gradually gave way to a more reliable firing mechanism—the percussion cap (see pp.80–81)—which rendered it obsolete.

- **FLINTLOCK MUSKETS** were produced en masse in the late 17th century to equip armies in Europe. Large-scale military firearms production became possible in the early 18th century, and standardized patterns of flintlock weapons became available to the armies.
- **FLINTLOCK PISTOLS** were used widely as weapons for self-defense and in dueling in the 18th century. These firearms continued to be standardized into the 19th century, resulting in plain-looking mass-produced guns.
- **PERCUSSION CAPS** began replacing the flintlock in most of Europe by the 1830s. Flintlock weapons were gradually upgraded by converting them to employ percussion caps.

THE PERCUSSION CAP MECHANISM

EARLY FLINTOCK GUNS

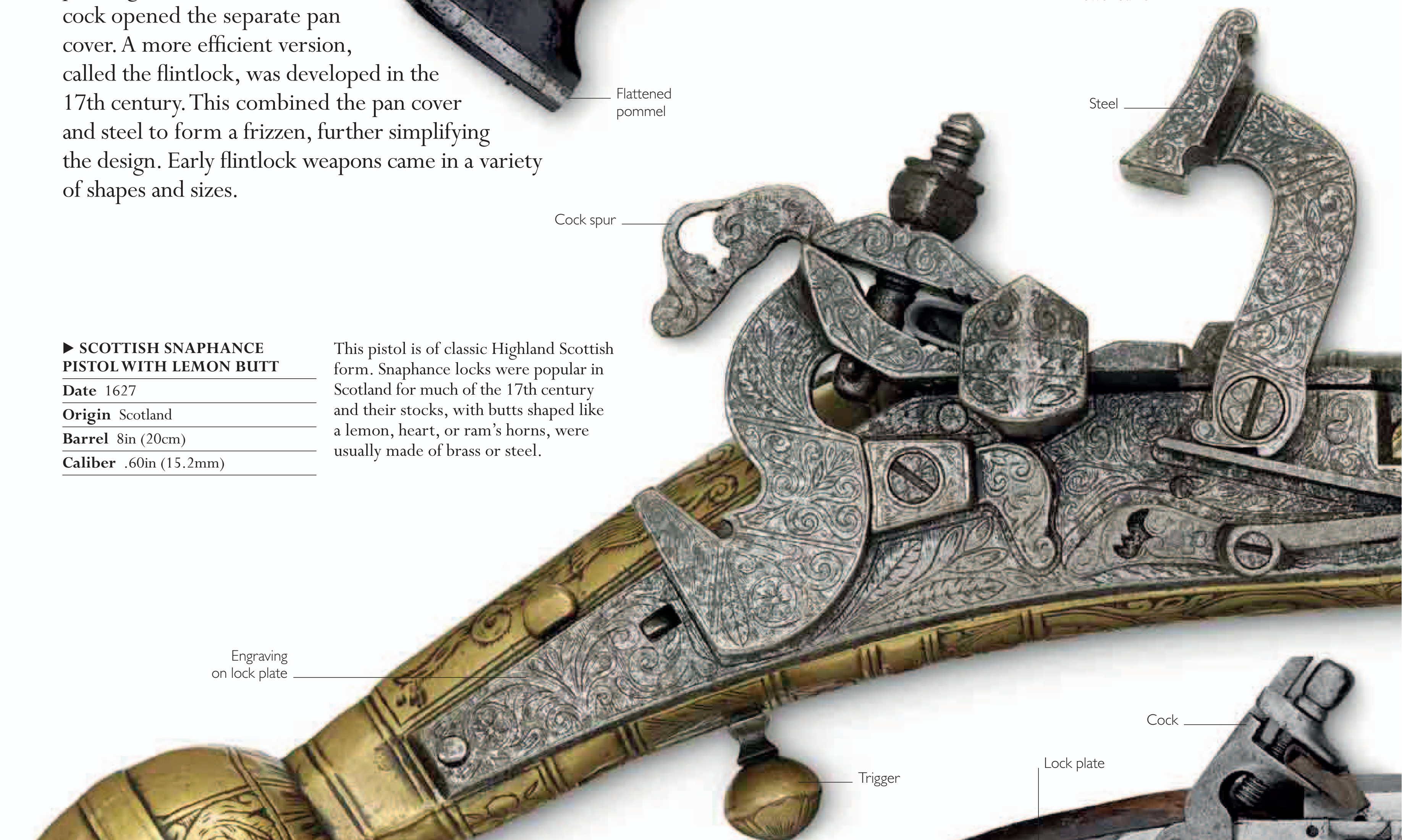
Around the 1560s, a new form of gunlock was developed to overcome the inherent problems of the wheel-lock (see p. 38). Made out of fewer parts than its predecessor, it used the principle of striking a piece of flint against hardened steel to create sparks to ignite priming powder. The first form of this lock was the snaphance, which had a steel on the end of a pivoting arm. Movement of the cock opened the separate pan cover. A more efficient version, called the flintlock, was developed in the 17th century. This combined the pan cover and steel to form a frizzen, further simplifying the design. Early flintlock weapons came in a variety of shapes and sizes.

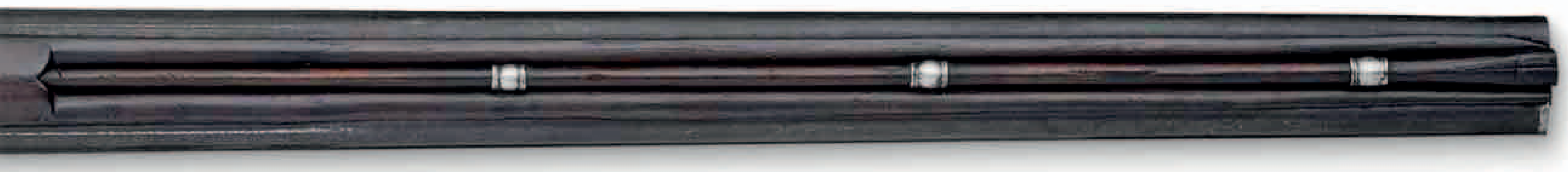


▶ SCOTTISH SNAPHANCE PISTOL WITH LEMON BUTT

Date	1627
Origin	Scotland
Barrel	8in (20cm)
Caliber	.60in (15.2mm)

This pistol is of classic Highland Scottish form. Snaphance locks were popular in Scotland for much of the 17th century and their stocks, with butts shaped like a lemon, heart, or ram's horns, were usually made of brass or steel.

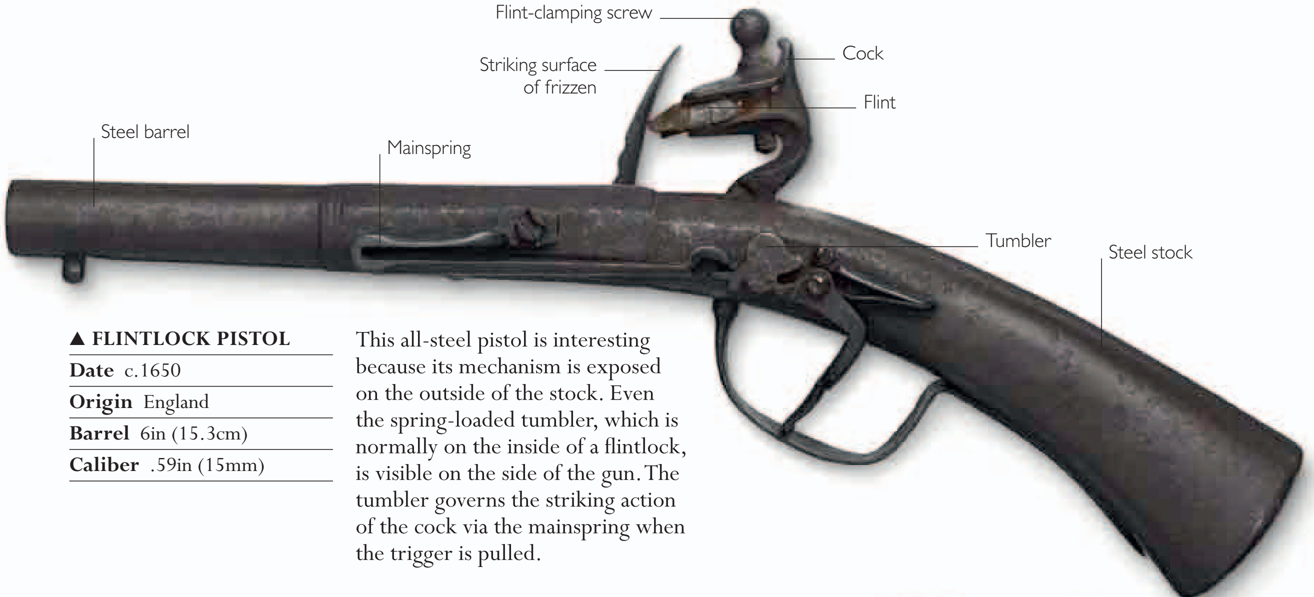




▲ DUTCH DOUBLE-BARRELED FLINTLOCK

Date c.1650
Origin Netherlands
Barrel 19¾in (50.3cm)
Caliber .51in (13mm)

Multibarreled pistols gave travelers the advantage of additional firepower if attacked. The barrels on this pistol can be rotated by hand, in what is known as the Wender system. Once the upper barrel has been fired, a catch is drawn back to allow the two to be turned, bringing the unfired barrel up from beneath. Each barrel has its own pan and frizzen.



▲ FLINTLOCK PISTOL

Date c.1650
Origin England
Barrel 6in (15.3cm)
Caliber .59in (15mm)

This all-steel pistol is interesting because its mechanism is exposed on the outside of the stock. Even the spring-loaded tumbler, which is normally on the inside of a flintlock, is visible on the side of the gun. The tumbler governs the striking action of the cock via the mainspring when the trigger is pulled.

▲ ENGLISH FLINTLOCK PISTOL

Date c.1650
Origin England
Barrel 14¼in (34.2cm)
Caliber .57in (14.5mm)

English gunmakers produced many thousands of plain but functional military firearms during the period of the English Civil War in the middle of the 17th century. This pistol is of the type that was usually issued in pairs to cavalry troopers and carried in two holsters mounted on the front of the saddle. It has a lock plate and stock shaped like those of a wheel-lock, which was a fashionable design at this time.

FLINTLOCK PISTOLS (1650–1700)

In the second half of the 17th century, flintlock firearms in Europe were developed into the form they were to keep until well into the 19th century. Various flintlock mechanisms had been in use by the middle of the 17th century, but by 1700 the "French" design of lock had become the most common throughout Europe. Seen predominantly in the "sear" or cock-release mechanism underneath the lock plate of the gun, French influence was also considerable on the form and decoration of pistols and other firearms. However, regional styles, such as those in Austria and Silesia (in modern-day Poland, Germany, and the Czech Republic), continued to prosper.

▲ AUSTRIAN HOLSTER PISTOL

Date	c.1690
Origin	Austria
Barrel	14in (35.5cm)
Caliber	.64in (16.2mm)

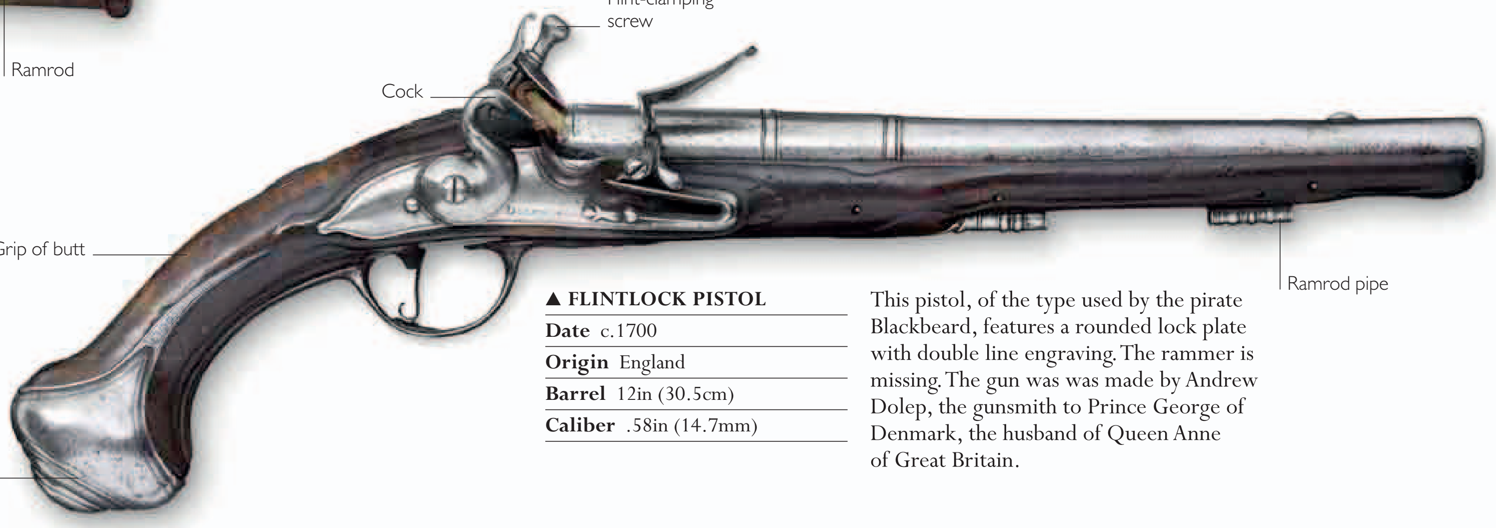
Holster pistols were heavy, with long barrels and metal butt caps. Made in Vienna by Lamarre, this ornate example, although certainly atypical in the extent and high quality of its decoration, represents the state of the gunmaker's art as it was in the last decades of the 17th century.

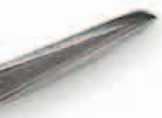
FULL VIEW

▲ SILESIAN HOLSTER PISTOL

Date	c.1680
Origin	Silesia
Barrel	14in (35.5cm)
Caliber	.54in (13.7mm)

This large, sophisticated holster pistol was made in the principality of Teschen (now divided between the Czech Republic and Poland), but shows considerable German influence in the angular shape and beveled edges of its lock. The staghorn inlaid decoration of the stock is also of German origin and indicates that the gun was made as a presentation piece.





▲ FLINTLOCK PISTOL

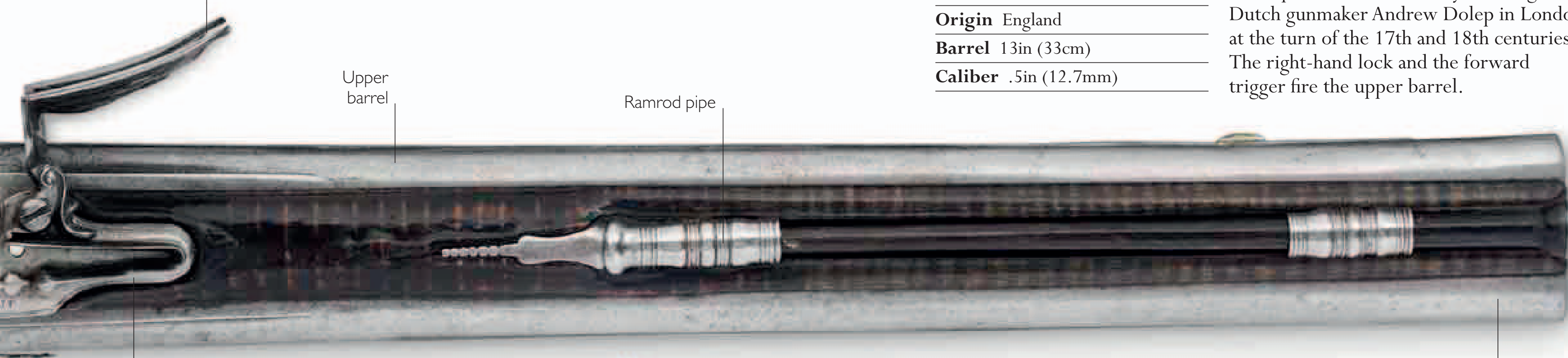
Date	c.1700
Origin	England
Barrel	12in (30.5cm)
Caliber	.58in (14.7mm)

This pistol, of the type used by the pirate Blackbeard, features a rounded lock plate with double line engraving. The rammer is missing. The gun was was made by Andrew Dolep, the gunsmith to Prince George of Denmark, the husband of Queen Anne of Great Britain.

▼ DOUBLE-BARRELED PISTOL

Date	1700
Origin	England
Barrel	13in (33cm)
Caliber	.5in (12.7mm)

This is one of a pair of excellent English twin-lock, double-barreled, over-and-under pistols. It was made by the émigré Dutch gunmaker Andrew Dolep in London at the turn of the 17th and 18th centuries. The right-hand lock and the forward trigger fire the upper barrel.



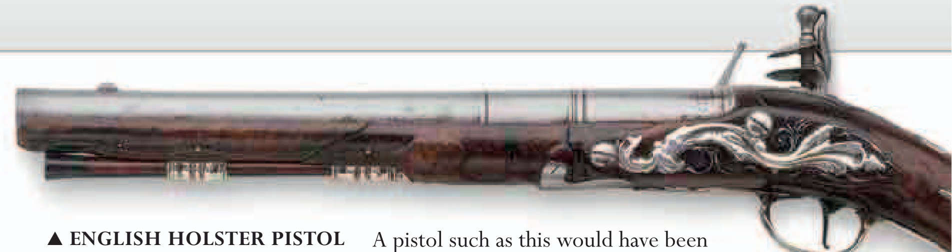
▲ FLEMISH FLINTLOCK PISTOL

Date	c.1700
Origin	Netherlands
Barrel	10½in (26cm)
Caliber	.57in (14.4mm)

During this period, even everyday firearms frequently received some embellishment in the shape of carving. Some were also given silver mountings, as can be seen on this piece by the Flemish gunmaker Guillaume Henoul.

FLINTLOCK PISTOLS (1701–75)

During this period, decorated silver mounts and the occasional use of inlaid wire became common on pistols for private use, while military pistols were still handsome pieces but rather plain. Although nearly all guns of the time were loaded through the muzzle, some pistols were breech-loading weapons, made with barrels that unscrewed for loading at the breech, which could be quicker and easier.



▲ ENGLISH HOLSTER PISTOL

Date	c.1720
Origin	England
Barrel	10in (25.4cm)
Caliber	.64in (16.2mm)

A pistol such as this would have been carried in a holster on the saddle of a horse (gun holsters worn by people were later inventions). After being discharged, holster pistols were often used as bludgeons.

▲ SPANISH BREECH-LOADING PISTOL

Date	c.1725
Origin	Spain
Barrel	10in (25.4cm)
Caliber	.55in (13.9mm)

The miquelet lock, like the flintlock, had a combined steel and pan cover. But its mainspring, which powered the cock, was external, while that of a true flintlock was inside. This miquelet lock pistol is unusual in having a breechblock that screws out with one full turn of the trigger guard to which it is attached, allowing the ball and powder charge to be inserted.

▲ WILSON PISTOL

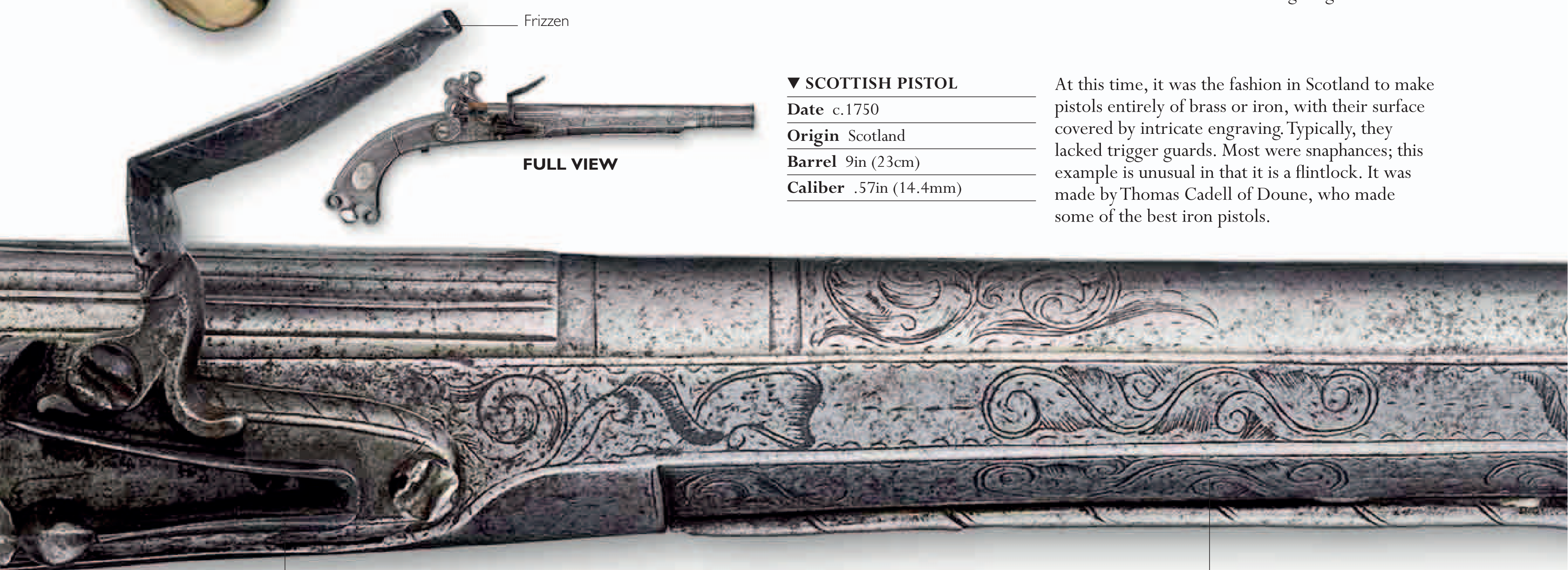
Date	c.1730
Origin	UK
Barrel	5½in (13cm)
Caliber	.59in (15.1mm)

Robert Wilson was a maker of fine pistols during the 18th century. His firearms were sought-after collector's pieces and of the sort used by the famous highwayman Dick Turpin. Paired pistols were usually either for dueling or came in a boxed collector's set.

▲ BRITISH HEAVY DRAGOON PISTOL

Date	1747
Origin	England
Barrel	12in (30.5cm)
Caliber	.65in (16.5mm)

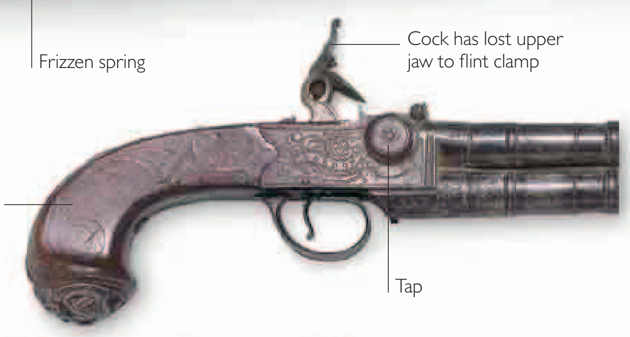
Unlike pistols for private use, military pistols were quite plain. Officers in the French chasseurs, hussars, and dragoons generally carried flintlock pistols similar to this British example. One of a pair, it has a heavy brass butt plate that could be used as a club in hand-to-hand fighting.



▼ SCOTTISH PISTOL

Date	c.1750
Origin	Scotland
Barrel	9in (23cm)
Caliber	.57in (14.4mm)

At this time, it was the fashion in Scotland to make pistols entirely of brass or iron, with their surface covered by intricate engraving. Typically, they lacked trigger guards. Most were snaphances; this example is unusual in that it is a flintlock. It was made by Thomas Cadell of Doune, who made some of the best iron pistols.



◀ DOUBLE-BARRELED TAP-ACTION PISTOL

Date	1763
Origin	UK
Barrel	2in (5.1cm)
Caliber	.22in (5.6mm)

In this pistol, a rotating rod—operated by a small "tap" handle on the left side—lies beneath the cock. The pan is formed out of a shallow channel in the rod. A touchhole in the pan connects with the upper barrel. Once this barrel is fired, the tap is turned and another pan appears, whose touchhole is connected to the lower barrel. This enables two shots to be fired in quick succession.

▲ LIÈGE PISTOL

Date	1765
Origin	Belgium
Barrel	9in (23cm)
Caliber	.62in (15.7mm)

Made in the city of Liège by M. Delince, this holster pistol appears to have been shortened at the muzzle, and shows signs of heavy use. This example lacks the internal reinforcing bridle, which was standard at the time, to stop the frizzen screw from breaking under the force of the falling cock.

FLINTLOCK PISTOLS (1776–1800)

In the late 18th century, flintlock firearms achieved a state of technical perfection and elegance that would last until the flintlock gave way to percussion weapons in the 19th century. Certain styles became popular, such as the "Queen Anne" pistol in UK, with its characteristic "cannon" barrel. Refinements in the flintlock mechanism were relatively few, but included a variant called the box-lock mechanism, in which the cock was placed centrally within the pistol, making the gun easier to carry.

▲ QUEEN ANNE PISTOL

Date 1775
Origin UK
Barrel 4½in (11.7cm)
Caliber .46in (11.7mm)

The distinctive form of the Queen Anne pistol continued long after the eponymous lady's death in 1714. The tapered "cannon" barrel screwed into a standing breech, in which the lock plate, trigger plate, and butt strap were forged in one piece. This double-barreled example is by Griffin and Tow.

▲ RAPPAHANNOCK PISTOL

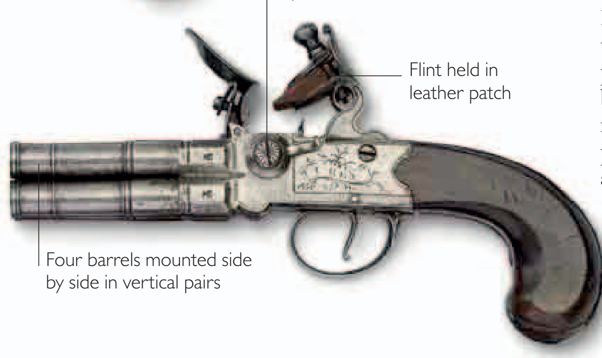
Date c.1776
Origin US
Barrel 9in (23cm)
Caliber .69in (17.5mm)

At the Rappahannock Forge near Falmouth, Virginia, Scottish émigré James Hunter produced the first American-manufactured military pistol. It was a copy of the British Light Dragoon pistol and was used by the Light Dragoons in the Continental Army.

▲ FRENCH MODÈLE 1777 PISTOL

Date 1782
Origin France
Barrel 8½in (21.5cm)
Caliber .69in (17.5mm)

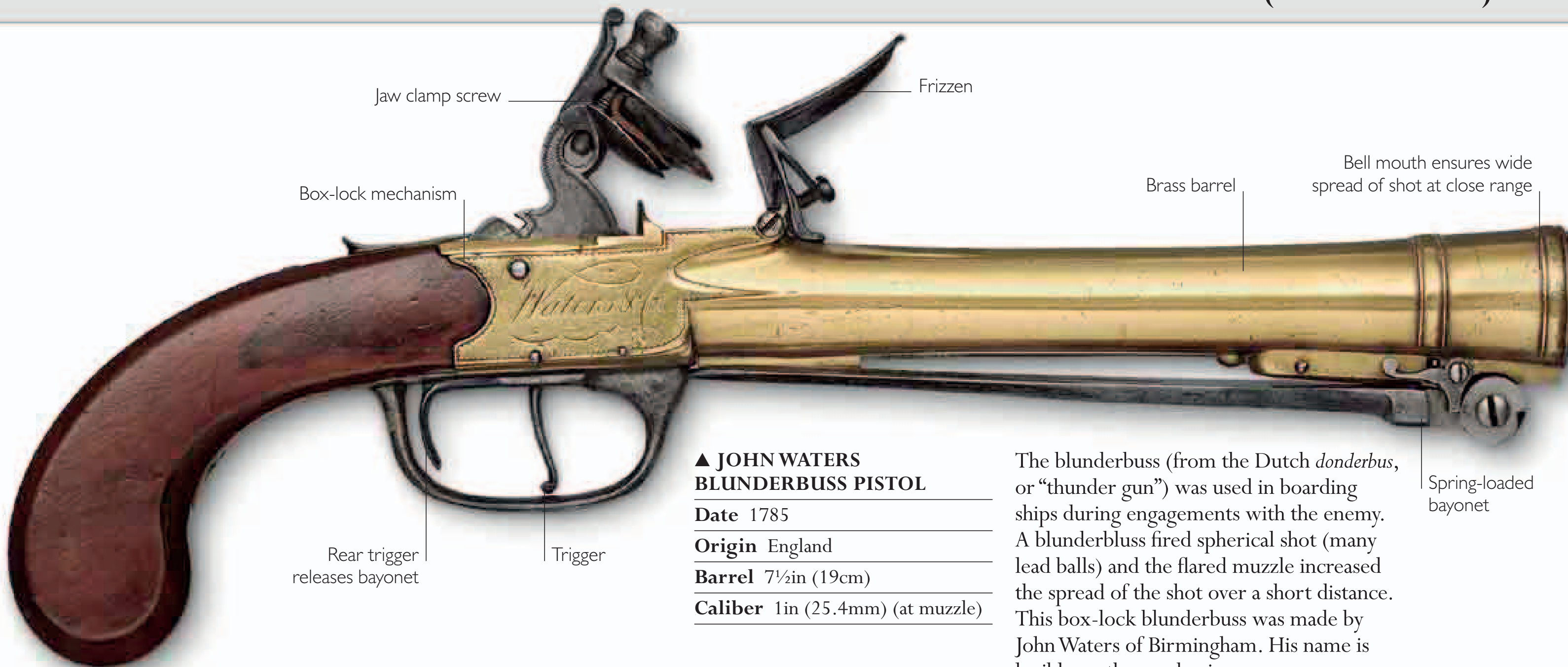
French military firearms were well constructed. This cavalry pistol has a lock mechanism built within a brass body and it lacks a forestock. Its ramrod passes through the lock body and into the wooden butt.



▶ FOUR-BARRELED TAP-ACTION PISTOL

Date 1780
Origin UK
Barrel 2½in (6.35cm)
Caliber .38in (9.6mm)

A revolver is a gun with a number of chambers—each carrying a round—in a revolving cylinder. An alternative to this system was to multiply the number of barrels. Two barrels, each with its own lock, were quite common, and four—and even six—became feasible with the invention of the tap (see p.45). The taps, one for each vertical pair, presented priming for each of the two lower barrels when turned.



▲ JOHN WATERS BLUNDERBUSS PISTOL

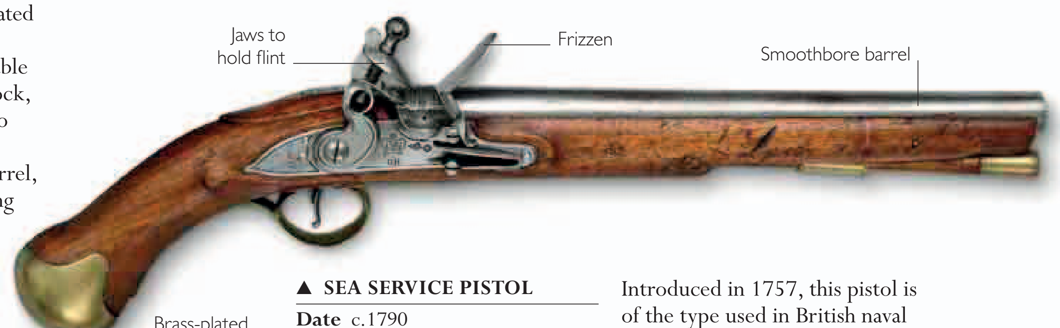
Date 1785
Origin England
Barrel 7½in (19cm)
Caliber 1in (25.4mm) (at muzzle)

The blunderbuss (from the Dutch *donderbus*, or "thunder gun") was used in boarding ships during engagements with the enemy. A blunderbluss fired spherical shot (many lead balls) and the flared muzzle increased the spread of the shot over a short distance. This box-lock blunderbuss was made by John Waters of Birmingham. His name is legible on the mechanism.

▲ PUNJABI FLINTLOCK PISTOL

Date c.1800
Origin Lahore (in modern-day Pakistan)
Barrel 8½in (21.5cm)
Caliber .55in (14mm)

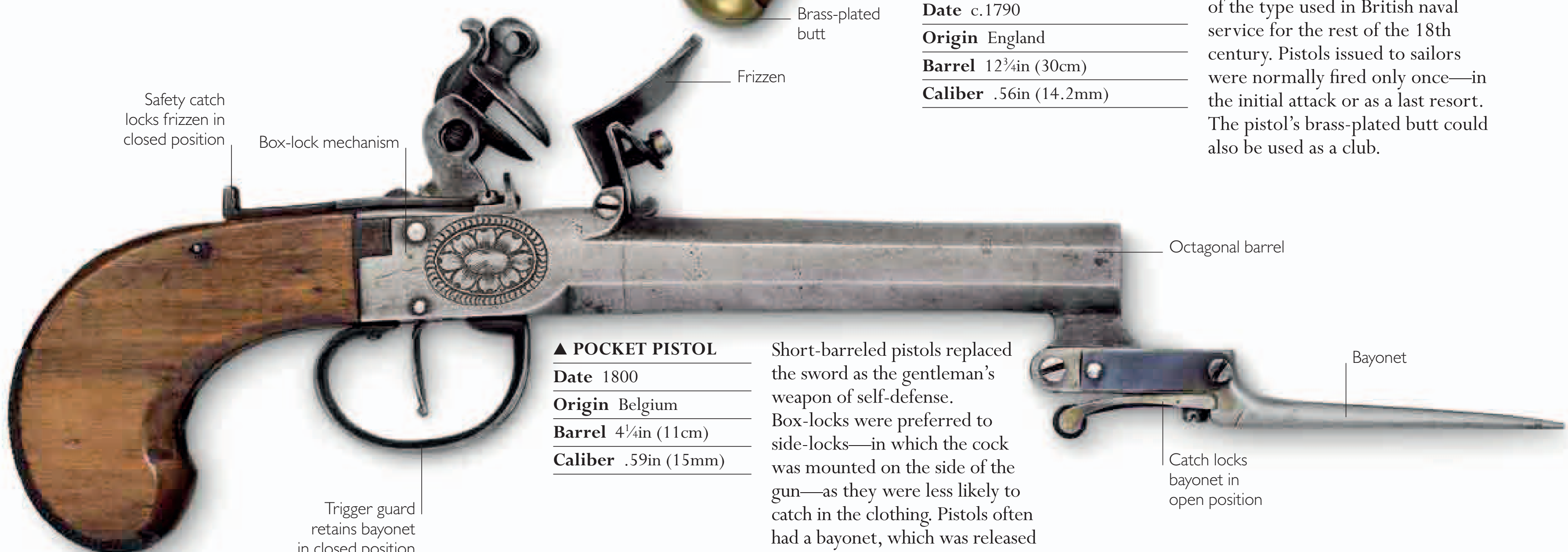
This is one of a pair of superbly decorated pistols made in Lahore. By the early 19th century, Sikh gunmakers were able to fashion the components of a flintlock, although they were mostly devoted to making workaday muskets known as *jazails*. This pistol has a "Damascus" barrel, formed by a process of pattern-welding in which spirally welded tubes were made from specially prepared strips of iron.



▲ SEA SERVICE PISTOL

Date c.1790
Origin England
Barrel 12¾in (30cm)
Caliber .56in (14.2mm)

Introduced in 1757, this pistol is of the type used in British naval service for the rest of the 18th century. Pistols issued to sailors were normally fired only once—in the initial attack or as a last resort. The pistol's brass-plated butt could also be used as a club.



▲ POCKET PISTOL

Date 1800
Origin Belgium
Barrel 4¼in (11cm)
Caliber .59in (15mm)

Short-barreled pistols replaced the sword as the gentleman's weapon of self-defense. Box-locks were preferred to side-locks—in which the cock was mounted on the side of the gun—as they were less likely to catch in the clothing. Pistols often had a bayonet, which was released by pulling back the trigger guard.

FLINTLOCK PISTOLS (1801–30)

By the beginning of the 19th century, the flintlock mechanism had been in use for more than two hundred years but was still the principal ignition system for firearms. Flintlocks fitted to privately purchased weapons, such as the dueling pistol on this page, had some refinements, including the addition of prawls and steadying spurs on the trigger guard, to make the gun easier to aim, but the basic principle of flint on steel remained unchanged. Armies and navies in Europe and North America continued to use flintlock pistols well into the 1830s.

▲ FLEMISH POCKET PISTOL

Date	1805
Origin	Netherlands
Barrel	4¼in (10.9cm)
Caliber	.52in (13.2mm)

This box-lock pocket pistol has an integral spring-loaded bayonet, operated by pulling back on the trigger guard. The catch on its lock prevented the cock from falling accidentally. This kind of safety catch had been present in some pistols since the mid-16th century. This gun's lock plate is engraved and the butt is finely carved—the work of A. Juliard, a Flemish gunmaker of repute.

▲ HARPERS FERRY MODEL 1805 PISTOL

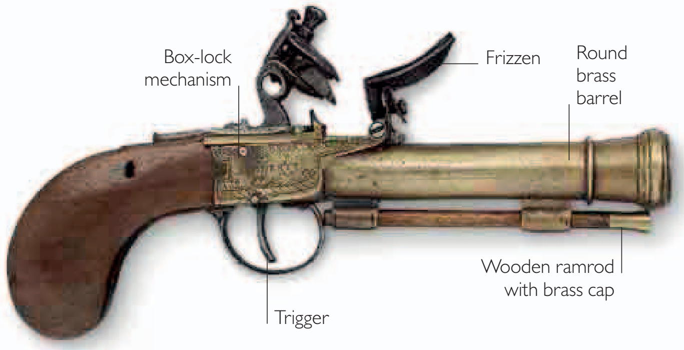
Date	1805
Origin	US
Barrel	10in (25.4cm)
Caliber	.54in (13.7mm)

The Model 1805 was the first pistol manufactured at the newly established Federal Armory and Arsenal at Harpers Ferry (in modern-day West Virginia). It was robust enough to be reversed and wielded as a club if required.

▲ FLINTLOCK DUELING PISTOL

Date	1815
Origin	UK
Barrel	9in (23cm)
Caliber	.51in (13.1mm)

Pistols specifically designed for dueling made their first appearance in Britain after 1780. They were invariably sold as a matched pair, cased, with all the accessories necessary for their use (see pp.106–07). "Saw handle" butts with pronounced prawls and steadying spurs on the trigger guard were later additions.



◀ ITALIAN POCKET PISTOL

Date	1810
Origin	Italy
Barrel	4¾in (12.3cm)
Caliber	.85in (21.6mm)

Gunmaking flourished in post-Renaissance Italy (the English word "pistol" probably derives from Pistoia, a city famous for gun manufacture). Although the industry was in decline by the 19th century, craftsmen like Lamberti, creator of this pistol, still thrived.

▲ FRENCH HOLSTER PISTOL

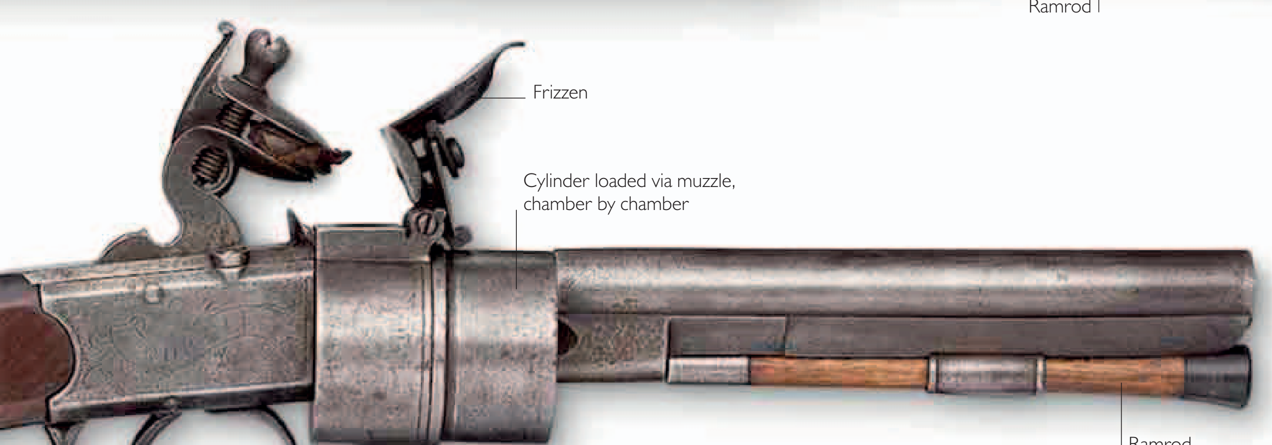
Date	c.1810
Origin	France
Barrel	Not known
Caliber	Not known

Military pistols like this were often well made and robust, but because they were smoothbore, they were not accurate and had limited range. Most were intended for use in extremely close combat. Cavalry usually relied on the sword as the principal weapon, and only used pistols as a last resort.

▲ NEW LAND-PATTERN PISTOL

Date	1810
Origin	UK
Barrel	9in (23cm)
Caliber	.65in (16.5mm)

The British Army's New Land-Pattern Pistol, introduced in 1802, was a competent, sturdy design that remained in service until flintlocks gave way to percussion (see pp.80–81) in the 1840s.



▲ FLINTLOCK REVOLVER

Date	c.1820
Origin	UK
Barrel	5in (12.4cm)
Caliber	.45in (11.4mm)

Around 1680, John Dafte of London designed a pistol with a revolving, multichambered cylinder that was indexed (each chamber rotated into position) manually by the cocking action. Elisha Collier of Boston gained a British patent for an improved version in 1814, and it was produced in London by John Evans in 1819. This slender pistol is less bulky than Collier's design, and was one of the many flintlock revolvers made by European gunmakers in the early 19th century.

▲ TURN-OFF POCKET PISTOL

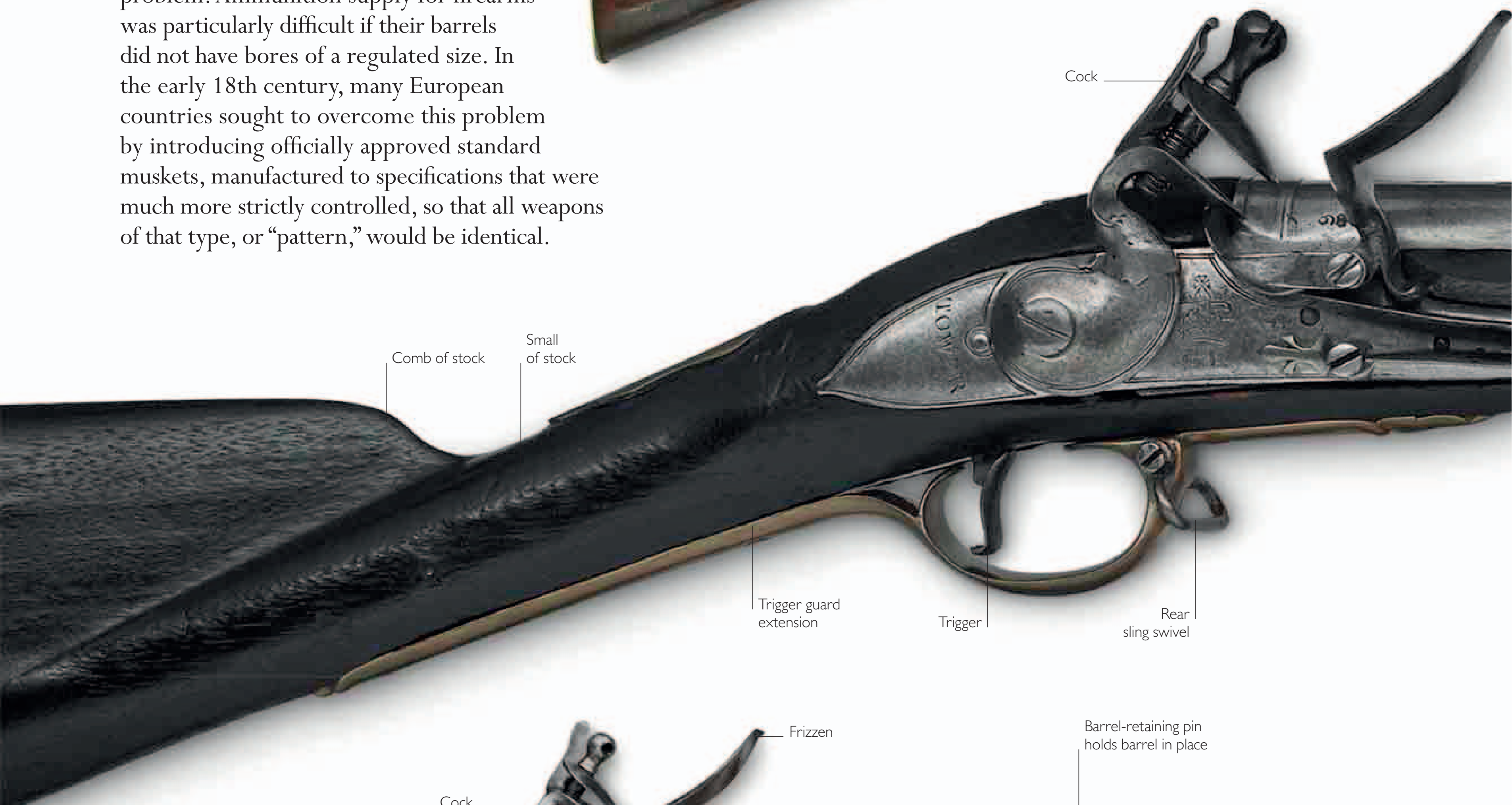
Date	1810
Origin	France
Barrel	1½in (4cm)
Caliber	.52in (13.2mm)

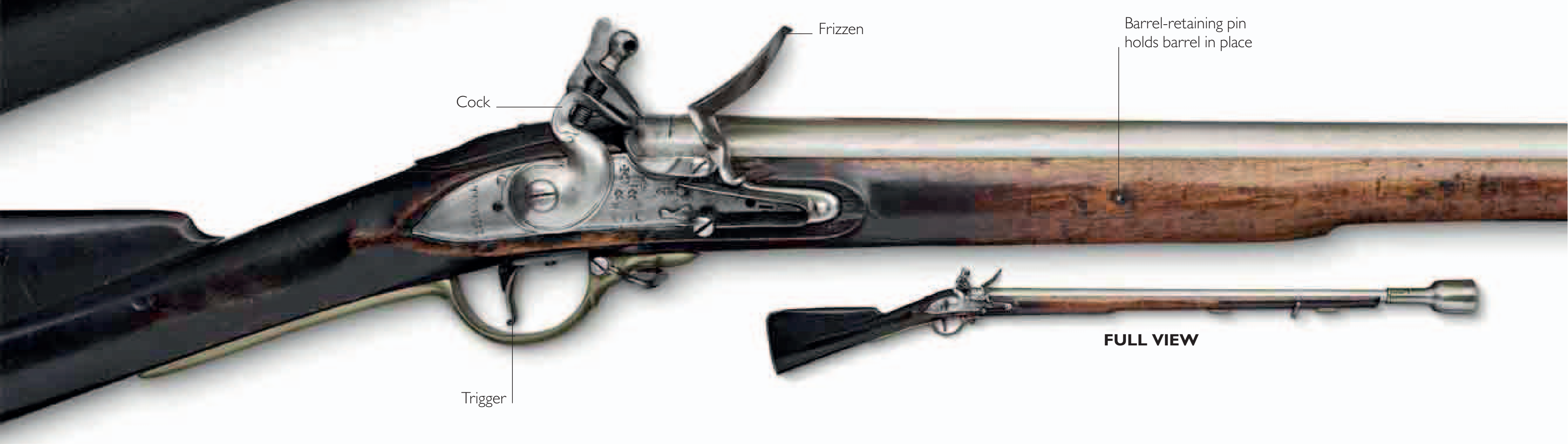
Turn-off pistols were fitted with barrels that could be unscrewed, or "turned off," to reload at the breech. The screw-on barrel allowed this pistol to be loaded with a tighter-fitting ball and thus shoot both straighter and harder. Turn-off pistols were slow to reload, but their small size made them popular for self-defense.

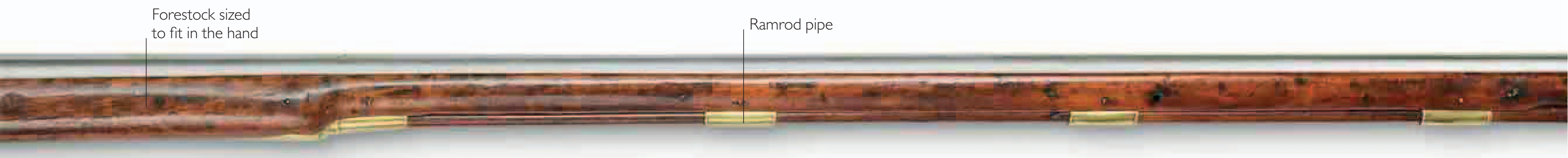
THE FRENCH REVOLUTION
Flintlock muzzle-loaders were still common in France in the 1830s. Firing muskets produced thick, white smoke from burning gunpowder, as seen in this painting of the battle of the rue de Rohan (July 1830) in the French Revolution. At the center, a man in a top hat is priming his lock.

MUSKETS (1650–1769)

Throughout the 17th century, European armies purchased muskets mostly as complete weapons, rather than in parts from various companies that were then assembled by craftsmen. These muskets were made by commercial gunmakers working under contract to government authorities. There was little control over size, shape, and quality, which made maintaining large numbers of firearms a major logistical problem. Ammunition supply for firearms was particularly difficult if their barrels did not have bores of a regulated size. In the early 18th century, many European countries sought to overcome this problem by introducing officially approved standard muskets, manufactured to specifications that were much more strictly controlled, so that all weapons of that type, or "pattern," would be identical.







▲ LONG LAND-PATTERN FLINTLOCK MUSKET

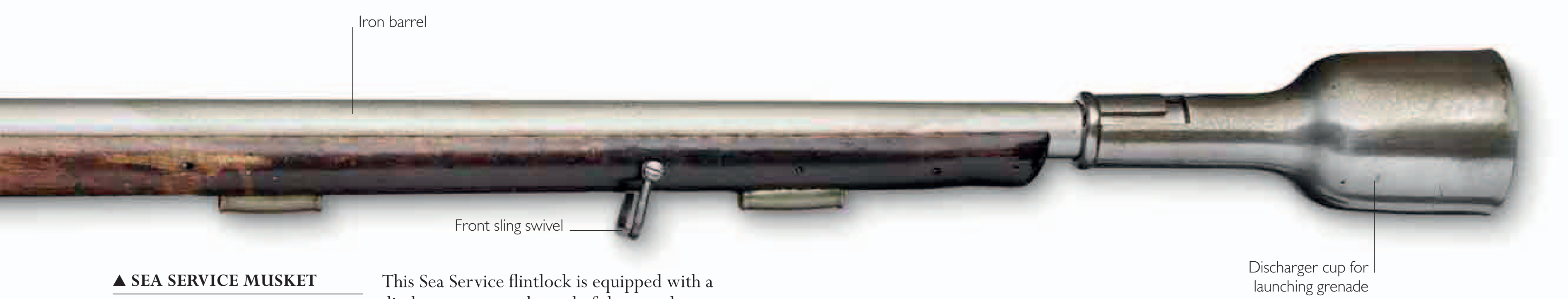
Date	1742
Origin	England
Barrel	46in (116.8cm)
Caliber	.76in (19.3mm)

The original Land-Pattern Musket, or "Brown Bess," was produced in the 1720s. This is a modified version, issued in 1742. It had a new trigger guard, a more pronounced comb to the stock, and a bridle extending from the pan to support the frizzen's pivot screw. This gun was made by Walter Tippin, a Birmingham gunmaker, and is a "sealed pattern," meaning that it was retained in the Tower of London Armoury as a model for other gunmakers producing this type of musket.

▲ BRITISH MUSKET

Date	1750s
Origin	UK
Barrel	44in (111.7cm)
Caliber	.80in (20.3mm)

This musket has the furniture (parts such as butt plate, trigger guard, and ramrod pipe) of a Land-Pattern musket. It may have been produced for naval service rather than use on the battlefield, as Sea Service muskets were usually plainer and simpler than those used by infantry.



▲ SEA SERVICE MUSKET

Date	Mid-18th century
Origin	England
Barrel	37in (94cm)
Caliber	.75in (19mm)

This Sea Service flintlock is equipped with a discharger cup on the end of the muzzle. Developed in the mid-18th century, the discharger was used for firing cast-iron grenades and was an ideal weapon for close-range boarding actions.

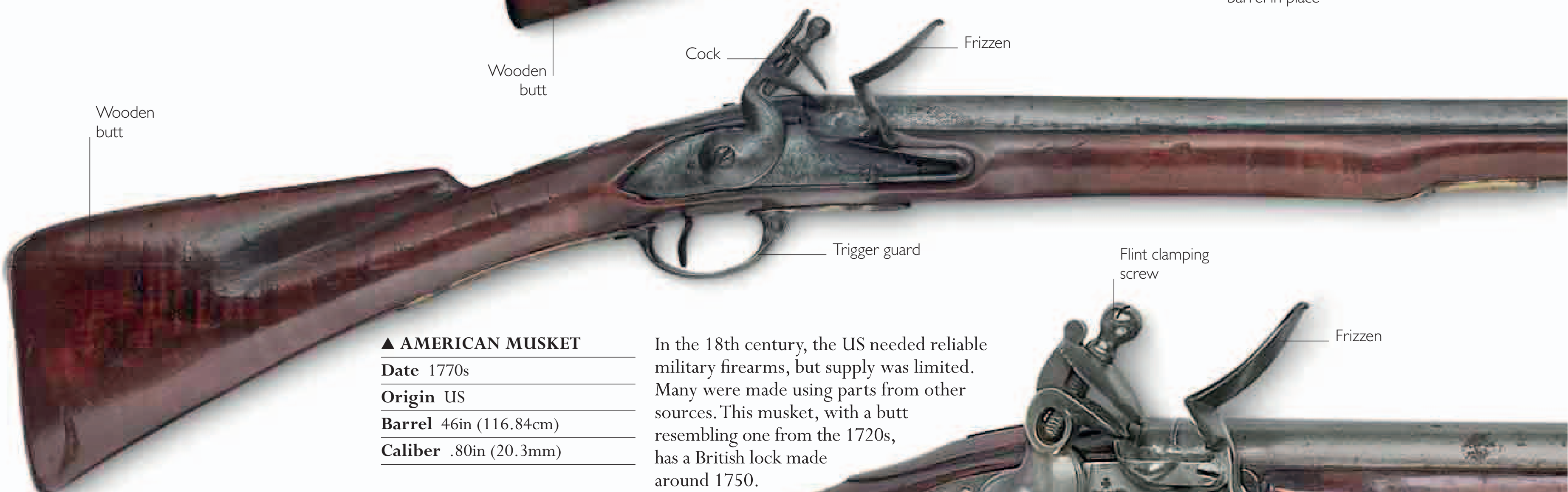
MUSKETS (1770–1830)

In the later years of the 18th century, greater uniformity in shape, size, and bore diameter of muskets had evolved following the introduction of standard patterns of military musket. Most European countries adopted a robust and often handsome form of this weapon that formed the principal firearm for infantry. Some countries, such as Britain, favored a form of construction in which the barrel was held in place on the stock of the gun by iron pins, but many preferred the use of barrel bands, which made removal and reinstallation of the barrel much easier.

▶ AMERICAN MUSKET

Date	1770
Origin	US
Barrel	45in (114.3cm)
Caliber	.80in (20.3mm)

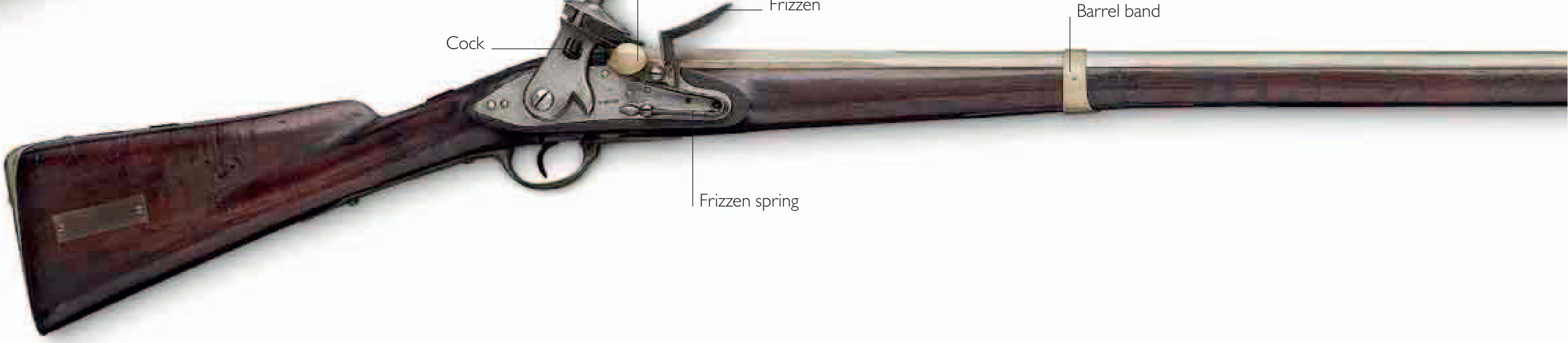
While the rifle is often seen as the archetypal American firearm of the American Revolutionary War (1775–83), many smoothbore muskets were used by American troops. Many of these, such as this one, resembled those used by British forces.



▲ AMERICAN MUSKET

Date	1770s
Origin	US
Barrel	46in (116.84cm)
Caliber	.80in (20.3mm)

In the 18th century, the US needed reliable military firearms, but supply was limited. Many were made using parts from other sources. This musket, with a butt resembling one from the 1720s, has a British lock made around 1750.



▲ **MUSKET MODEL 1795, TYPE I**

Date	1795
Origin	US
Barrel	49in (124.5cm)
Caliber	.69in (17.5mm)

After the end of the Revolutionary War, the US adopted its own pattern of musket, based very closely on the French Charleville Model of 1763/66. This is the first type of the new pattern of US musket produced at Springfield Armory (see pp.62–63). During its service life, this musket underwent several internal mechanical modifications.

▲ **MUSKET MODEL 1795, TYPE II**

Date	1799
Origin	US
Barrel	46¾in (119cm)
Caliber	.69in (17.5mm)

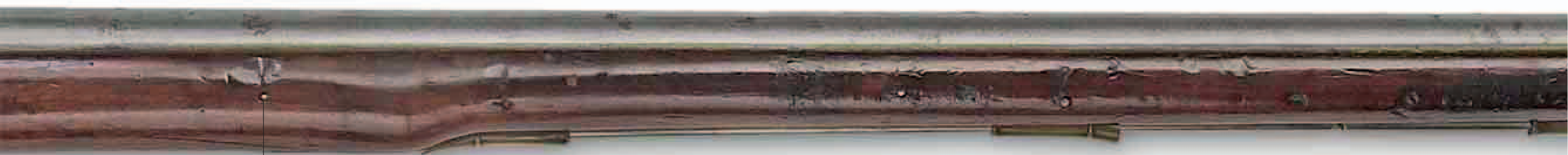
This is a modification of the Type I musket. Examples of the Type I and II muskets were carried by members of the Lewis and Clark Expedition of 1804–06. They were also in general issue to US troops during the War of 1812, between the US and Britain. Built originally at Springfield Armory, Massachusetts, this musket was later also produced at Harpers Ferry (in modern-day West Virginia).

FULL VIEW

▼ **INDIA-PATTERN MUSKET**

Date	1797 onward
Origin	UK
Barrel	39in (99cm)
Caliber	.75in (19mm)

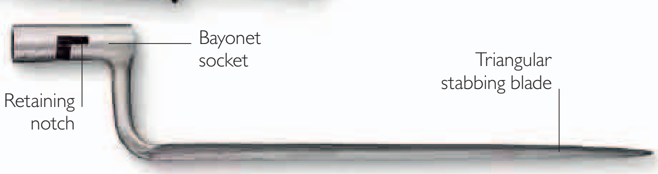
Before the outbreak of war with France in 1793, Britain had been planning a new pattern of musket, but this was not yet in production. To overcome a shortage of weapons, Britain bought British East India Company muskets as an emergency measure. These saw service throughout the Napoleonic Wars (1803–15).

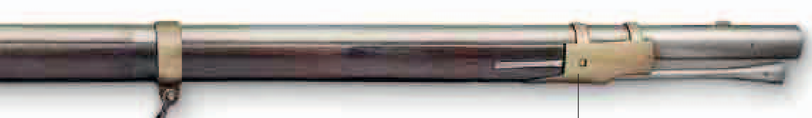


▲ **AUSTRIAN MODEL 1798 MUSKET**

Date	1798
Origin	Austria
Barrel	45in (114.3cm)
Caliber	.65in (16.5mm)

When Emperor Leopold of Austria and King Frederick William of Prussia declared their intention to restore Louis XVI of France to his throne in 1791, Austria found itself outgunned by the French. Eventually, Austria commissioned a new musket, a copy of the French Model 1777, but with some improvements, notably in the way the ramrod could be housed easily in the stock.





◀ **SPANISH MUSKET**

Date	c.1800
Origin	Spain
Barrel	43½in (110.5cm)
Caliber	.72in (18.3mm)

This musket resembles French patterns, but it is one of very few muskets of the time that has a flash guard. The guard is a metal (in this case, brass) disk fixed to the end of the pan. When a soldier fired a musket, a jet of hot gas from the exploding main charge shot out sideways from the touchhole. The flash guard helped to deflect this jet of gas upward, preventing it from hitting a neighboring soldier in the face.

FLINTLOCK RIFLES, CARBINES, AND SHOTGUNS (1650–1760)

Rifles had greater accuracy than smoothbore weapons and were used successfully in hunting. This spurred their military use, in which specialized marksmen, or "sharpshooters," could select and eliminate a particular target. A carbine was usually a lighter version of a military musket, or later, rifle, often of smaller caliber and shorter barrel. Some were specially developed for cavalry, or other troops where a lighter, handier weapon was an advantage.

▲ FLINTLOCK REVOLVING SPORTING GUN

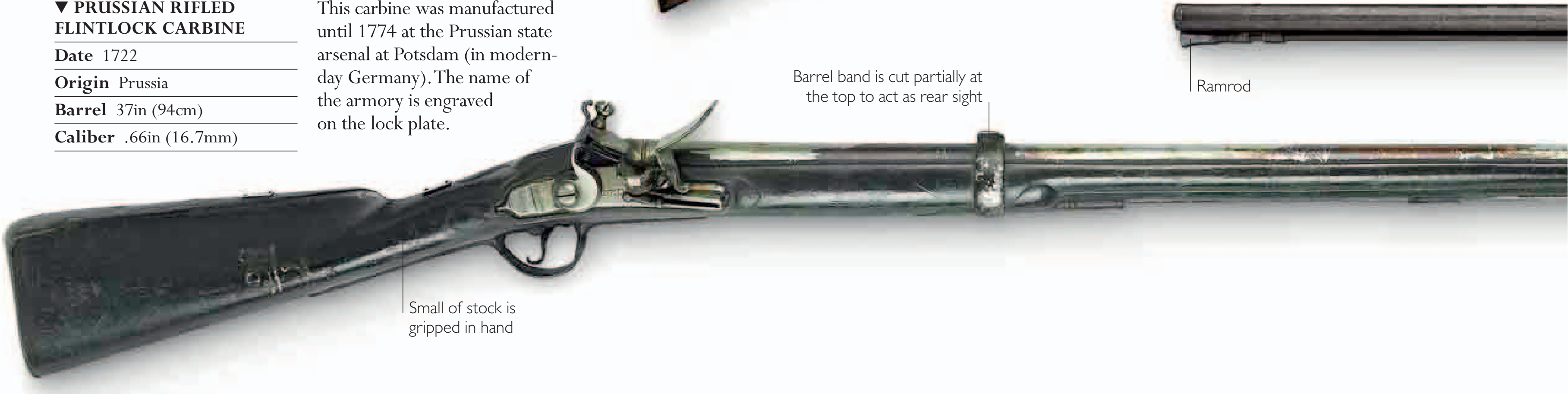
Date	c.1670
Origin	France
Barrel	31¼in (79.5cm)
Caliber	.59in (15.1mm)

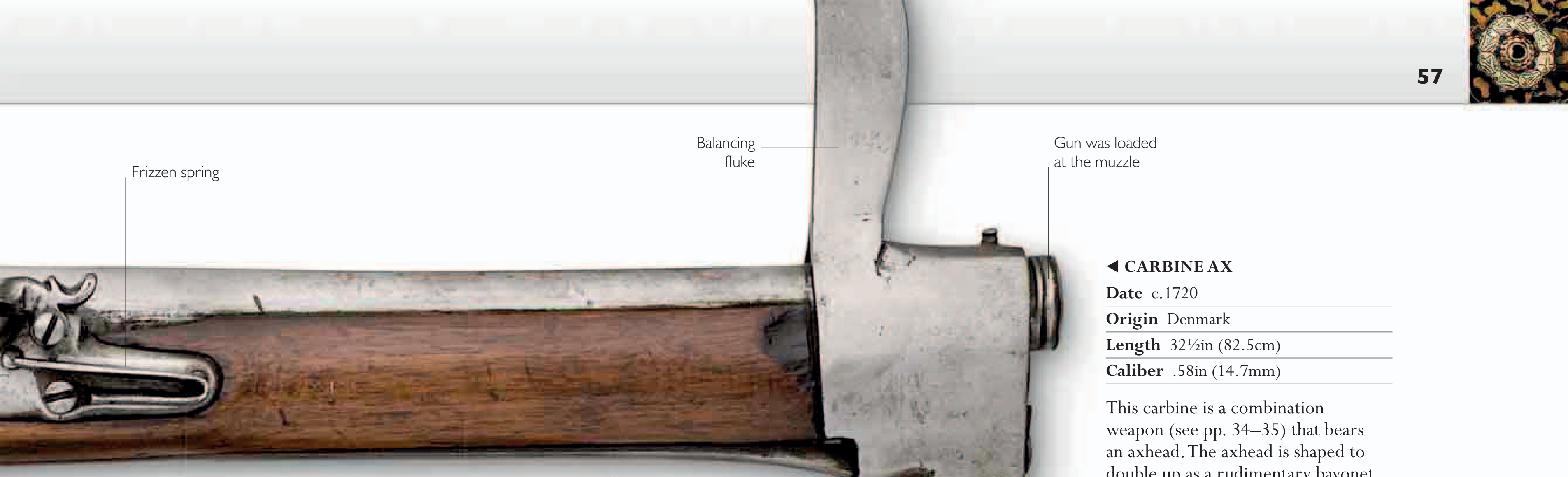
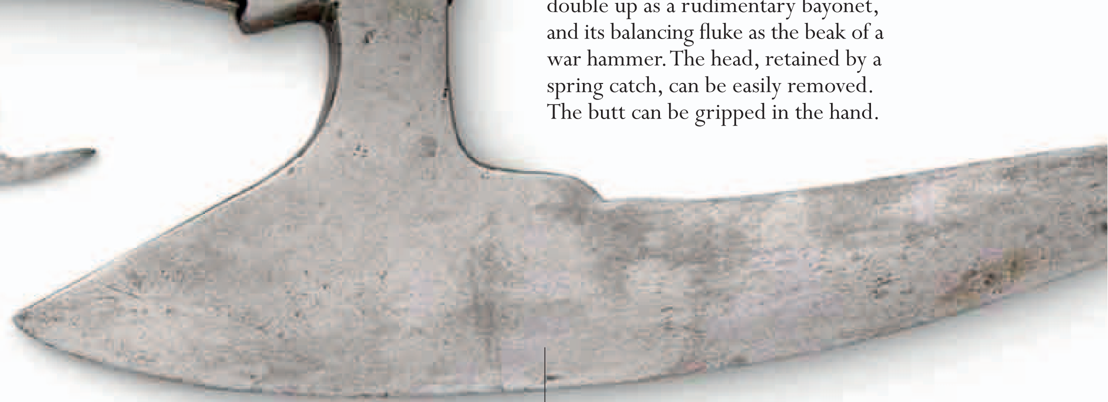
French gunmakers produced some of the finest sporting guns of the 17th century. This rifle has three revolving chambers, each equipped with its own striker and spring. All revolvers, and other multibarrel guns, of the muzzle-loading type were at risk from a dangerous chain reaction, in which firing one chamber could accidentally set off all the others.

▼ PRUSSIAN RIFLED FLINTLOCK CARBINE

Date	1722
Origin	Prussia
Barrel	37in (94cm)
Caliber	.66in (16.7mm)

This carbine was manufactured until 1774 at the Prussian state arsenal at Potsdam (in modern-day Germany). The name of the armory is engraved on the lock plate.



FULL VIEW

◀ **CARBINE AX**

Date c.1720

Origin Denmark

Length 32½in (82.5cm)

Caliber .58in (14.7mm)

This carbine is a combination weapon (see pp. 34–35) that bears an axhead. The axhead is shaped to double up as a rudimentary bayonet, and its balancing fluke as the beak of a war hammer. The head, retained by a spring catch, can be easily removed. The butt can be gripped in the hand.

▼ **LIGHT DRAGOON FLINTLOCK CARBINE**

Date 1756

Origin England

Barrel 36in (91.4cm)

Caliber .66in (16.7mm)

British dragoons carried this carbine during the Seven Years' War (1756–63). It was a scaled-down version of the Long Land-Pattern musket (see pp.52–53), with a shorter barrel and in a smaller caliber.

◀ **PENNSYLVANIA RIFLE**

Date 1760

Origin Colonial America

Barrel 45in (114cm)

Caliber .45in (11.4mm)

This flintlock weapon is an ancestor of the celebrated Kentucky long rifle (see p.97) of later American frontiersmen. In trained hands, it was accurate at up to 1,200ft (365m). The long, rifled barrel made it far more accurate than the muskets used by European armies.

▲ **FLINTLOCK DOUBLE-BARRELED GUN**

Date c.1760

Origin France

Barrel 32in (81.3cm)

Caliber .59in (15.1mm)

This unusual double-barreled shotgun bears the name of its maker, Bouillet of Paris. The firing mechanism, including the flint, is concealed in a box to try to make it waterproof. The two levers in front of the trigger guard cocked the piece ready for discharging the barrels.

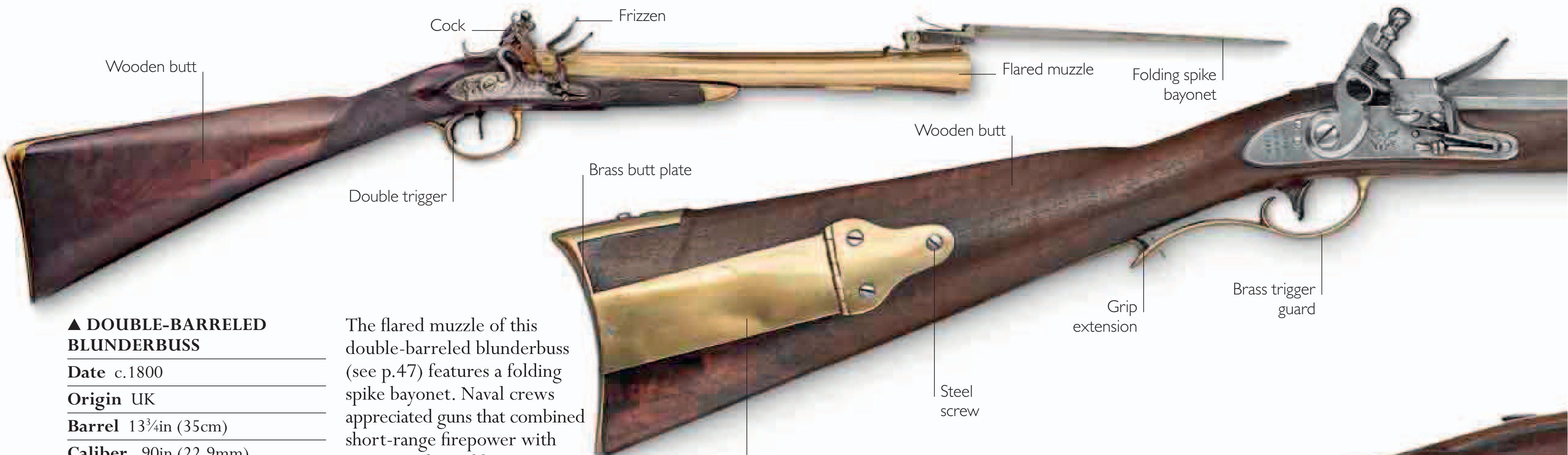
FLINTLOCK RIFLES, CARBINES, AND BLUNDERBUSSES (1761–1830)

During the 18th century, rifled weapons first made their mark on the battlefield. Military rifles were not only accurate, they also allowed soldiers to fire at long-range targets. However, muskets and carbines, all smoothbore weapons at the time, continued to be the most common firearms in most armies, with rifles still being supplied only to elite sharpshooter companies. Blunderbusses, which fired lead shot that spread out over a wide area in just a short distance, provided an excellent weapon for self-defense. In Europe, these were often carried by guards on mail coaches.

▲ ENGLISH FLINTLOCK RIFLE

Date	1791
Origin	England
Barrel	32in (81cm)
Caliber	.68in (17.3mm)

Innovative London gunsmith Henry Nock made several volley guns (see p.83) for the Royal Navy and numbered Ezekiel Baker (see pp.60–61) among his apprentices. Nock designed this flintlock rifle—possibly an officer's private purchase—with nine-groove rifling.



▲ DOUBLE-BARRELED BLUNDERBUSS

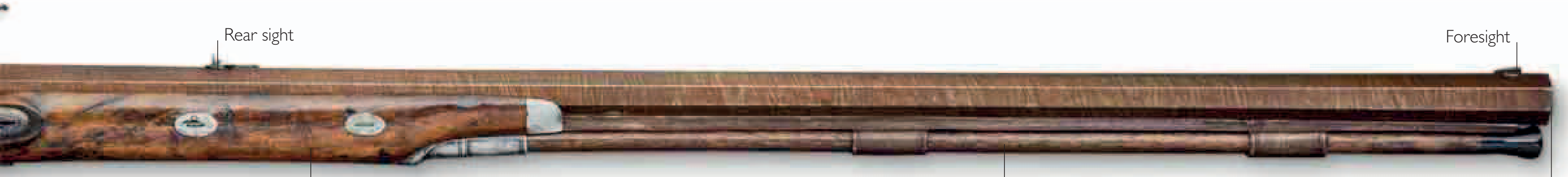
Date	c.1800
Origin	UK
Barrel	13¾in (35cm)
Caliber	.90in (22.9mm) (at muzzle)

The flared muzzle of this double-barreled blunderbuss (see p.47) features a folding spike bayonet. Naval crews appreciated guns that combined short-range firepower with a weapon for stabbing.

▲ CLEMMES FLINTLOCK BLUNDERBUSS

Date	1810
Origin	UK
Barrel	12½in (31.75cm)
Caliber	1.2in (30.5mm) (at muzzle)

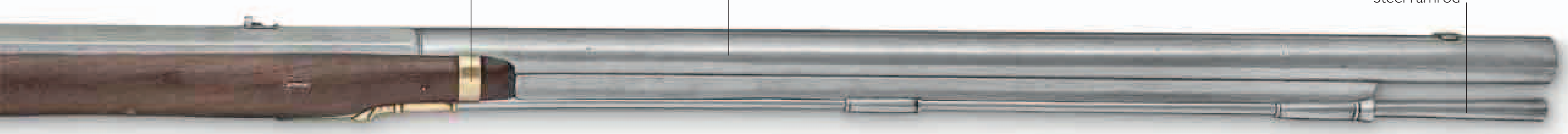
This blunderbuss had a short effective range of around 30 yards (27m), depending on the type of lead shot used. A few larger-diameter shot would have greater penetrating power, while a large number of small shot would cover a target area more completely, leaving fewer chances of missing the target.



▲ HEAVY DRAGOON CARBINE PATTERN 1796

Date	c.1805
Origin	UK
Barrel	26in (66cm)
Caliber	.75in (19mm)

Napoleonic-era carbines such as this one had shorter barrels than earlier models. Dragoons were mounted infantry, and while on horseback, each dragoon clipped the carbine to his belt, from which it hung next to his thigh.



▲ HARPER'S FERRY RIFLE

Date	1814
Origin	US
Barrel	35½in (90cm)
Caliber	.54in (13.7mm)

Following the success of American riflemen during the American Revolutionary War (1775–83), it was surprising that the first official US military rifle followed a European design rather than that of the traditional long rifle (see pp.96–97). Introduced in 1803, this rifle was built at the US Armory at Harpers Ferry (in modern-day West Virginia).

▲ HALL RIFLE

Date	1819
Origin	US
Barrel	32½in (82.5cm)
Caliber	.54in (13.7mm)

John Hancock Hall's rifle, designed in 1811 and introduced into service in 1819, was the first regulation American rifle that was loaded at the breech; hinged at the front, it tipped up at a 30-degree angle for loading. Hall rifles and carbines were eventually produced in percussion form (see pp.80–81), too, where the entire breech unit could be removed and used as a pistol. Many breech-loading guns of the flintlock period had cleaning rods instead of the ramrods seen in muzzle-loaders.

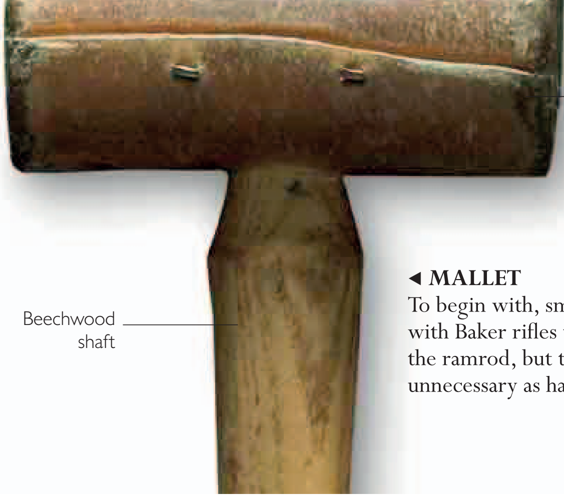
SHOWCASE

BAKER RIFLE

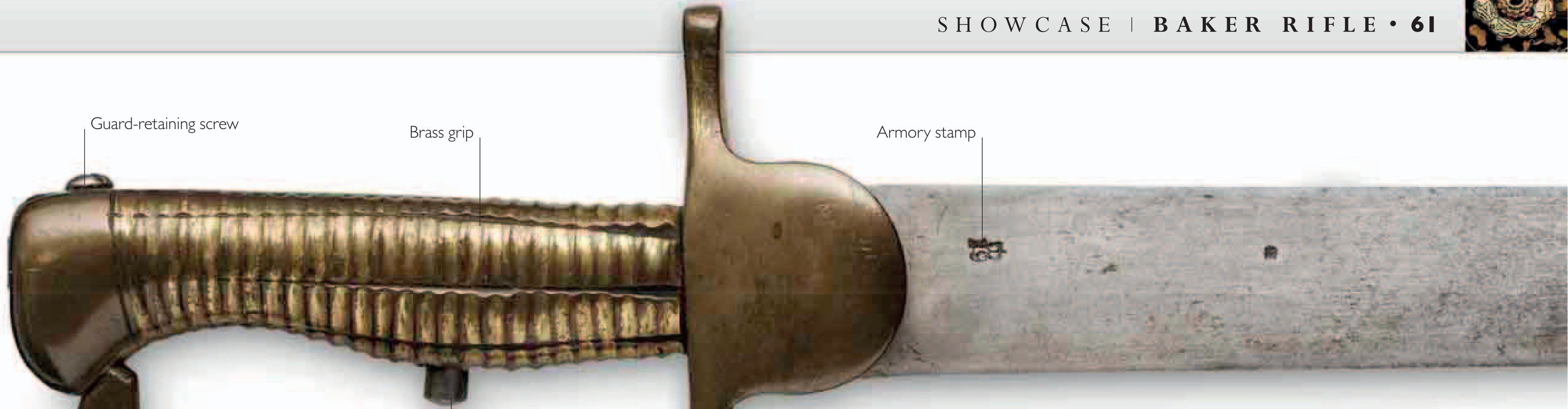
In February 1800, the Baker rifle won a competition organized by the British Army's Board of Ordnance and became the first rifle officially adopted by the British Army. Its novel feature lay in its barrel. With shallow or "slow" rifling—in which the grooves turn by just a quarter along the length of the barrel—it stayed clean, and thus usable, for longer. The Baker rifle was issued to select men at first, and remained in service for more than 35 years.

BAKER RIFLE	
Date	1802–37
Origin	England
Barrel	30in (76cm)
Caliber	.62in (15.8mm)

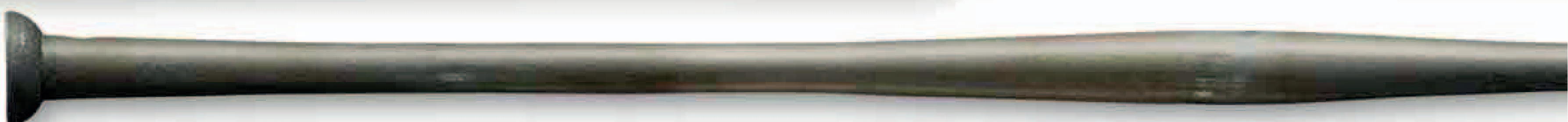
▲ BAKER RIFLE
Designed by Ezekiel Baker, this rifle was a robust weapon, crafted to keep on working even under the most difficult conditions. With its short barrel (30in/76cm instead of the more customary 39in/99cm), it was not particularly accurate, but was still a great improvement over the smoothbore musket then in general use.



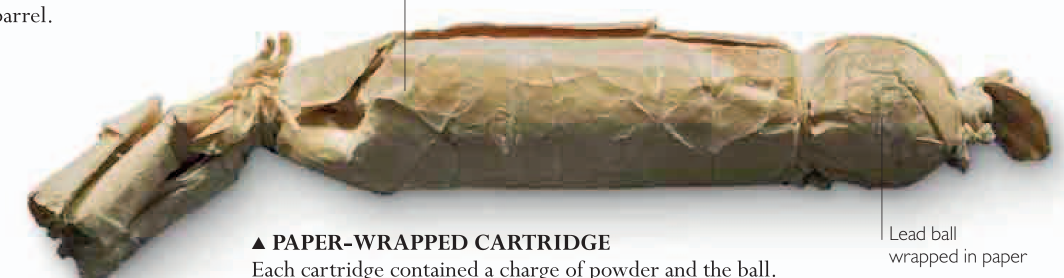
◄ MALLET
To begin with, small mallets were issued with Baker rifles to ram down the ball with the ramrod, but these were soon found to be unnecessary as hand pressure alone was sufficient.



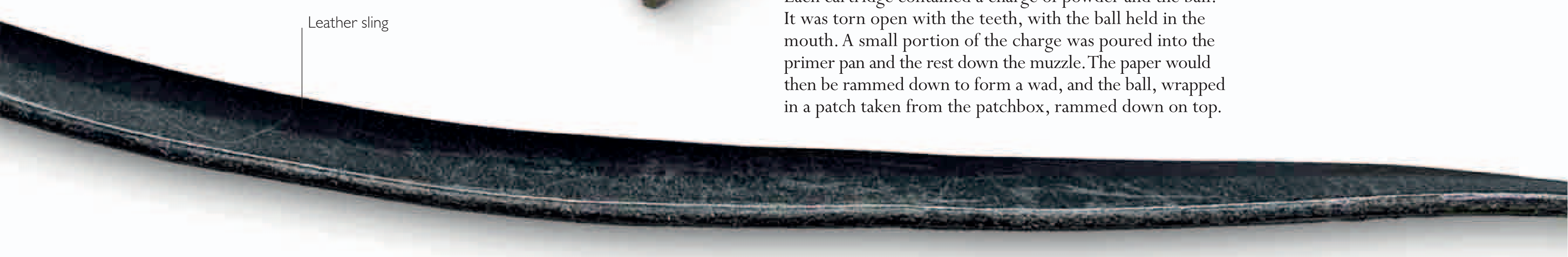
▲ SWORD BAYONET
The Baker rifle was supplied with a sword bayonet that could be used alone or mounted on the rifle. At 24in (61cm) long, it was unwieldy, but it was necessary to compensate for the rifle being so much shorter than other weapons then in use.



▲ RAMROD
The steel rod was used to ram the charge and projectile into the barrel.



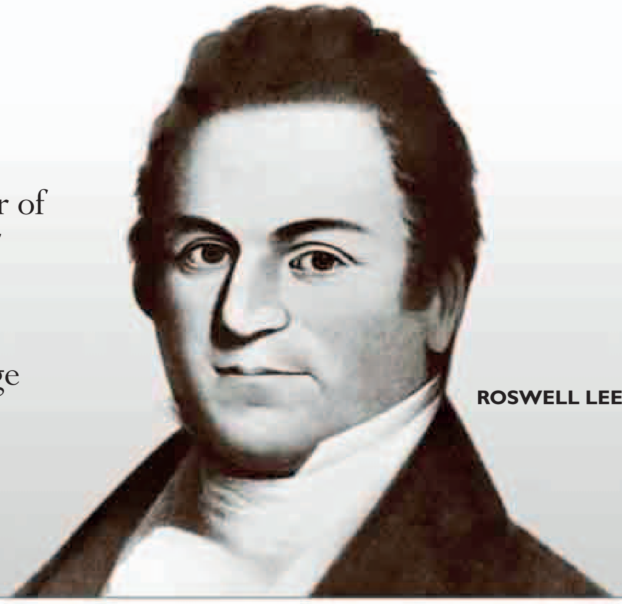
▲ PAPER-WRAPPED CARTRIDGE
Each cartridge contained a charge of powder and the ball. It was torn open with the teeth, with the ball held in the mouth. A small portion of the charge was poured into the primer pan and the rest down the muzzle. The paper would then be rammed down to form a wad, and the ball, wrapped in a patch taken from the patchbox, rammed down on top.



GREAT GUNSMITHS

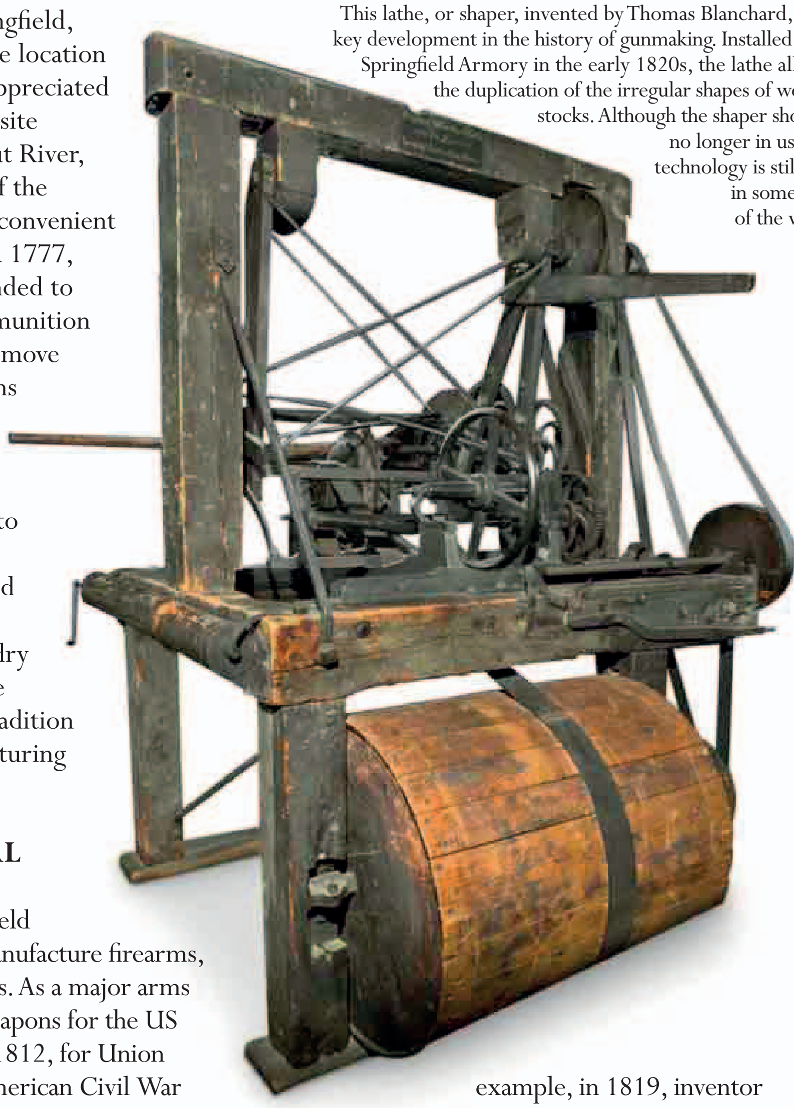
SPRINGFIELD ARMORY

The Springfield Armory was the most important manufacturer of military firearms in the US between 1794 and 1968. Established in 1777 as the country's key weapons store during the Revolutionary War, the Armory became famous for pioneering the kind of mass-production techniques that allowed precision-engineered products to be built in large numbers. Led by Roswell Lee between 1815 and 1833, the Armory's mechanized production techniques had a huge impact, not only on the firearms business but also on American industry as a whole.



ROSWELL LEE

George Washington himself recommended Springfield, Massachusetts, as the location for an arsenal. He appreciated the high, defensible site near the Connecticut River, and the proximity of the river and roads was convenient for transportation. In 1777, the arsenal was founded to store a range of ammunition and arms. When the move was made to weapons manufacture in the 1790s, there was an expansion to lower-lying land to the south and west, near water that could provide a source of power. Here a foundry and workshops were built, beginning a tradition of firearms manufacturing in the area.



▼ **BLANCHARD'S "LATHE"**
This lathe, or shaper, invented by Thomas Blanchard, was a key development in the history of gunmaking. Installed at the Springfield Armory in the early 1820s, the lathe allowed the duplication of the irregular shapes of wooden stocks. Although the shaper shown is no longer in use, this technology is still used in some parts of the world.

AN INDUSTRIAL PIONEER

In 1794, the Springfield Armory began to manufacture firearms, starting with muskets. As a major arms producer it made weapons for the US forces in the War of 1812, for Union troops during the American Civil War (1861–65), and in the Spanish–American War (1898). The Armory became a center for innovation as engineers and craft workers found ways of making better weapons and improving the efficiency of the production process. Some of these developments were groundbreaking, placing the Armory at the forefront of the Industrial Revolution. For example, in 1819, inventor Thomas Blanchard devised a machine on which workers could produce rifle stocks. Blanchard's machine, usually known as a lathe, was strictly a shaper, working in a way similar to a modern key-cutting machine in which an original shape is copied on to a stock blank. It enabled gun stocks to be mass-produced for the first time. Springfield also pioneered the production of guns using interchangeable parts (a field also developed by Samuel Colt and many others), allowing firearms to be assembled at speed and repaired with ease. This method of production relied not only on new machinery but also depended on the division of labor, with separate workshops for different parts of the production process, precise measuring and gauging of components, and good quality control. By the time of the Civil War, the Armory was using state-of-the-art machines for milling, turning, grinding, and shaping, some driven by water, others by newly installed steam engines. These technological advances were accompanied by up-to-date management and accounting methods, introduced by Colonel Roswell Lee, who became superintendent of the Armory in 1815.

VOLUME PRODUCTION

The Armory's production facility was adaptable, producing a range of muzzle-loading weapons. In the 1840s, the Armory achieved the goal of producing firearms with interchangeable parts, and was able to build guns in large numbers during many conflicts of the 19th century. From about 85,000 Charleville Pattern smoothbore muskets (without interchangeable parts) produced between 1795 and 1815, the Armory's volume of production jumped to 800,000 Springfield Model 1861 rifled muskets (with interchangeable parts) during the Civil War. The techniques of mass production developed at Springfield during the 19th century made the Armory well placed to produce firearms in the huge numbers needed for major 20th-century conflicts. New improvements, such as the arrival of electrical power, also helped the Armory in this respect.

The early 20th century saw the production of bolt-action repeating rifles, including the

MODEL 1863 TYPE II MUSKET

MODEL 1873 TRAPDOOR RIFLE

M1 GARAND RIFLE

1777 The Springfield Arsenal is founded. As a store for weapons and ammunition, it plays a key role in the Revolutionary War.

1787 Daniel Shays and a group of rebels attempt to capture the arsenal in protest against unfair taxation and the debt collection practices of the Massachusetts state government, but are repelled by the state militia.

1795 Weapons production at the Armory begins with the Springfield "Charleville Pattern" Musket.

1815 Roswell Lee becomes superintendent of the Armory and leads efforts to mechanize production and improve management.

1863 The Model 1863 Type II is the last muzzle-loading long gun produced by the Armory.

1873 The US Army adopts the breech-loading Model 1873 "Trapdoor" rifle.

1936 The semiautomatic M1 Garand rifle is launched. It becomes the first general issue self-loading rifle to be accepted for military service in the US.

1968 Springfield Armory is closed; its buildings are preserved as the Springfield Armory National Historic Site.

Krag rifle, designed in Norway, and the Model 1903, which was designed in Springfield. The retooling and adaptation required to produce these new weapons was a challenge, but thanks to machine upgrades and a reorganization of the workforce, they were successfully put into production and demonstrated that the Armory could build quality firearms en masse. The Armory's Model 1903 was used in both world wars. It was followed by a new generation of semiautomatic firearms, including the famed Garand rifle of 1936, which made US infantrymen much better equipped than those in other parts of the world who were issued with slower bolt-action rifles. Such products kept the Armory going through the mid-20th century, until the US government decided to rely solely on private manufacturers and shut down the facility in 1968.

"It has long been considered a **privilege** to be employed at **Springfield Armory**."

G. TALCOTT, LT. COL. OF ORDNANCE, **ADDRESSING THE US SENATE, 1842**

▼ SHARPENING CUTTERS
A woman sharpens cutters for a milling machine at Springfield Armory in around 1943. The cutters were not only used for manufacturing rifle parts but also for building the tools used to make those parts.

EUROPEAN HUNTING GUNS

By the beginning of the 18th century, gunmakers in most parts of Europe were making sporting firearms in popular styles based originally on French designs. The flintlock now predominated in most of Europe. While a more austere style emerged, the remaining ornamentation became more sophisticated, with minimal decorative inlaying and emphasis placed on the natural qualities of the wood. The flintlock mechanism in these guns had become efficient enough that sportsmen could shoot not only stationary targets but also birds in flight. A breakthrough invention in this period was a repeating breech-loading flintlock gun.

▲ ITALIAN REPEATING FLINTLOCK

Date	c.1690
Origin	Italy
Barrel	35in (89cm)
Caliber	.53in (13.5mm)

Italian gunmaker Michele Lorenzoni lived in Florence from 1683 to 1733 and invented an early form of repeating flintlock breech-loader. Paired magazines, one for powder and the other for shot, were located in the butt, and the breechblock was rotated for charging by means of a lever on the left side of the gun.

▲ FLINTLOCK SPORTING GUN

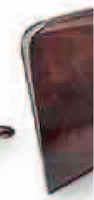
Date	1700
Origin	England
Barrel	55in (139.5cm)
Caliber	.75in (19mm)

This full-stocked sporting gun, by John Shaw, bears a remarkable resemblance to military firearms of the time. However, the attention that has been paid to the selection of the wood for its stock immediately sets it apart, as does the care that has been lavished on its finishing.

▲ ENGLISH SPORTING GUN

Date	1760
Origin	England
Barrel	36in (91.4cm)
Caliber	.68in (17.3mm)

The gunmaker Benjamin Griffin worked in fashionable Bond Street in London from 1735 to 1770, and was joined in 1750 by his son Joseph. Both father and son were renowned for their excellent pistols and long guns. Many of these, such as the example seen here, were graced with ornate engraving to the metal parts, decorative brasswork, and silver-wire inlay.

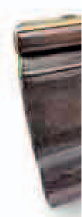


FULL VIEW

▲ ENGLISH FLINTLOCK SPORTING GUN

Date	1690
Origin	England
Barrel	38in (96.5cm)
Caliber	.75in (19mm)

Andrew Dolep was a Dutch gunmaker who settled in London and set up shop near Charing Cross. He produced this magnificent flintlock—its walnut stock extensively inlaid with silver wire—toward the end of his career. Dolep is credited with the design of the "Brown Bess" musket (see p.53), which this gun resembles.



▲ RUSSIAN FLINTLOCK

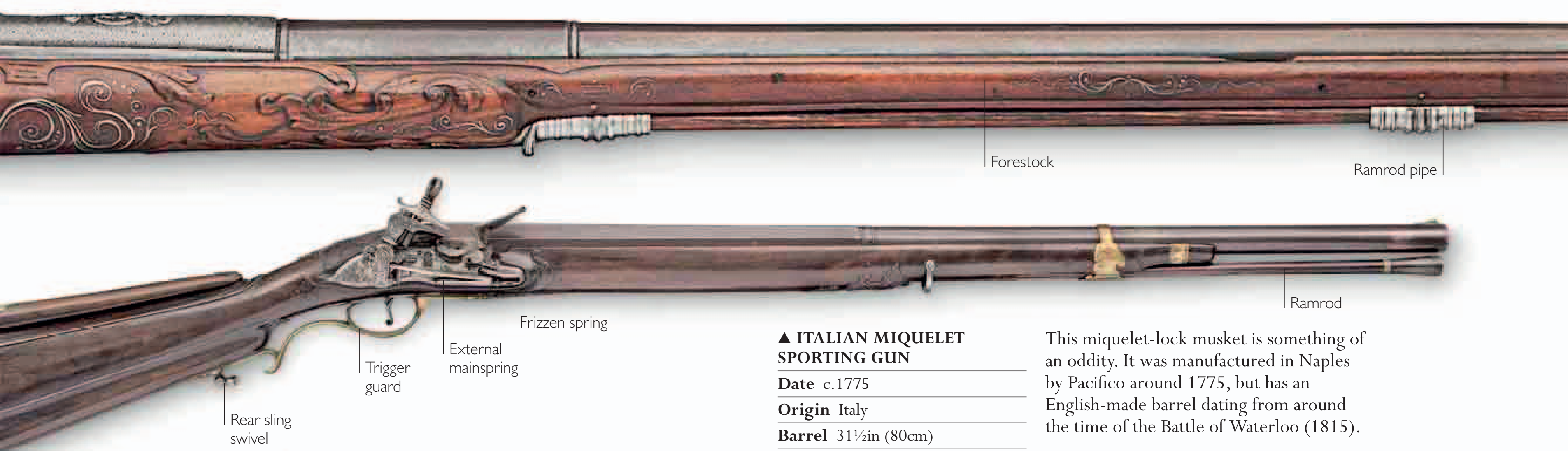
Date	1770
Origin	Russia
Barrel	35in (89.8cm)
Caliber	.35in (8.9mm)

This beautifully decorated sporting gun was made by Ivan Permjakov, one of the most accomplished Russian gunmakers. It may have been recovered after the Battle of Alma River in 1854, during the Crimean War. Perhaps it was lost from the gear of one of the officers in the Russian force.

▲ DOUBLE-BARRELED FLINTLOCK SHOTGUN

Date	c.1770
Origin	England
Barrel	35½in (90.2cm)
Caliber	.60in (15.2mm)

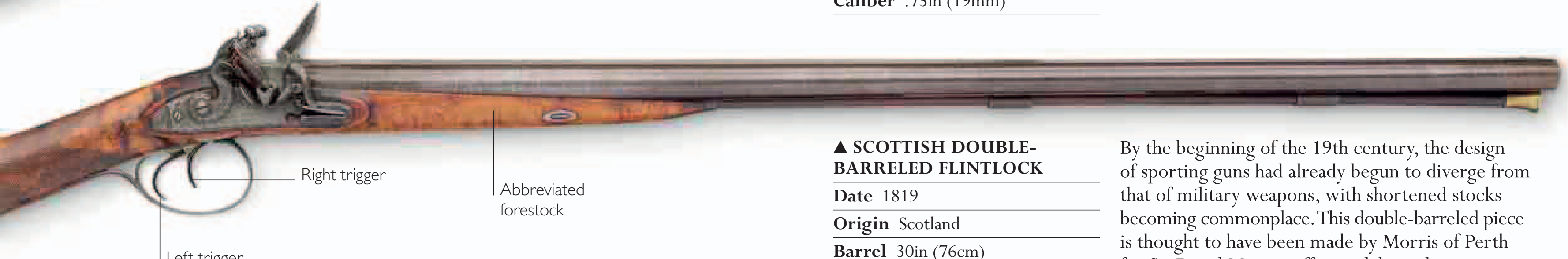
This side-by-side double-barreled flintlock shotgun, attributed to the gunmaker Hadley, is typical of high-class fowling pieces of the latter part of the 18th century. Not only is its short stock silver mounted, but both its pans and its touchholes are gold-plated to fend off corrosion.



▲ ITALIAN MIQUELET SPORTING GUN

Date	c.1775
Origin	Italy
Barrel	31½in (80cm)
Caliber	.75in (19mm)

This miquelet-lock musket is something of an oddity. It was manufactured in Naples by Pacifico around 1775, but has an English-made barrel dating from around the time of the Battle of Waterloo (1815).



▲ SCOTTISH DOUBLE-BARRELED FLINTLOCK

Date	1819
Origin	Scotland
Barrel	30in (76cm)
Caliber	.68in (17.3mm)

By the beginning of the 19th century, the design of sporting guns had already begun to diverge from that of military weapons, with shortened stocks becoming commonplace. This double-barreled piece is thought to have been made by Morris of Perth for Sir David Montcrieffe, a celebrated sportsman.

FIELD AND SIEGE ARTILLERY (1650–1780)

Different types of artillery had become well-established by the mid-17th century. Field artillery was portable, and was towed into battle alongside infantry and cavalry. These guns were known as 6-, 9-, and 12-pounders, referring to the weight of the iron balls they fired. Siege artillery was composed of 18-pounders and even heavier guns, designed to break down fortifications. Mortars, short-barreled guns set at a high angle of elevation for use during sieges, had also been developed. Most large cannons were muzzle-loading. Cannon made of wrought iron were rarely being built, as guns could now be made more cheaply and quickly from cast iron, which had recently been perfected.

▲ INDIAN 6-POUNDER

Date	1693–1743
Origin	India
Length	12½ft (3.86m)
Caliber	3.74in (95mm)

Like many artillery pieces of the time, this gun is described by the weight of its ammunition—6-lb (2.72-kg) iron balls. The caliber of such weapons is based on the diameter of the shot they fired. The 6-pounder's cast bronze barrel has a bore lined with strips of iron, to make it more durable.

▲ SINHALESE BRONZE GUN

Date	1699
Origin	Ceylon (modern-day Sri Lanka)
Length	4ft (1.19m)
Caliber	2.1in (53.3mm)

This small field gun is decorated with bands of stylized foliage and has the badge of the Dutch East India Company. The name Jaffanapatnam (a town in northern Ceylon) is written around the breech.

▲ BRONZE THREE-BARRELED GUN

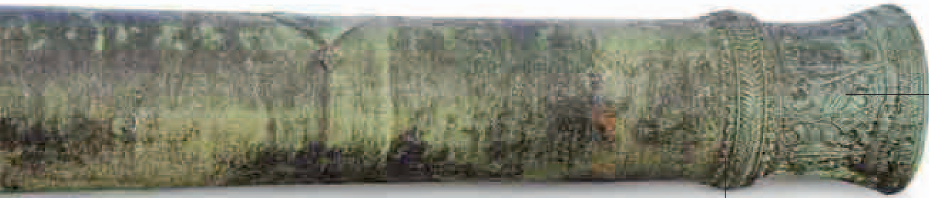
Date	1704
Origin	France
Length	5¼ft (1.62m)
Caliber	.04in (1.15mm)

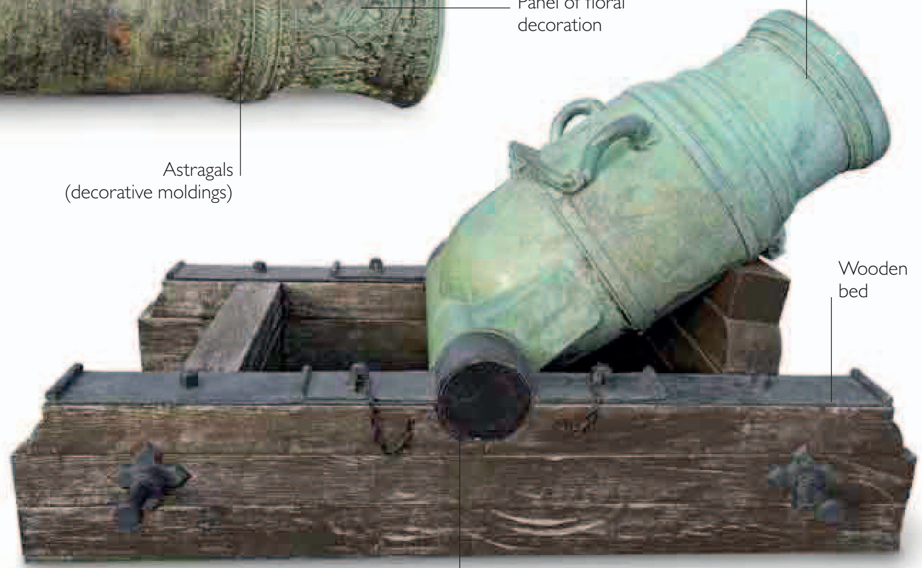
Three barrels, two side by side with the third above, were cast in one piece and could be fired one at a time or simultaneously. The intriguing design did not prove successful in practice, because this field gun was difficult to reload and very heavy to maneuver.

◀ COEHORN MORTAR

Date	c.1720
Origin	England
Length	1ft (0.32m)
Caliber	4.5in (114.3mm)

The Coehorn Mortar was a small, portable mortar used to despatch grenades. Swiss-born Andrew Schalch, first Master Founder of the Royal Brass Foundry at Woolwich in England, cast this one. It is mounted on its original wooden bed, which is just 12in (30cm) wide and 20in (51cm) long.





▶ **BRONZE 13-IN SEA SERVICE MORTAR**

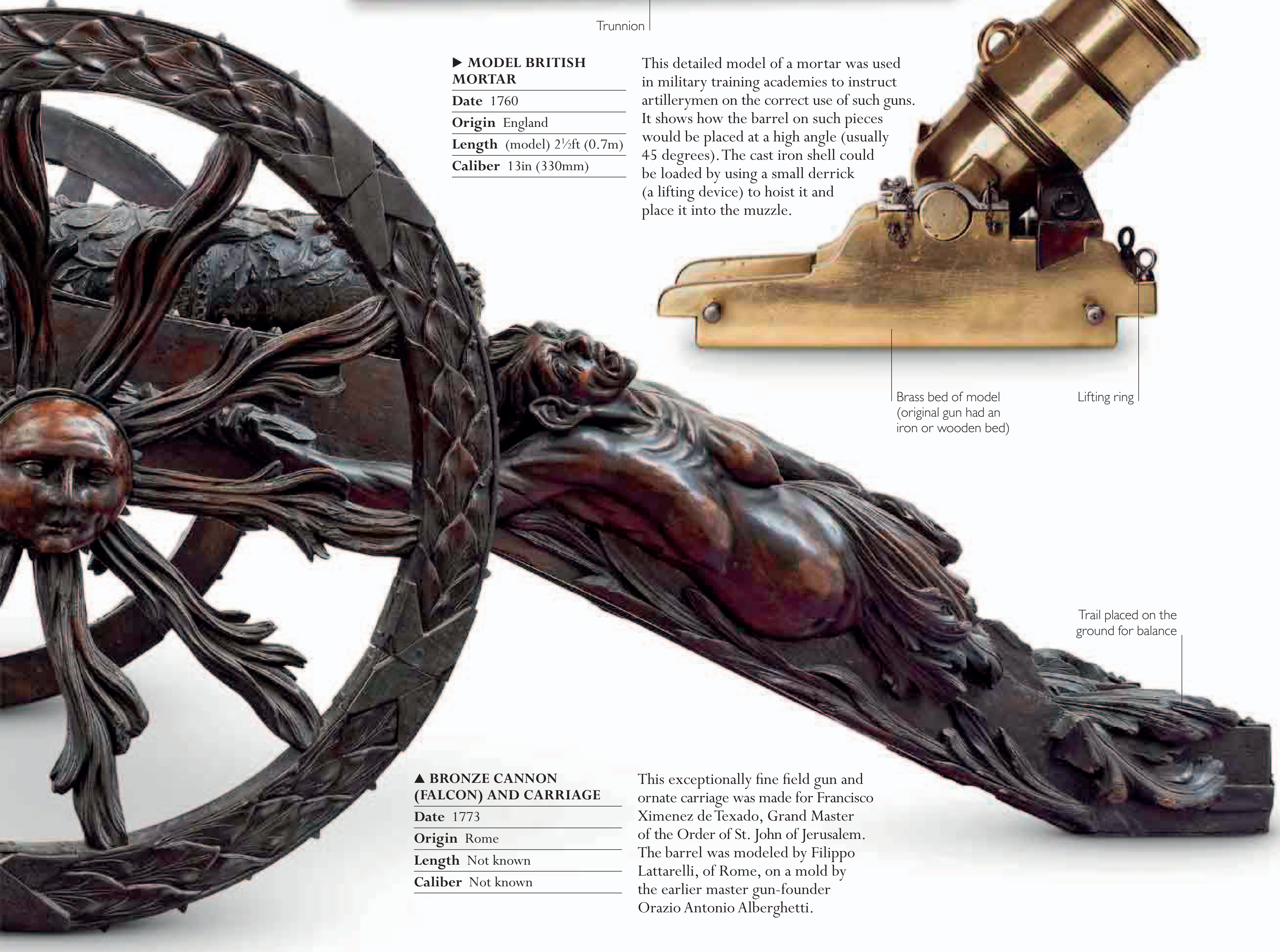
Date	1726
Origin	UK
Length	5¼ft (1.6m)
Caliber	13in (330mm)

Mortars could be fired over the walls of fortifications to cause large-scale destruction, or into enemy troop formations to injure many soldiers at once. Sea service mortars were used to bombard fortifications on shore.

▶ **MODEL BRITISH MORTAR**

Date	1760
Origin	England
Length	(model) 2½ft (0.7m)
Caliber	13in (330mm)

This detailed model of a mortar was used in military training academies to instruct artillerymen on the correct use of such guns. It shows how the barrel on such pieces would be placed at a high angle (usually 45 degrees). The cast iron shell could be loaded by using a small derrick (a lifting device) to hoist it and place it into the muzzle.



▲ **BRONZE CANNON (FALCON) AND CARRIAGE**

Date	1773
Origin	Rome
Length	Not known
Caliber	Not known

This exceptionally fine field gun and ornate carriage was made for Francisco Ximenez de Texado, Grand Master of the Order of St. John of Jerusalem. The barrel was modeled by Filippo Lattarelli, of Rome, on a mold by the earlier master gun-founder Orazio Antonio Alberghetti.

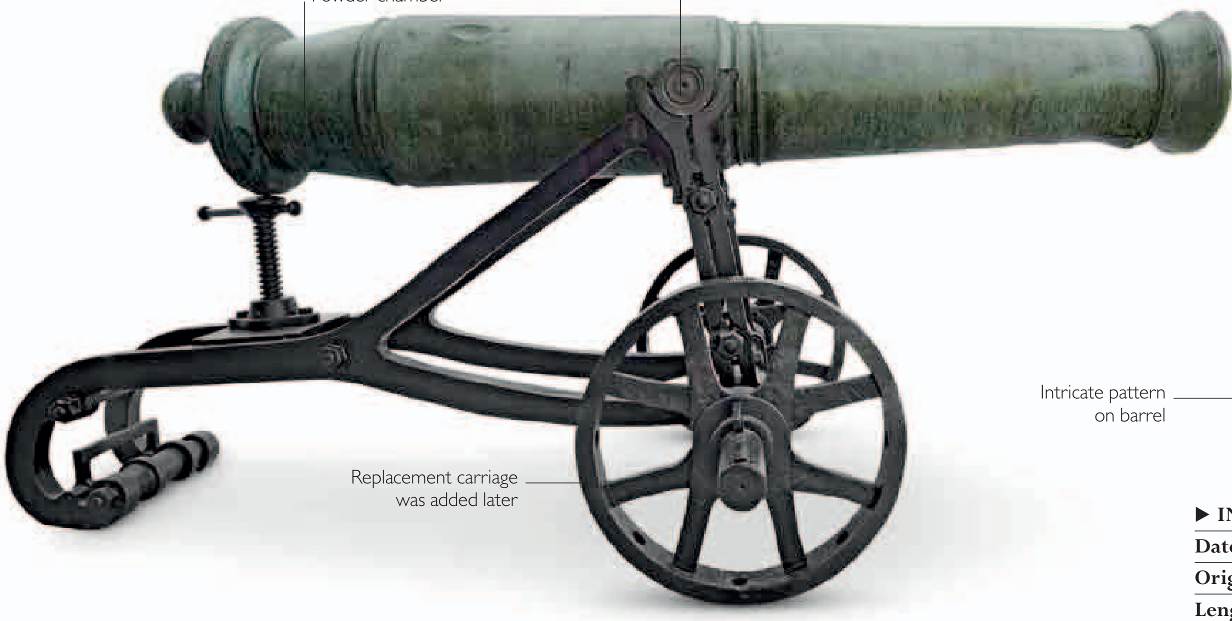
FIELD AND SIEGE ARTILLERY (1781–1830)

In the 17th century, many gunmakers in Europe decided to make muzzle-loading guns rather than breech-loaders, as improvements in gunpowder made it more difficult to build breech-loading guns that could withstand the pressure of firing. As a result, by the 18th century, almost all types of large-caliber artillery were muzzle-loading. Deployed on battlefields, field artillery fired solid shot, explosive shells, or canister shot (shot made of smaller balls). Siege artillery was employed for consistent bombardment of fortifications and fired larger types of shot and shell from prepared emplacements.

▲ BRONZE ROYAL MORTAR

Date	1800
Origin	England
Length	1¼ft (0.39m)
Caliber	5.7in (144.8mm)
Range	800 yards (730m)

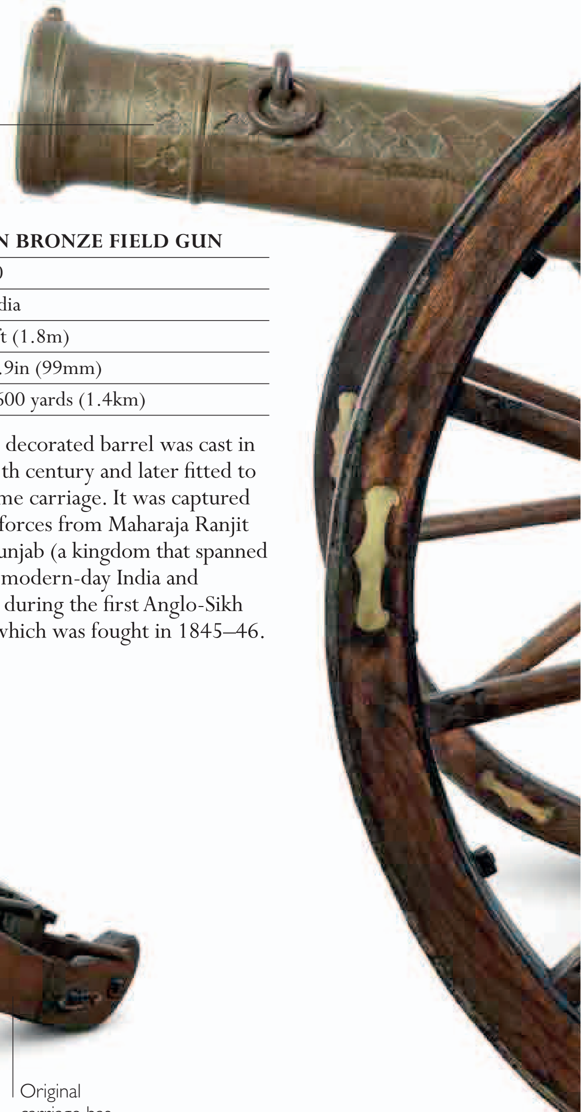
A standard mortar in British field service, this weapon was cast at the Woolwich Royal Brass Foundry. It fired a spherical, cast iron explosive shell at a high angle. Although transported by cart, it was placed on the ground during firing.



▲ RUSSIAN LICORNE

Date	1793
Origin	Russia
Length	9ft (2.8m)
Caliber	8.07in (205mm)
Range	1,800 yards (1.6km)

This gun, which saw action in the Crimean War (1853–56), could fire horizontally or at an elevated trajectory. It carried gunpowder in a powder chamber shaped like a cone. It could shoot spherical explosive shells as well as cannonballs.



▶ INDIAN BRONZE FIELD GUN

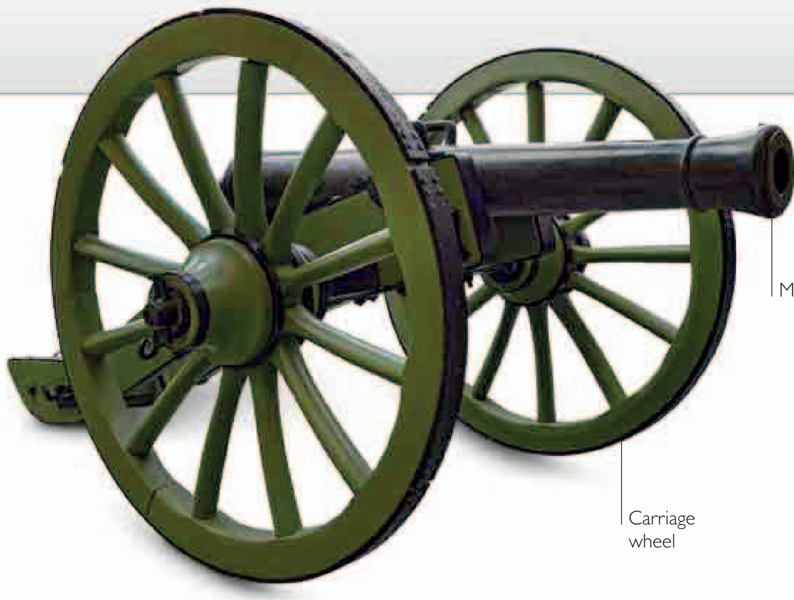
Date	1800
Origin	India
Length	6ft (1.8m)
Caliber	3.9in (99mm)
Range	1,600 yards (1.4km)

This finely decorated barrel was cast in the late 18th century and later fitted to its handsome carriage. It was captured by British forces from Maharaja Ranjit Singh of Punjab (a kingdom that spanned regions in modern-day India and Pakistan) during the first Anglo-Sikh War, which was fought in 1845–46.

▶ FRENCH 12-POUNDER FIELD GUN

Date	1794
Origin	France
Length	6¾ft (2.1m)
Caliber	4.8in (122mm)
Range	2,000 yards (1.8km)

This 12-pounder was named "Voltaire" after the French Enlightenment philosopher François-Marie Arouet de Voltaire (1694–1778), whose name is engraved into the forward part of the gun's barrel. The barrel exhibits battle damage, possibly caused by British guns at the Battle of Waterloo (1815).



▲ FRENCH 6-POUNDER FIELD GUN

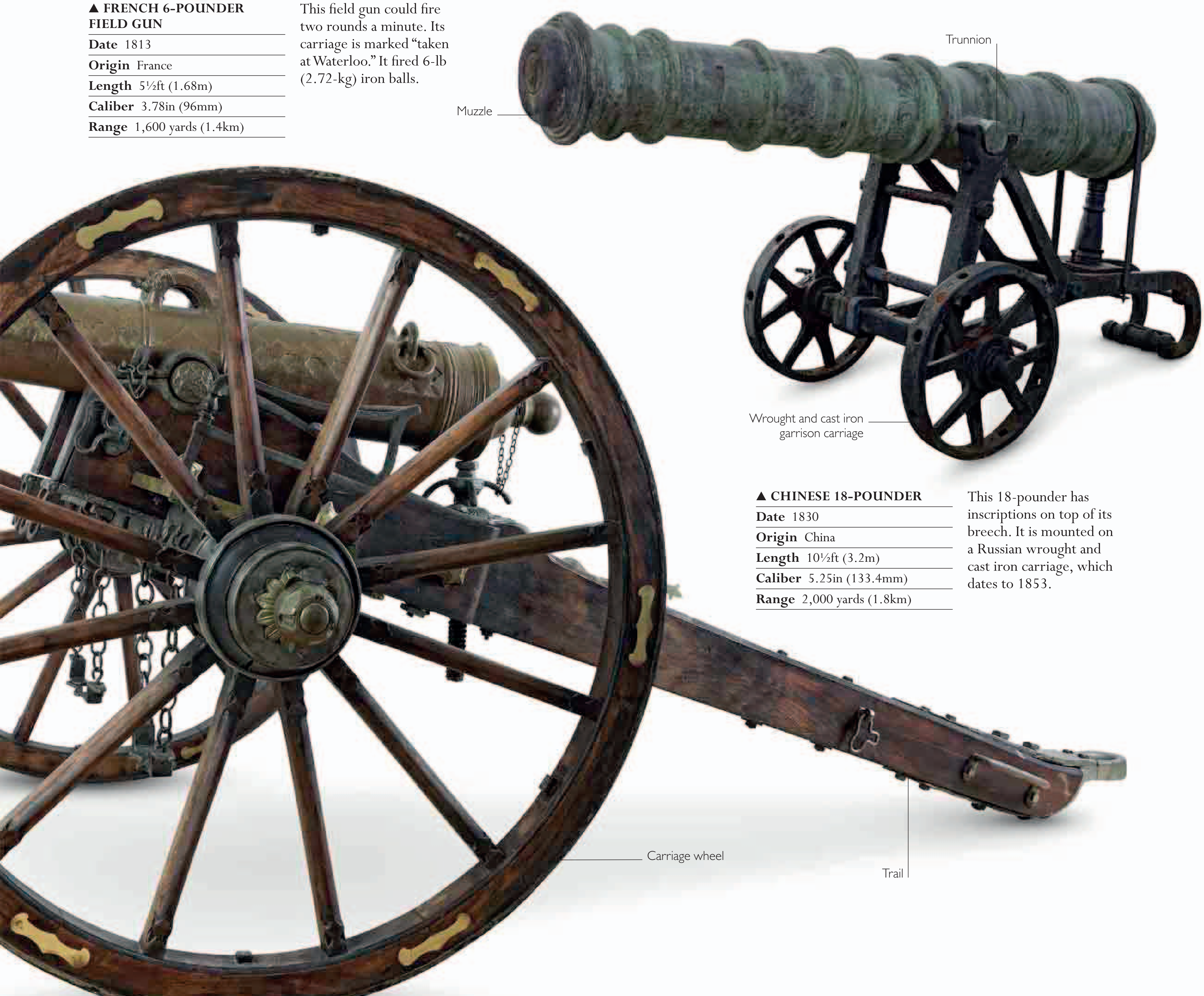
Date 1813
Origin France
Length 5½ft (1.68m)
Caliber 3.78in (96mm)
Range 1,600 yards (1.4km)

This field gun could fire two rounds a minute. Its carriage is marked "taken at Waterloo." It fired 6-lb (2.72-kg) iron balls.

▼ CHINESE SILK GUN

Date c.1825
Origin China
Length 2¾ft (0.83m)
Caliber 2.5in (63.5mm)
Range 200 yards (180m)

This unusual cannon, designed for portability, was made from a copper tube wrapped with iron wire and silk cord. It derived from some earlier guns which were made from bamboo wound with cord. Chinese paintings show soldiers lying on the battlefield firing similar guns.



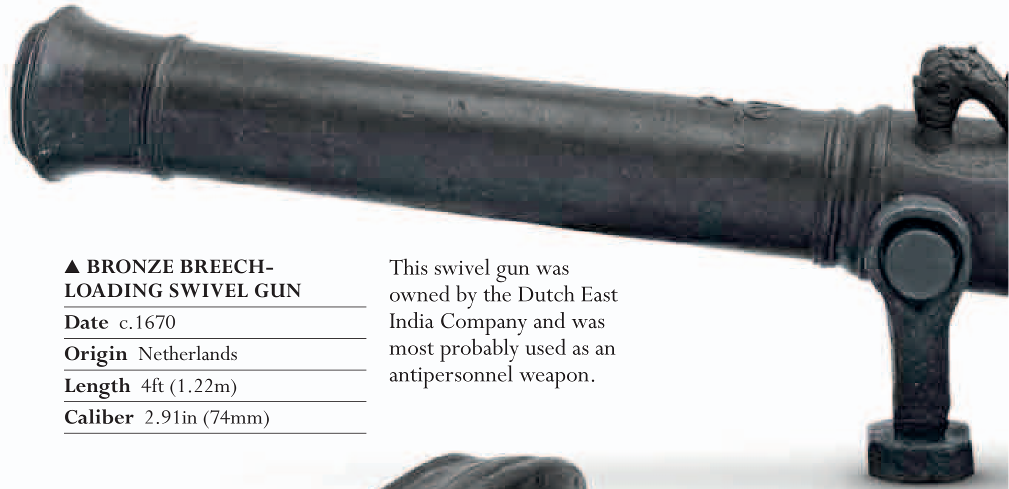
▲ CHINESE 18-POUNDER

Date 1830
Origin China
Length 10½ft (3.2m)
Caliber 5.25in (133.4mm)
Range 2,000 yards (1.8km)

This 18-pounder has inscriptions on top of its breech. It is mounted on a Russian wrought and cast iron carriage, which dates to 1853.

NAVAL GUNS

Although most artillery pieces were muzzle-loading by the 18th century, some naval guns continued to be breech-loading. In naval warfare, different types of gun could be useful in different situations, so special pieces of artillery were developed. For longer ranges, conventional cannon were used, mounted on carriages with wooden wheels, or "trucks," while for close-in attacks, a short-barreled type of gun called a carronade was very effective. Sometimes known as the "smasher," the carronade was built in different sizes and could fire solid shot or explosive shells with great power, although it did not have great range. Mortars could be used to attack ships, but were more often used to shell defenses or troops on shore.



▲ BRONZE BREECH-LOADING SWIVEL GUN

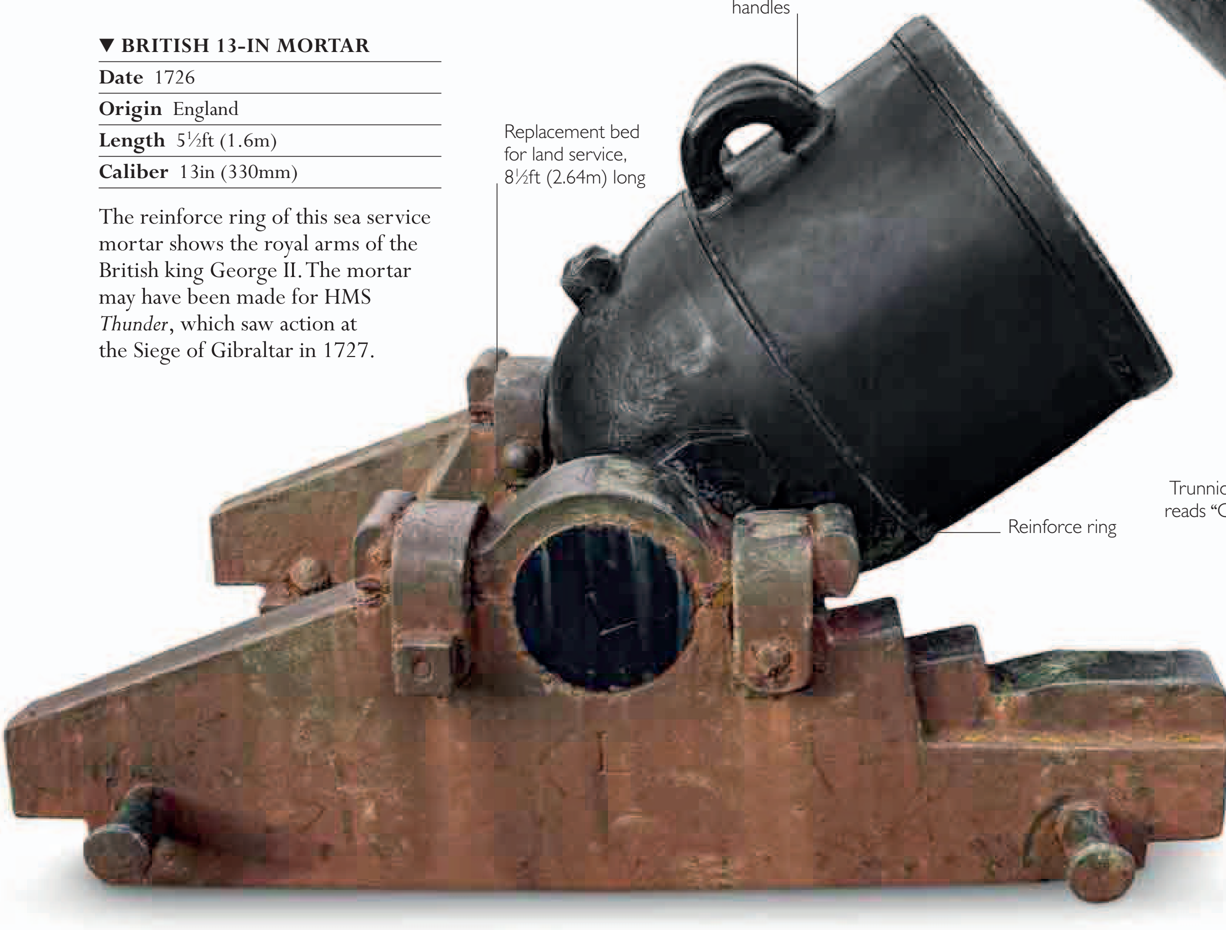
Date	c.1670
Origin	Netherlands
Length	4ft (1.22m)
Caliber	2.91in (74mm)

This swivel gun was owned by the Dutch East India Company and was most probably used as an antipersonnel weapon.

▶ FOUR-POUNDER SWIVEL GUN

Date	1778
Origin	Scotland
Length	1ft (0.32m)
Caliber	3.30in (84mm)

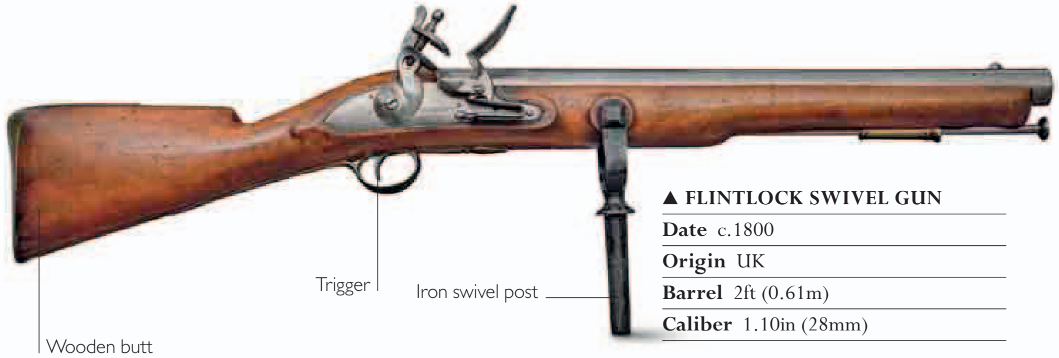
This short, heavy swivel gun was one of the prototypes for the carronade made by the Carron Ironworks. Its trunnions—used to elevate and lower the gun—are equipped with pivots, and the cascabel—used to secure the gun against recoil—is connected to a long, curved tiller for directing the gun.



▼ BRITISH 13-IN MORTAR

Date	1726
Origin	England
Length	5½ft (1.6m)
Caliber	13in (330mm)

The reinforce ring of this sea service mortar shows the royal arms of the British king George II. The mortar may have been made for HMS *Thunder*, which saw action at the Siege of Gibraltar in 1727.



▲ FLINTLOCK SWIVEL GUN

Date c.1800

Origin UK

Barrel 2ft (0.61m)

Caliber 1.10in (28mm)

Fired with a flintlock mechanism more common on muskets or pistols, this swivel gun was fired at enemy ships prior to a boarding attempt. Because it could be swiveled, the gun—moving from side to side—had a wide arc of fire.

▲ CAST-IRON CARRONADE

Date 1808

Origin Scotland

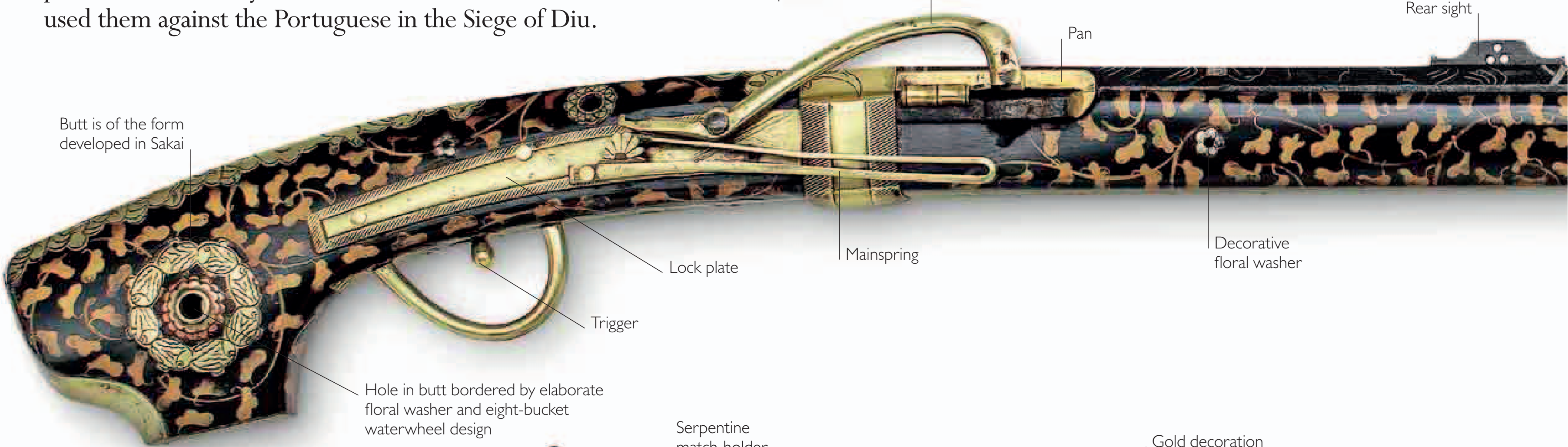
Length 3½ft (1.1m)

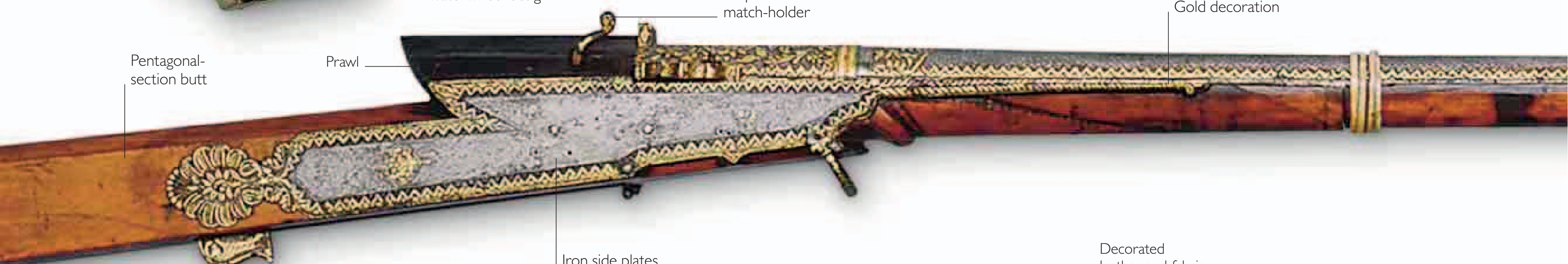
Caliber 5.7in (145mm)

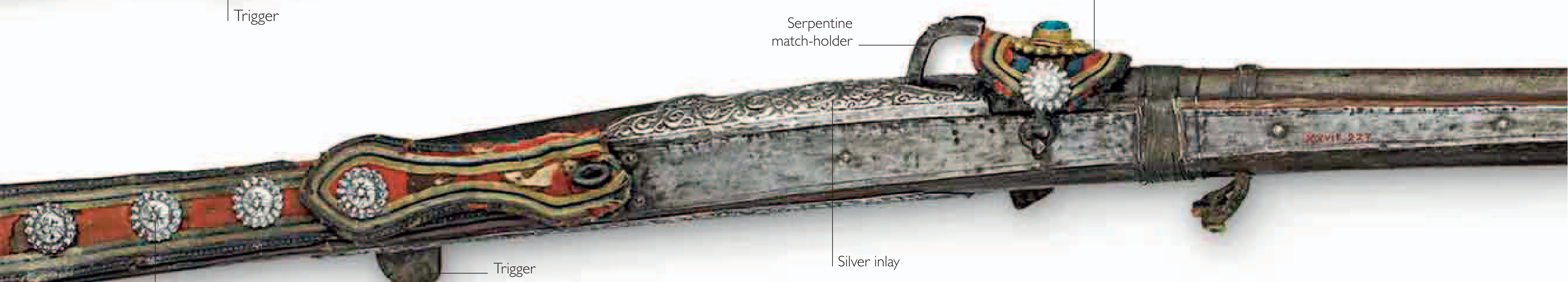
This 24-pounder carronade was made with a raised sight in the reinforce ring and a recess in the muzzle ring for a removable sight. The muzzle was recessed for easy loading.

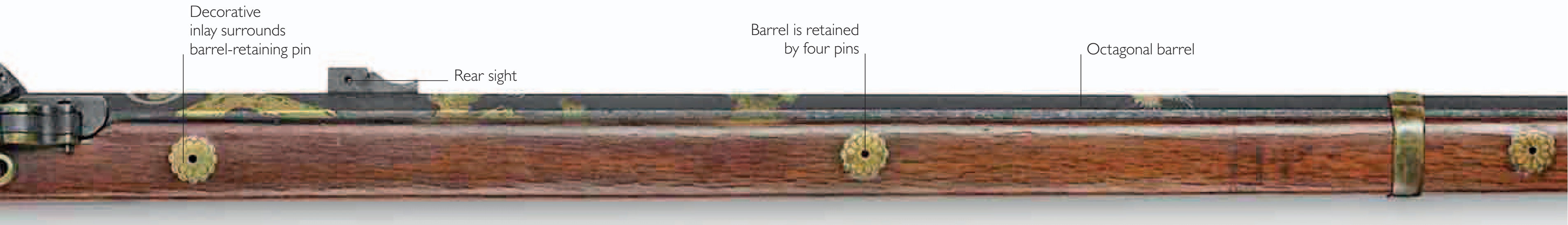
ASIAN FIREARMS (1650–1780)

Firearms arrived in Japan in 1543 with Portuguese traders who had traveled from their base in India. The Japanese initially resisted the use of gunpowder weapons, preferring their traditional bows and swords, but eventually saw the advantages of a coordinated use of matchlock muskets in battle, notably at Sekigahara in 1600. Until the late 19th century, Japanese muskets retained the Portuguese snap-matchlock design, a mechanism in which the serpentine was held back by a catch and fell forward under spring pressure when a user pulled the trigger. Matchlock muskets in other parts of Asia varied in style between regions although the matchlock used was the squeeze-type (see p.74). In India, matchlock guns had been present from as early as 1531, when the Ottomans used them against the Portuguese in the Siege of Diu.









▲ HI NAWA JYU

Date	Early 18th century
Origin	Japan
Barrel	40½in (103cm)
Caliber	.52in (13.3mm)

Japanese *hi nawa jyu* (matchlocks) could fire three bullets a minute and pierce typical samurai armour at 165ft (50m). This matchlock was made by Kunitomo Tobei Shigeyasu of Omi, western Japan. The influence of the Sakai school (below) is evident in its red oak stock although it has limited decoration.


FULL VIEW


FULL VIEW

▲ HI NAWA JYU

Date	c.1700
Origin	Japan
Barrel	39¼in (100cm)
Caliber	.44in (11.4mm)

This early 18th-century matchlock musket is the work of the Enami family of Sakai, widely held to be among the finest Japanese gunmakers of the preindustrial era. The stock is made of red oak, and its decoration may have been added at a later date.

▲ INDIAN CARNATIC TORADAR

Date	18th century
Origin	India
Barrel	44½in (113cm)
Caliber	.629in (16mm)

The barrel of this simple, straight-stalked matchlock musket, or toradar, is exquisitely decorated with incised flowers and foliage, and entirely gilded. Made in Mysore, southern India, the musket's incised side plates are made of iron, and on its trigger it has a tiger in *koftgari*—a method of inlaying gold into steel or iron.


FULL VIEW

FULL VIEW

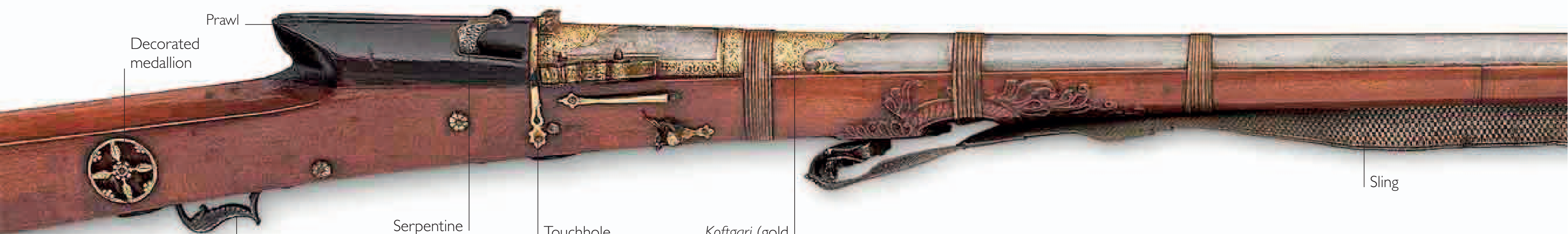
▲ TIBETAN MEDA

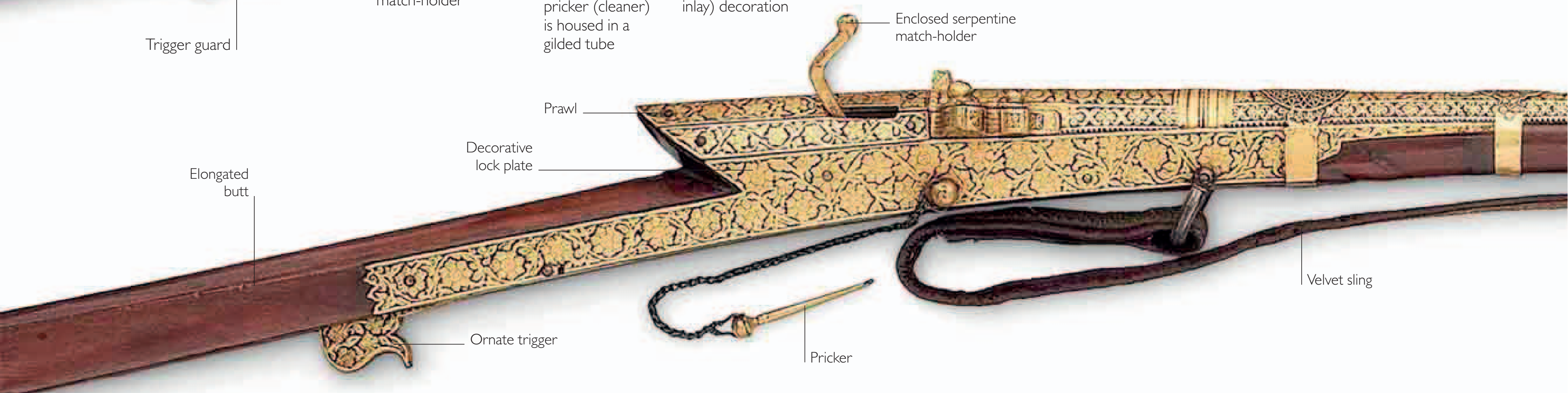
Date	c.1780
Origin	Tibet
Barrel	43¾in (111cm)
Caliber	.66in (17mm)

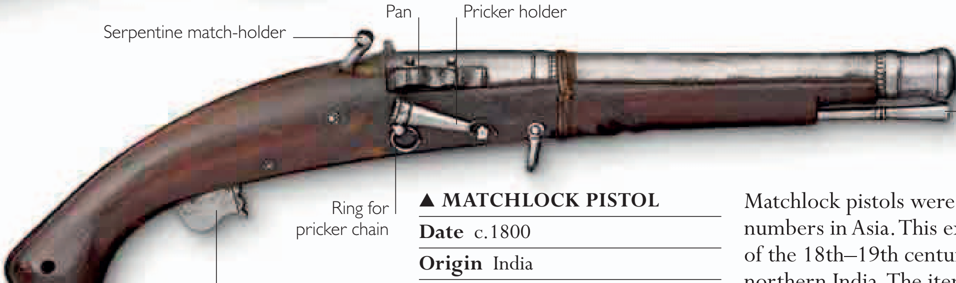
Tibet was largely isolated from the rest of the world, but carried out trade with India and China. This *meda* (matchlock) shows Chinese influence in form and decoration. Attached to the forestock is an unusual rest, while the ramrod is a modern replacement.

ASIAN FIREARMS (1781–1830)

In Asia, guns remained technically simple for more than 500 years. The matchlock mechanism used, similar to that in Europe, persisted well into the late 19th century. While the snap-matchlock mechanism was used in Japan (see p.72), in India and elsewhere in Asia, gunmakers commonly employed the squeeze-type matchlock. This type of matchlock was concealed almost fully within the stock. The serpentine was linked to a trigger bar, which released it when a user pulled the trigger. In India, the guns varied between regions in the form of their stocks, and in their chiseled and gilded decoration. Matchlock pistols were made only in Asia, while people in Europe were using pistols driven by flintlocks and wheel-locks—mechanisms that would reach some parts of Asia only later and never be used in other parts.







▲ MATCHLOCK PISTOL

Date	c.1800
Origin	India
Barrel	9¾in (24.5cm)
Caliber	.63in (16mm)

Matchlock pistols were manufactured in small numbers in Asia. This example, from the turn of the 18th–19th centuries, was produced in northern India. The items below the pan are a holder for the prickers and a ring to which its chain was attached.


FULL VIEW

▲ INDORE TORADAR

Date	c.1800
Origin	India
Barrel	44in (112cm)
Caliber	.55in (13.9mm)

The stock of this toradar from Indore in central India has a pronounced recurve. Three leather thongs serve as barrel bands, while a fourth band, closest to the breech, is made of wire.

▲ INDIAN TORADAR

Date	19th century
Origin	India
Barrel	49¾in (126cm)
Caliber	.55in (14mm)

This toradar has a stock of polished red wood with circular pierced medallions on each side of the butt of iron, with gilding and *koftgari* applied over red velvet. The barrel has an elaborate arabesque decoration in gold *koftgari* at the breech, and the muzzle is fashioned into the shape of a tiger's head.

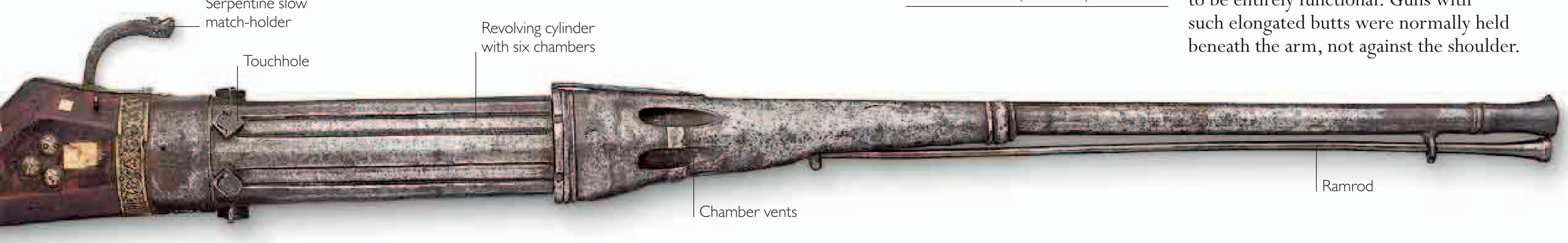

FULL VIEW


FULL VIEW

▲ BUNDUKH TORADAR

Date	c.1800
Origin	India
Barrel	45¼in (115cm)
Caliber	.55in (13.9mm)

This very ornate matchlock musket was probably made in Gwalior, central India. Like all matchlocks, it was supplied with a touchhole pricker, although since this, too, is gilded, it can hardly be considered to be entirely functional. Guns with such elongated butts were normally held beneath the arm, not against the shoulder.



▲ MATCHLOCK REVOLVING MUSKET

Date	c.1800
Origin	India
Barrel	24½in (62cm)
Caliber	.60in (15.2mm)

An unusual matchlock revolving musket from Indore, central India, this gun uses a mechanical sophistication sometimes seen in European flintlocks—the use of a revolving cylinder to create a multi-shot weapon (see p.49). The chambers were rotated into position manually.

▼ CHINESE WALL GUN

Date	c.1830
Origin	China
Barrel	63in (160cm)
Caliber	Not known

Wall guns were designed to be fired from a rest, and they were far too long and unwieldy to be used in any other way. This example is extremely simple in both design and execution, and it is completely devoid of decoration.

KYRGYZ HUNTING PARTY
In Kyrgyzstan, the nobility used matchlock guns for hunting. These arms were used widely in Central Asia well into the 20th century. Some guns, such as the one seen on the far right of this illustration from 1830, had a forked rest below the muzzle to assist aiming.

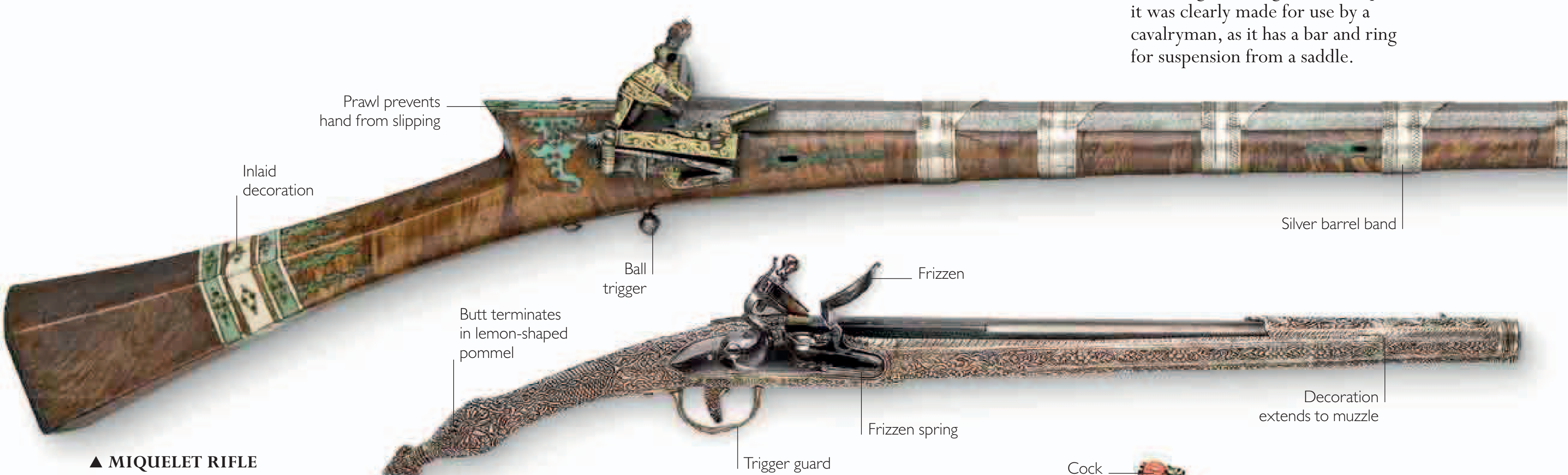
OTTOMAN FIREARMS

The military forces of the Ottoman Empire appreciated the value of muskets in warfare. At the end of the 17th century, the Ottoman Empire's occupation of large portions of southwest Europe ensured an inflow of military technology from the West. Fine examples of Ottoman snaphance, miquelet, and flintlock handguns were produced in the 18th century. Ornate decoration defines many of these pieces, with Islamic and Indian influences apparent in the use of inlaid precious metal and stones, and the sumptuous application of floral and geometric designs.

▲ FLINTLOCK BLUNDERBUSS

Date	Early 18th century
Origin	Turkey
Barrel	13½in (34.3cm)
Caliber	1.2in (30.5mm) (at muzzle)

Despite its being furnished with a shoulder stock that is incised, carved, and inlaid with silver, this blunderbuss (see p.47) is actually a large cavalry pistol. The work of "the Dervish Amrullah," according to an engraved inscription, it was clearly made for use by a cavalryman, as it has a bar and ring for suspension from a saddle.



▲ MIQUELET RIFLE

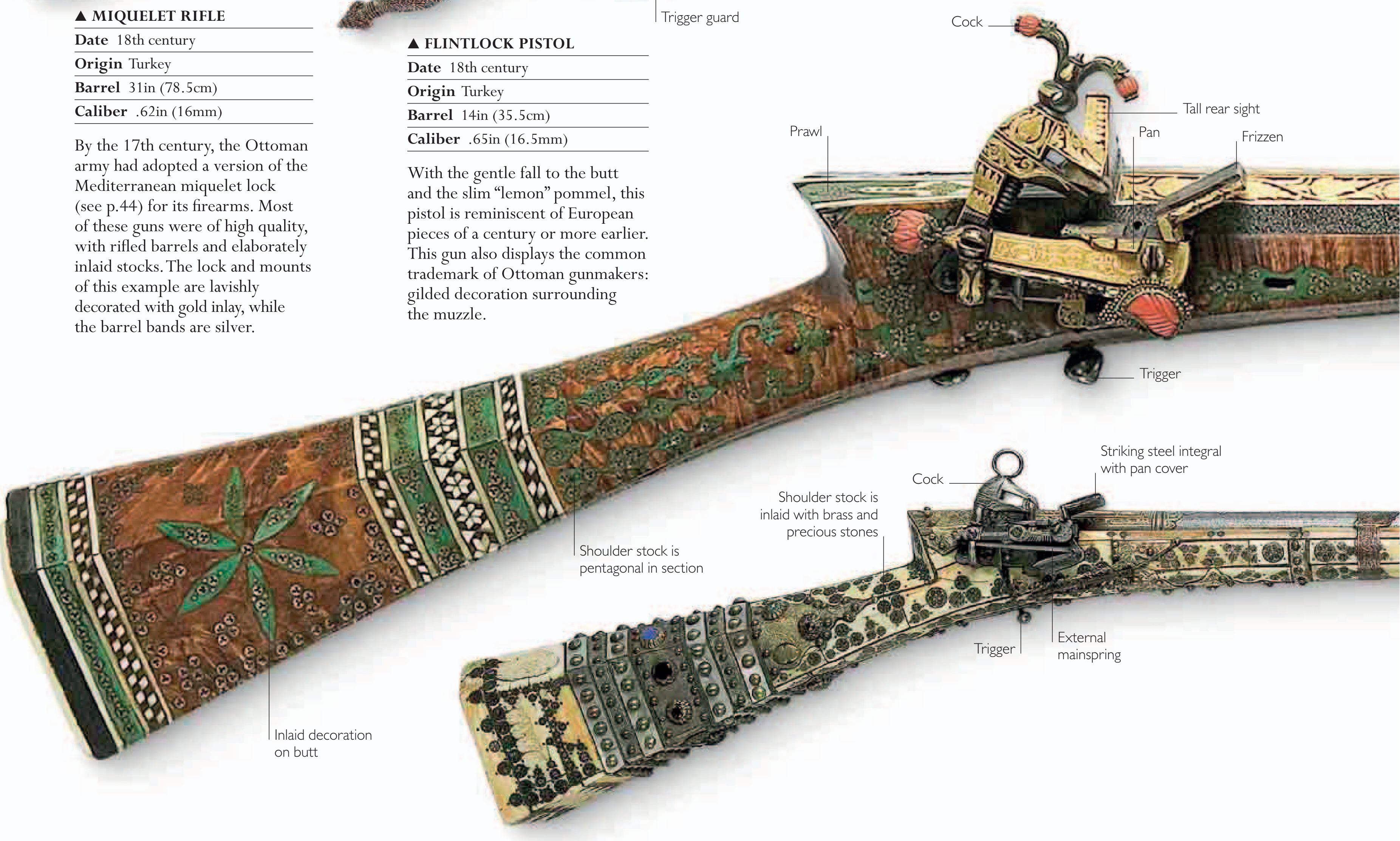
Date	18th century
Origin	Turkey
Barrel	31in (78.5cm)
Caliber	.62in (16mm)

By the 17th century, the Ottoman army had adopted a version of the Mediterranean miquelet lock (see p.44) for its firearms. Most of these guns were of high quality, with rifled barrels and elaborately inlaid stocks. The lock and mounts of this example are lavishly decorated with gold inlay, while the barrel bands are silver.

▲ FLINTLOCK PISTOL

Date	18th century
Origin	Turkey
Barrel	14in (35.5cm)
Caliber	.65in (16.5mm)

With the gentle fall to the butt and the slim "lemon" pommel, this pistol is reminiscent of European pieces of a century or more earlier. This gun also displays the common trademark of Ottoman gunmakers: gilded decoration surrounding the muzzle.



▲ FLINTLOCK PISTOL

Date Late 18th century

Origin Turkey

Barrel 12½in (31.75cm)

Caliber .62in (15.7mm)

A pistol such as this—stocked all the way to the muzzle, with its woodwork copiously inlaid and its lock, barrel, and trigger guard decorated with silver and gold—would have graced many arms cabinets in the Ottoman world. The flintlock firing this weapon appears to be of European origin.

▲ FLINTLOCK PISTOL

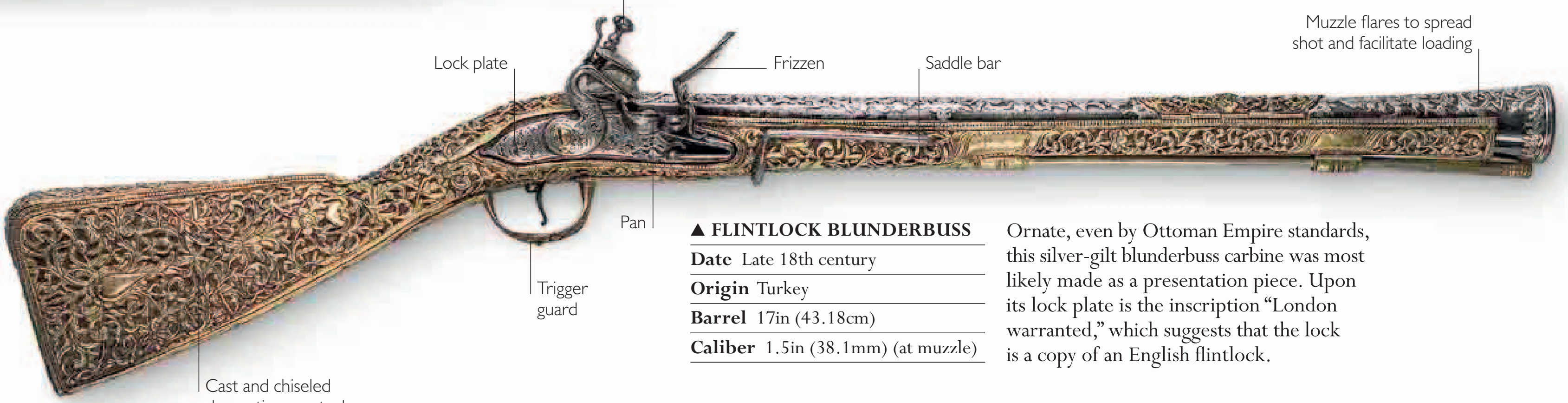
Date 1788

Origin Caucasus

Barrel 12in (30.5cm)

Caliber .60in (15.2mm)

The stocks and muzzle of this all-metal, ball-butt pistol (one of a pair) are covered with cast and chiseled silver gilt. The lock plate is inscribed “Rossi,” the maker’s name, suggesting that the lock, at least, was imported from Italy.



▲ FLINTLOCK BLUNDERBUSS

Date Late 18th century

Origin Turkey

Barrel 17in (43.18cm)

Caliber 1.5in (38.1mm) (at muzzle)

Ornate, even by Ottoman Empire standards, this silver-gilt blunderbuss carbine was most likely made as a presentation piece. Upon its lock plate is the inscription “London warranted,” which suggests that the lock is a copy of an English flintlock.

FULL VIEW

▲ MIQUELET LOCK RIFLE

Date Late 18th century

Origin Turkey

Barrel 32in (81.3cm)

Caliber .60in (15.2mm)

This rifle is of classic Turkish form. Its stock has the typical pentagonal-section butt, and fine inlaid decoration incorporating panels of metal wire and colored and natural ivory. The rifled “Damascus” barrel (see p.47) has a marked grain pattern and a tall aperture rear sight. The lock is decorated with gold and panels of coral.

▲ BALKAN MIQUELET TÜFENK

Date Early 19th century

Origin Turkey

Barrel 36in (91.4cm)

Caliber .55in (13.9mm)

This piece is reminiscent of Indian muskets. The stock is entirely covered in ivory and further embellished with inlays of precious stones and brass. The miquelet lock, common in Spain and Italy, is thought to have made its way to the Ottoman Empire via Africa.

TURNING POINT

FAIL-SAFE GUNS

Matchlocks, wheel-locks, and flintlocks used a small amount of gunpowder to prime the propellant (main gunpowder charge). In 1807, the Reverend Alexander Forsyth patented a way of igniting the propellant by using a different substance—a sensitive chemical primer that detonates when struck. Joshua Shaw later patented the percussion cap as the simplest way of making Forsyth's invention work. Firearms could now use chemical ignition. This key development in firearms technology enabled guns to fire instantaneously and reliably, unlike earlier guns with exposed gunpowder priming. It also enabled the development of the revolver and the self-contained metallic cartridge (see pp.122–23), now used by nearly every modern firearm.

▲ **PERCUSSION CAPS**
Percussion caps were small copper or brass cups containing a minute quantity of fulminate. A cap was held in place on a hollow plug, or nipple, that was attached to the breech of the gun.

In the early 19th century, Alexander Forsyth, an avid duck hunter, was frustrated by the shortcomings of the flintlock system. Although reliable, it suffered from the occasional "flash in the pan" when the priming powder would ignite but the gun would fail to fire. Along with the noise of the flint striking the frizzen and the puff of smoke, the "flash" alerted potential game, which would quickly disappear.

BEFORE

At the beginning of the 19th century, most guns were fired by the flintlock mechanism. In this, a piece of flint was struck against steel to create sparks that ignited some priming powder in a small pan alongside the barrel. The flame from this passed through a vent in the barrel and ignited the main charge.

- **LOOSE POWDER PLACED IN A PRIMING PAN** in small quantities was not efficient. Wind could blow it away and rain could make it wet. The powder could also ignite but fail to detonate the main charge.
- **DELAYS BETWEEN PULLING THE TRIGGER** and the gun actually discharging gave time for birds and animals, startled by the flash and smoke of the ignited priming powder, to escape.

FLINTLOCK MECHANISM

- **FLINTS NEEDED TO REPLACED** after 15 shots or so, and the quality of flints often varied. The hard steel face of the frizzen also wore out, reducing its ability to create a spark.

THE "SCENT-BOTTLE" LOCK

Forsyth set about devising a simpler, faster, and more effective means of ignition. He designed a mechanism that could be attached to any firearm. It used a detonating compound called mercury fulminate as a primer to ignite the main powder charge. The fulminate was held in a vessel shaped like a perfume bottle, which gave this mechanism the name "scent-bottle" lock. It was mounted on a hollow, cylindrical spindle and screwed into a flintlock gun's vent that had been specially enlarged.

Forsyth's invention embodied the fundamental principles of chemical ignition upon which all future gun and ammunition development would be based.

PERCUSSION DESIGN EVOLVES

Although revolutionary, the "scent-bottle" lock was unsafe as it carried a large quantity of a detonating compound, which could explode accidentally and injure the user. Many people attempted to adapt Forsyth's idea to design a variety of safer percussion systems that would use a tiny, isolated quantity of primer—just enough to prime the gun once. The gunmaker

▼ **THE THIN RED LINE**
Armed mainly with Pattern 1851 percussion rifles, the 93rd Highlanders regiment of the British Army bravely formed an unmoving line of defense against the Russian cavalry in the Battle of Balaclava in 1854. From a distance, they appeared to onlookers as a "thin red line" because of their red coats.

KEY **FIGURE**

Alexander John Forsyth
(1768–1843)

Alexander Forsyth graduated from King's College, Aberdeen, Scotland, in 1786, and in 1791, he was licensed as a minister in Belhelvie, Aberdeenshire. He was a game shooter as well as an amateur chemist and mechanic. His frustration with the flintlock's weaknesses spurred him to devise a better ignition system.

Joe Manton designed the "tube-lock"—in this, he placed the fulminate in a thin copper tube, which was inserted into a vent on one side of the barrel and struck with a hammer. Other systems included the "pellet-lock" and Edward Maynard's tape primer. The tape primer had the fulminate in a series of "caps" in a long tape and was popular in the US for a while. Even in recent times this was the "ammunition" for toy cap guns.

"... one of the most **ingenious**... one of the most useful **inventions** in modern times..."

ATTRIBUTED TO **COMMITTEE OF PATENTS ON JOSHUA SHAW'S CLAIM (FEBRUARY 1846)**

THE PERCUSSION CAP

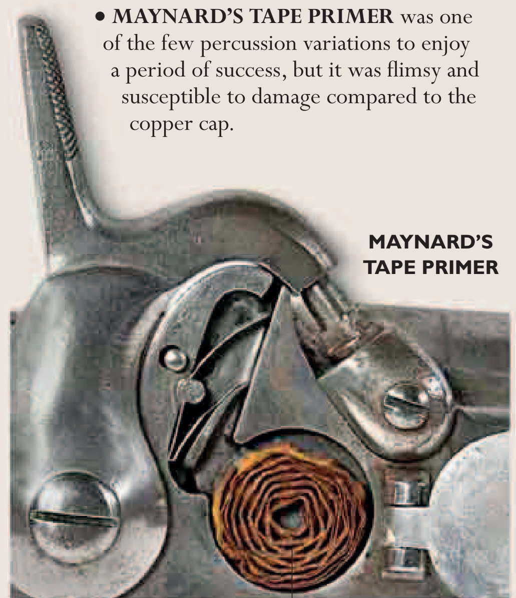
The breakthrough, however, was made in 1822 by Joshua Shaw, an English artist. He designed a tiny copper cup, put fulminate in it, and held it in place with a drop of varnish. Shaw placed this cuplike cap on a hollow plug, or nipple, screwed into the breech of a gun, ready to be struck by the hammer. Striking the cap ignited the primer, producing a flash that was relayed to the propellant via a vent in the barrel.

As the percussion system evolved, ultimately resulting in the percussion cap, guns were transformed by having a means of ignition that was reliable and easy to use. Reloading times for these guns decreased dramatically. Rifles employing percussion caps were common in the Crimean War (1853–56). An important battle in this war was the Battle of Balaclava, in which a small number of British troops armed with percussion rifles stood their ground against a Russian cavalry onslaught, firing at the larger force in a volley. The percussion rifles were precise and reliable, and they could be reloaded quickly, which allowed the British forces to repel the Russians. Percussion weapons were also used widely in the American Civil War (1861–65). The 1861 Springfield Rifled Musket was used to devastating effect by Union soldiers. The guns fired three shots per minute and, in the hands of skilled marksmen, could consistently hit targets within 500 yards (457m).

AFTER

The percussion cap rendered all other ignition systems obsolete. It simplified the loading and firing process and made the revolver a viable proposition. It also paved the way for the development of the self-contained metallic cartridge and breech-loading firearms.

- **MAYNARD'S TAPE PRIMER** was one of the few percussion variations to enjoy a period of success, but it was flimsy and susceptible to damage compared to the copper cap.



MAYNARD'S TAPE PRIMER

Tape primer

- **THE REVOLVER** became a truly practical proposition. Early revolvers required a system to cover the pan to prevent the priming powder from falling out when the cylinder rotated. The cover also had to be moved when each chamber in the cylinder was in a firing position. Percussion caps solved these problems, allowing revolvers to be produced en masse.

- **BREECH-LOADING FIREARMS** such as the Dreyse needle-fire rifle (see pp.108–09) were developed. These used combustible cartridges in conjunction with separate percussion-cap ignition.

- **SELF-CONTAINED METALLIC CARTRIDGES** evolved using the percussion cap. Guns could be reloaded by merely opening the weapon's breech end, loading the cartridge, closing the breech, and cocking the weapon.

EARLY METALLIC CARTRIDGE

EARLY PERCUSSION GUNS

A new way of priming a gun, by striking a small amount of chemical primer (a substance that ignites when struck), was invented in the 19th century. The first step toward this "percussion" system was taken by Alexander Forsyth, who developed a gunlock in which fulminate powder (the primer) was held in a magazine shaped like a scent bottle. Although this lock had advantages over the flintlock, loose fulminate was dangerous to use, so further devices were invented to contain just enough for priming a gun once. The evolution of percussion design culminated in the percussion cap (see pp.80–81). In the early 19th century, guns employed a variety of percussion locks, but the percussion cap had been almost universally adopted by the 1830s.

▲ **BELGIAN DUELING PISTOL**

Date	1830
Origin	Belgium
Barrel	9¼in (23.8cm)
Caliber	.31in (8mm)

Percussion-cap pistols were more reliable than even the best flintlocks, and one of their earliest uses was as dueling pistols. This half-stocked pistol by the gunmaker Folville, one of a cased pair, was made in Liège, Belgium, an internationally significant center of gunmaking at the time.

▲ FORSYTH PATENT PERCUSSION SPORTING GUN

Date	c.1808
Origin	England
Barrel	32½in (82.2cm)
Caliber	.73in (18.5mm)

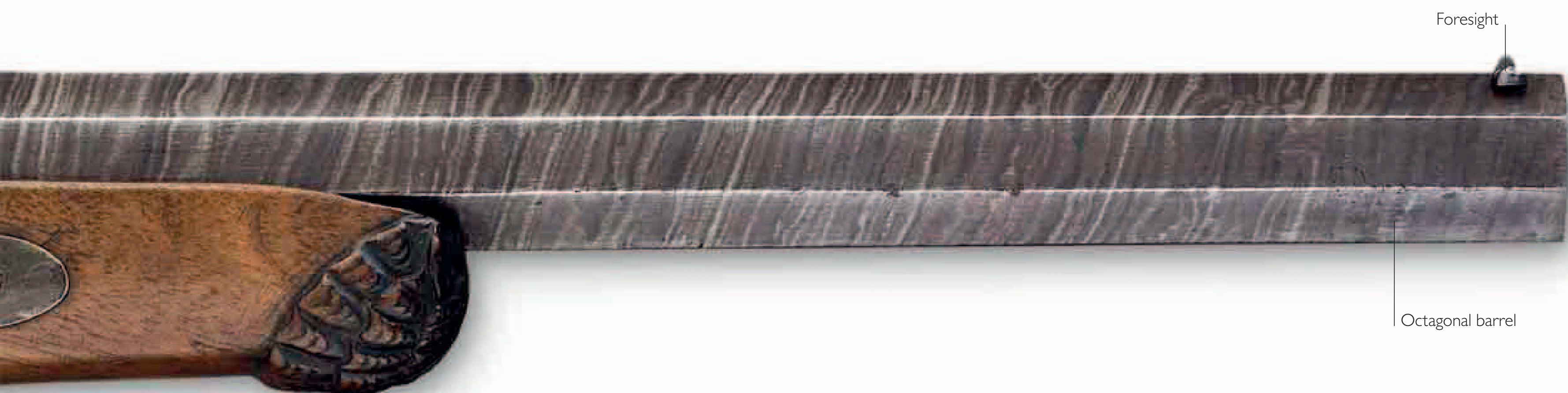
This sporting gun was fired using Forsyth's "scent-bottle" lock. Loose fulminate powder (the chemical primer) was contained in a rotating magazine. This was fitted with a striker. To fire the gun, a user pulled the hammer back and then rotated the vessel backward, which deposited some fulminate in a small hole in the axle. Pulling the trigger released the hammer, which hit the striker in the vessel, detonating the primer.

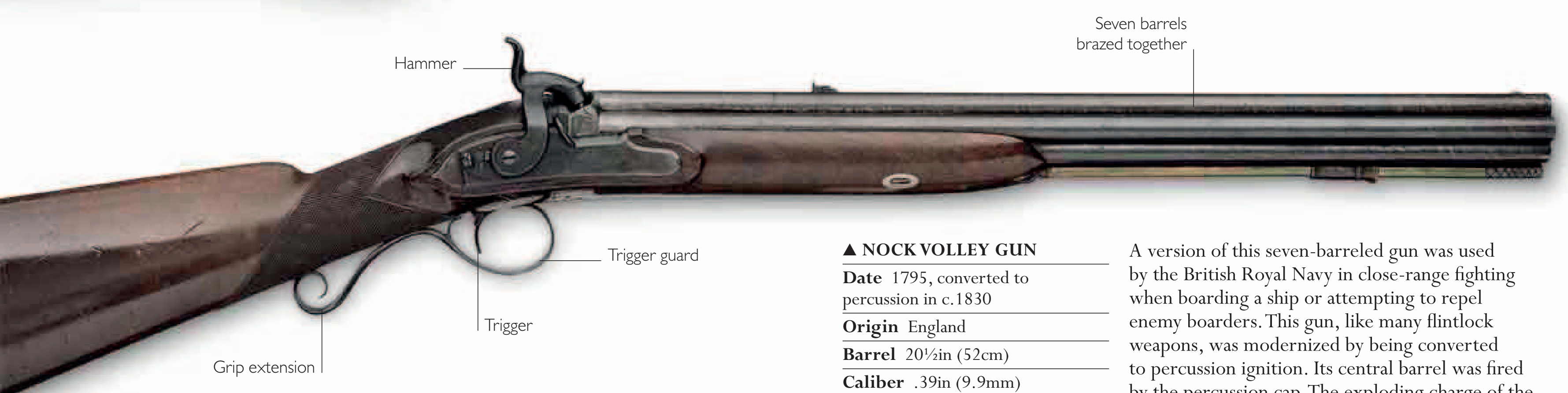
FULL VIEW

▲ ENGLISH PELLET-LOCK PERCUSSION GUN

Date	1820
Origin	England
Barrel	32¼in (82.2cm)
Caliber	.73in (18.5mm)

This gun utilized a "pellet-lock" system, which was a major early step in the evolution of percussion (chemical ignition) technology. The detonating material in this gun was bound with gum or varnish, and the pellets thus formed were contained in a rotating drum attached to the cock. Each partial rotation of the drum brought a fresh, unfired pellet over the nipple, onto which the pellet was driven by the hammer.





▲ NOCK VOLLEY GUN

Date	1795, converted to percussion in c.1830
Origin	England
Barrel	20½in (52cm)
Caliber	.39in (9.9mm)

A version of this seven-barreled gun was used by the British Royal Navy in close-range fighting when boarding a ship or attempting to repel enemy boarders. This gun, like many flintlock weapons, was modernized by being converted to percussion ignition. Its central barrel was fired by the percussion cap. The exploding charge of the gunpowder in its breech was linked by radiating vents to those of the other six barrels, which fired simultaneously as a volley.

US PERCUSSION MUSKET

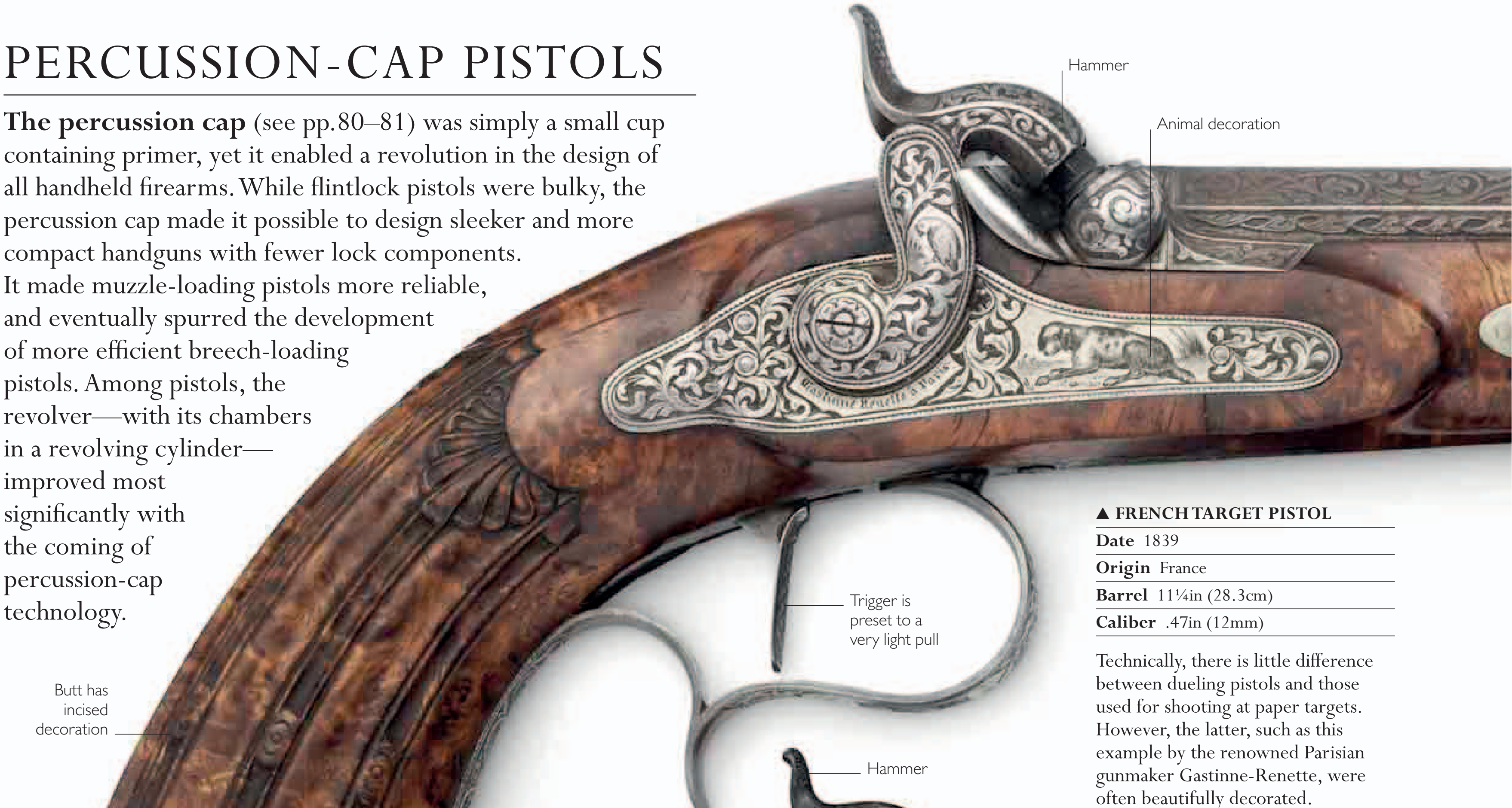
THE AGE OF CHANGE

1830–80

Firearms technology leaped ahead in the 19th century. Around 1830, the flintlock was still in almost universal military service, but the next 50 years saw the invention and adoption of percussion ignition, successful breech-loading mechanisms, the metallic cartridge, effective repeating firearms, and even machine-guns. Many of the mechanisms developed during that time are still in use today.

PERCUSSION-CAP PISTOLS

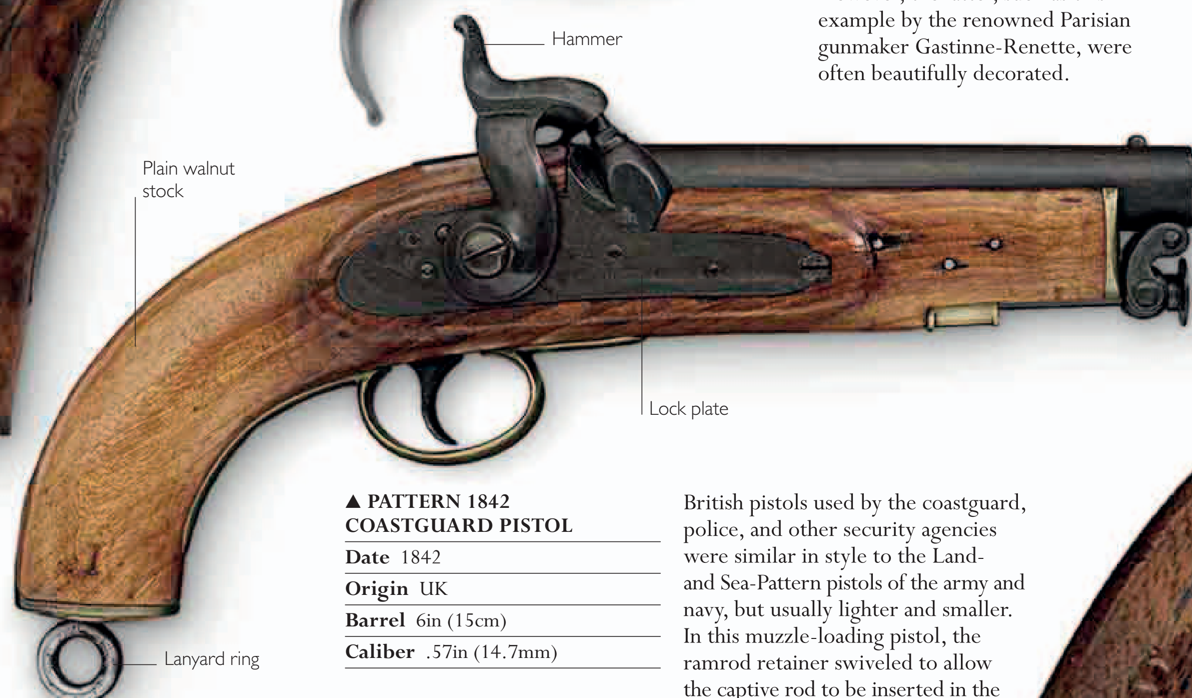
The percussion cap (see pp.80–81) was simply a small cup containing primer, yet it enabled a revolution in the design of all handheld firearms. While flintlock pistols were bulky, the percussion cap made it possible to design sleeker and more compact handguns with fewer lock components. It made muzzle-loading pistols more reliable, and eventually spurred the development of more efficient breech-loading pistols. Among pistols, the revolver—with its chambers in a revolving cylinder—improved most significantly with the coming of percussion-cap technology.



▲ **FRENCH TARGET PISTOL**

Date	1839
Origin	France
Barrel	11¼in (28.3cm)
Caliber	.47in (12mm)

Technically, there is little difference between dueling pistols and those used for shooting at paper targets. However, the latter, such as this example by the renowned Parisian gunmaker Gastinne-Renette, were often beautifully decorated.



▲ **PATTERN 1842 COASTGUARD PISTOL**

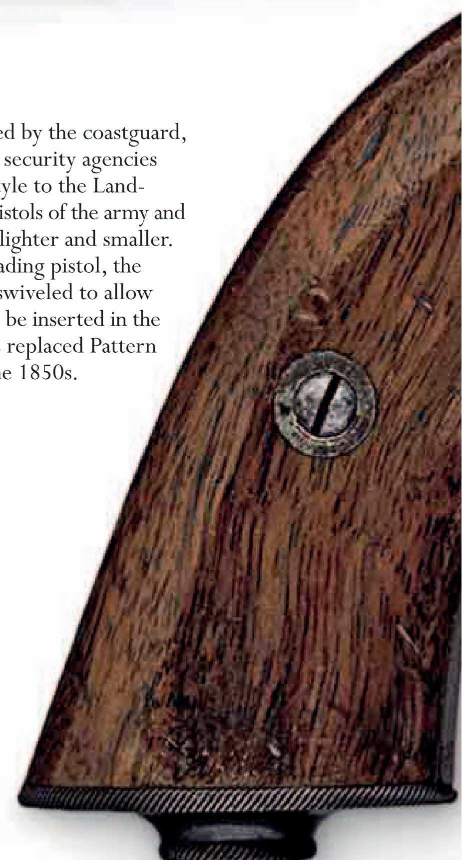
Date	1842
Origin	UK
Barrel	6in (15cm)
Caliber	.57in (14.7mm)

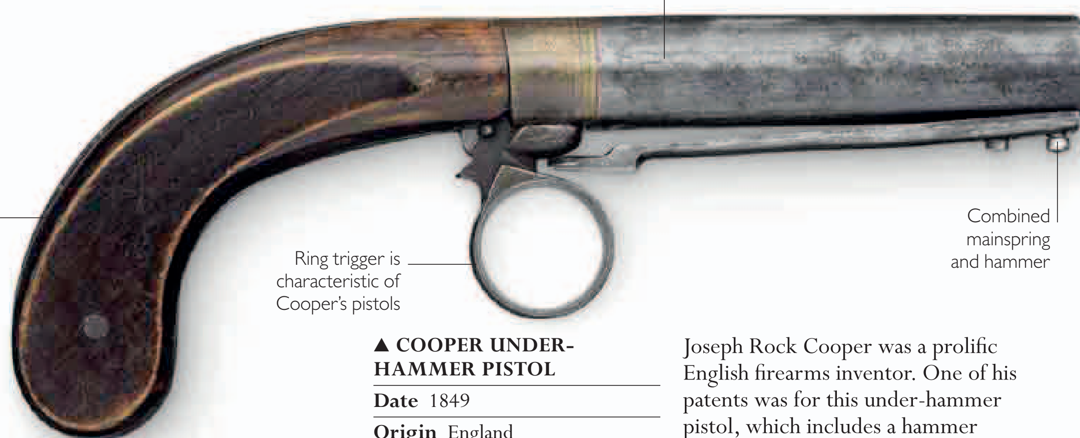
British pistols used by the coastguard, police, and other security agencies were similar in style to the Land- and Sea-Pattern pistols of the army and navy, but usually lighter and smaller. In this muzzle-loading pistol, the ramrod retainer swiveled to allow the captive rod to be inserted in the barrel. Revolvers replaced Pattern 1842 pistols in the 1850s.

▲ **BAR-HAMMER PEPPERBOX PISTOL**

Date	1849
Origin	UK
Barrel	3½in (9.1cm)
Caliber	.55in (13.9mm)

Pepperbox pistols had multiple barrels, which offered the advantage of multishot cylinder revolvers without their principal drawback—the leakage of propellant gas between chamber and barrel. Unfortunately, these pistols were generally inaccurate, except at point-blank range.





▲ COOPER UNDER-HAMMER PISTOL

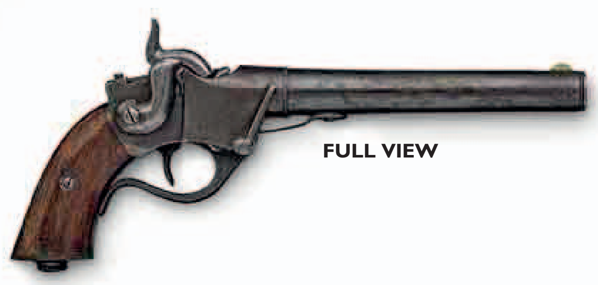
Date	1849
Origin	England
Barrel	4in (10cm)
Caliber	.45in (11.4mm)

Joseph Rock Cooper was a prolific English firearms inventor. One of his patents was for this under-hammer pistol, which includes a hammer located under the barrel along with the percussion-cap plug, or nipple.

▲ SHARPS BREECH-LOADING PISTOL

Date	c.1860
Origin	US
Barrel	5in (12.7cm)
Caliber	.34in (8.6mm)

American inventor Christian Sharps was famous for his breech-loading rifles and carbines. His pistols were based on the same principles as his early rifles and carbines (see p.110).



FULL VIEW

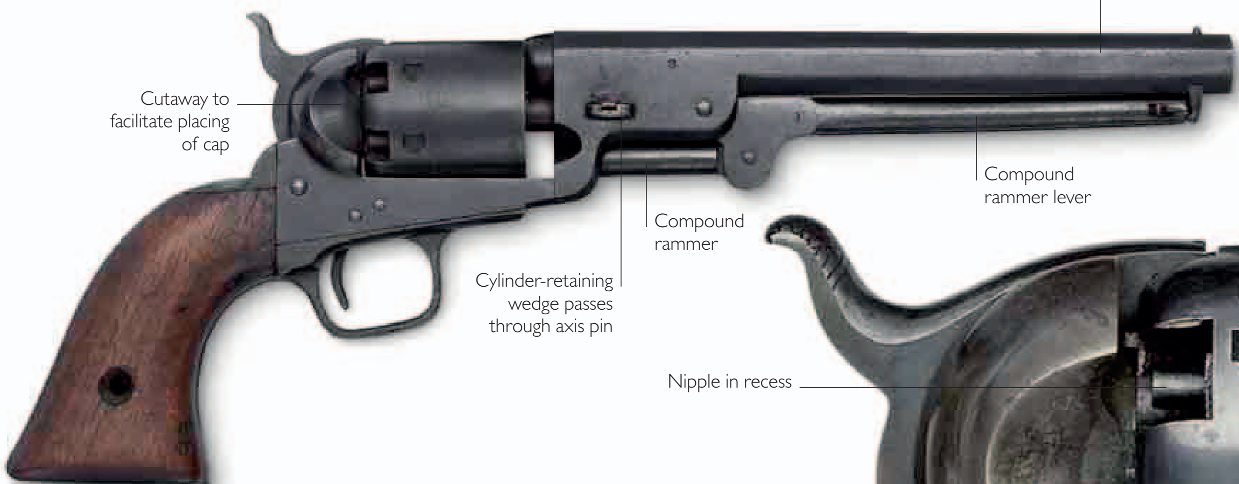
AMERICAN PERCUSSION-CAP REVOLVERS

Revolving pistols were made less cumbersome by the percussion cap (see pp.80–81), which improved the single-action revolver (in which the hammer is cocked manually) that had become a reality by the end of the 17th century. These revolvers were loaded with powder and projectile (bullet or ball) from the muzzle of each chamber with the help of a device called a compound rammer. Samuel Colt patented his revolver in the UK in 1835 and in the US in 1836. His revolver, and its later copies, mostly used an open-frame construction, while some other makers favored a solid frame, with a top strap of metal above the cylinder.

▶ COLT MODEL 1849 POCKET REVOLVER

Date 1849
Origin US
Barrel 4in (10.2cm)
Caliber .31in (7.87mm)

A revised version of his 1848 revolver, the Baby Dragoon, Samuel Colt's 1849 single-action Pocket revolver had a standard compound rammer, choice of three barrel lengths, and a five- or six-shot cylinder.



▲ COLT MODEL 1851 NAVY REVOLVER

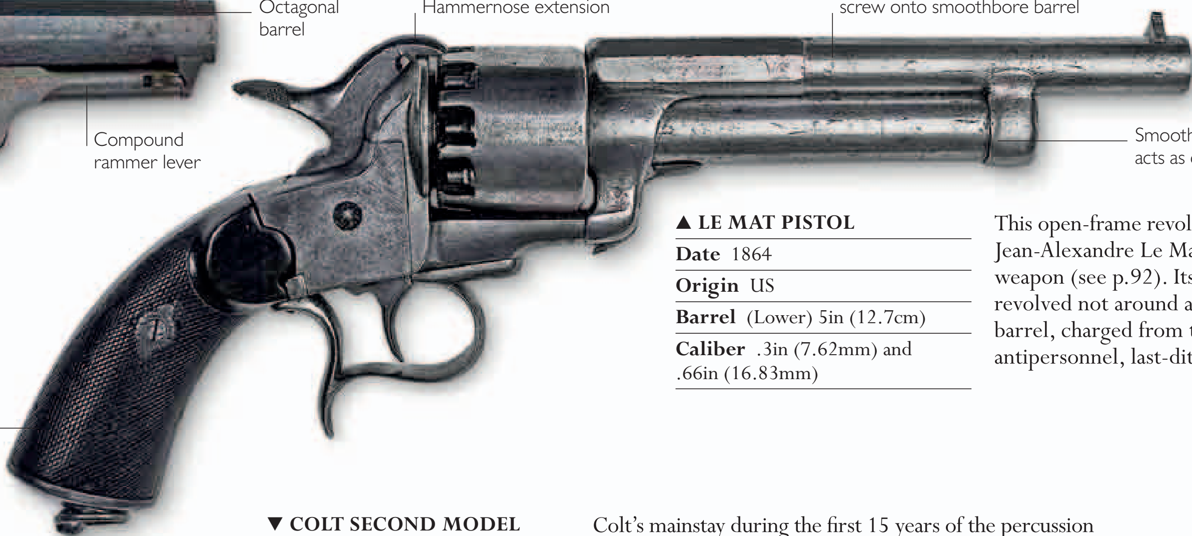
Date 1851
Origin England
Barrel 7½in (19cm)
Caliber .36in (9.14mm)

At the Great Exhibition of 1851 in London, Samuel Colt introduced the Navy Model, a single-action, open-frame light revolver in .36 in (9.14mm) rather than .44in (11.17mm) caliber. After the display, he obtained an order from the British government. This is one of the revolvers produced at his company's London factory.

▶ COLT MODEL 1855 POCKET REVOLVER

Date 1855
Origin US
Barrel 3½in (8.9cm)
Caliber .28in (7.1mm)

Elisha Root, the Colt Works Superintendent, designed the 1855 Pocket revolver. This single-action revolver had a solid-frame design in which the cylinder was held in a rectangular frame made by the top and bottom straps, the standing breech end, and the part of the frame forming the rear of the barrel.

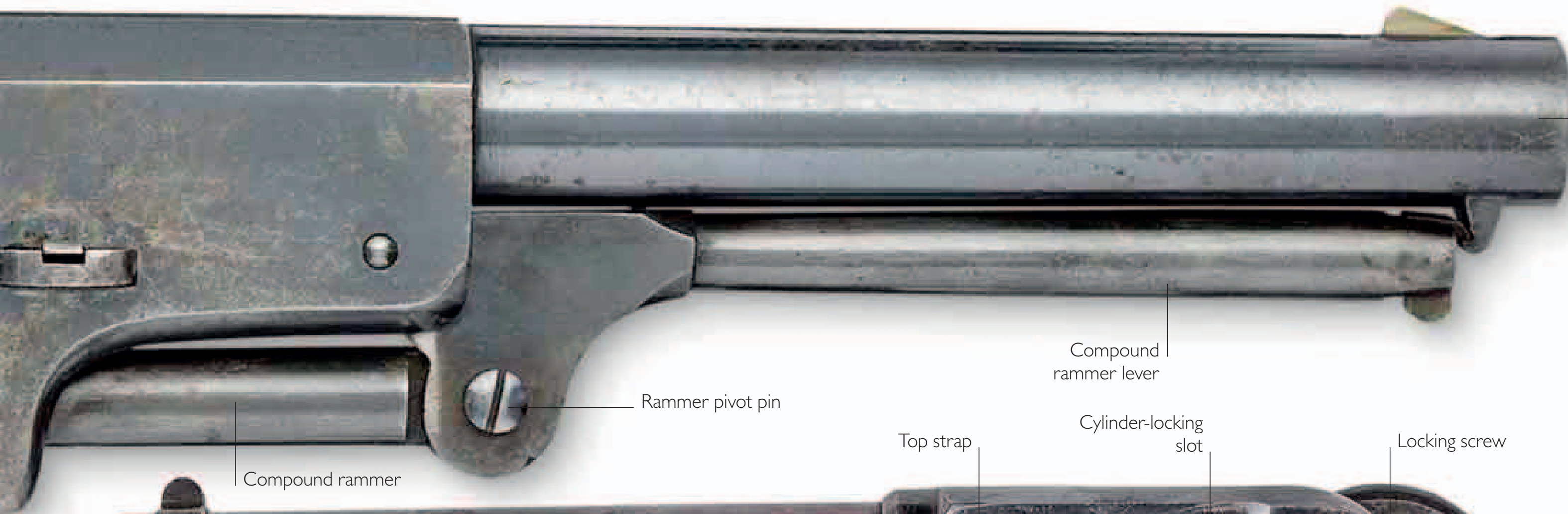


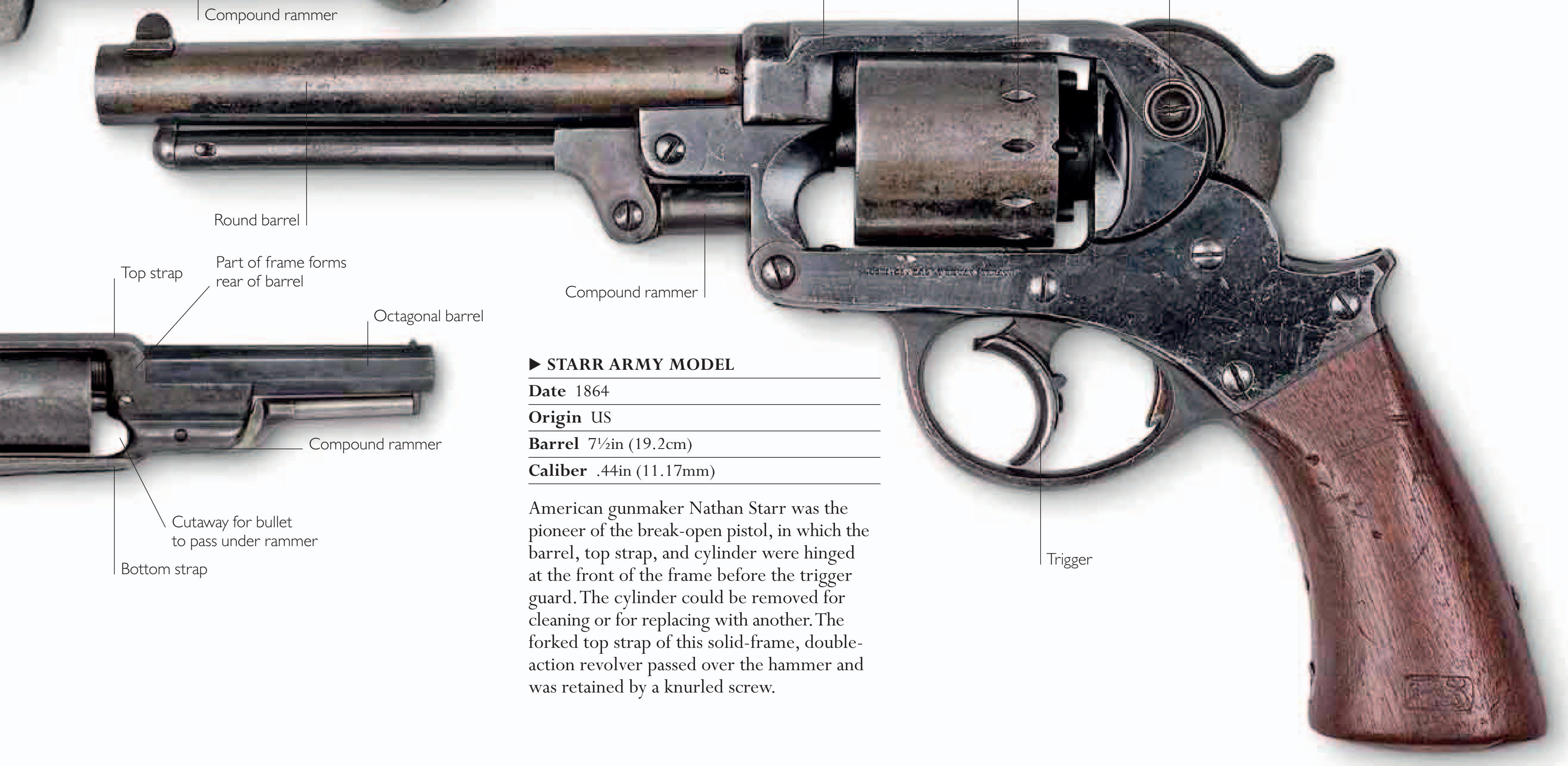
▲ LE MAT PISTOL
Date 1864
Origin US
Barrel (Lower) 5in (12.7cm)
Caliber .3in (7.62mm) and .66in (16.83mm)

This open-frame revolver designed by Frenchman Jean-Alexandre Le Mat was a double-action weapon (see p.92). Its nine-chambered cylinder revolved not around a pin but a second, unrifled barrel, charged from the muzzle with pellets, for antipersonnel, last-ditch defense.

▼ COLT SECOND MODEL DRAGOON PISTOL
Date 1849
Origin US
Barrel 7½in (19cm)
Caliber .44in (11.17mm)

Colt's mainstay during the first 15 years of the percussion era was the Dragoon Pistol, so called because it was intended as a sidearm for cavalrymen. A new factory was built at Hartford in Connecticut to produce this single-action revolver to fulfill an army contract.





▶ STARR ARMY MODEL
Date 1864
Origin US
Barrel 7½in (19.2cm)
Caliber .44in (11.17mm)

American gunmaker Nathan Starr was the pioneer of the break-open pistol, in which the barrel, top strap, and cylinder were hinged at the front of the frame before the trigger guard. The cylinder could be removed for cleaning or for replacing with another. The forked top strap of this solid-frame, double-action revolver passed over the hammer and was retained by a knurled screw.

SHOWCASE

COLT NAVY REVOLVER

By the late 1840s, Samuel Colt had manufactured several models of single-action revolver fired by percussion caps. These were all variations on his open-frame design, which allowed the removal of the cylinder for cleaning, or to fit another ready-loaded one. Colt's most successful percussion revolver, the Model 1851 Navy Revolver, sold in huge numbers. Seen here is the improved Model 1861.

COLT NAVY REVOLVER
Date 1861
Origin US
Barrel 7½in (19.1cm)
Caliber .36in (9.14mm)

▸ **COLT MODEL 1861 NAVY REVOLVER**
Colt was a firm believer in standardization in manufacture. One of the factors that made his pistols so sought-after was the interchangeability of their components, which meant that replacements for broken parts could be bought off the shelf, and that improvements could be easily incorporated. Some 38,843 examples of the Model 1861 Navy Revolver were produced before it was discontinued in 1873.

▸ **PERCUSSION CAPS**
Percussion caps, so called because of their shape, were made of two layers of copper foil with a minute quantity of fulminate of mercury, oxidizer, and a sustaining agent sandwiched between them. They were introduced in this form in about 1822.

▲ POWDER FLASK
By the 1860s, the traditional powder horn had given way to the flask, which incorporated a dispenser for a measured amount of powder as its spout. Most were ornamented with hunting or martial scenes.

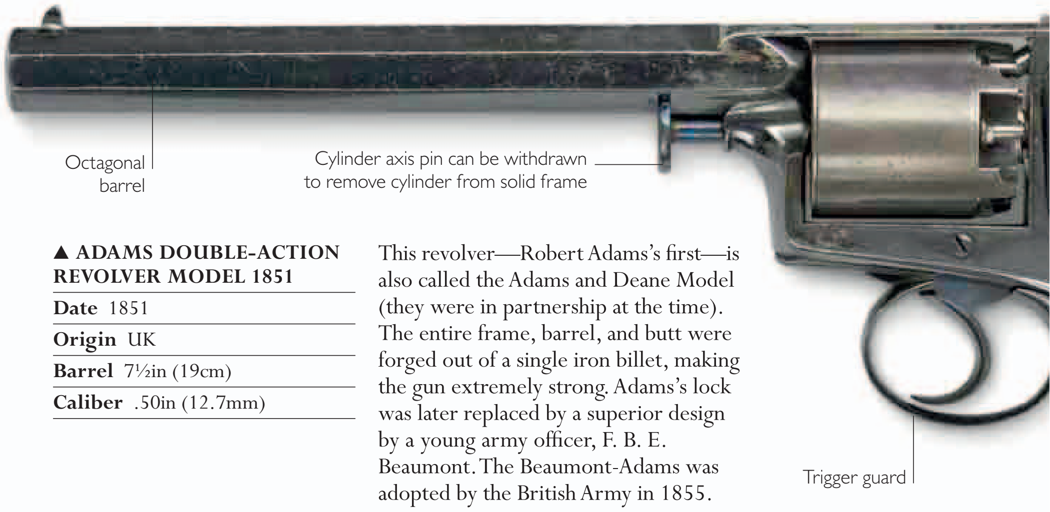
▼ AMMUNITION
As in all percussion revolvers, powder and projectile (bullet or ball) were loaded at the muzzle of each chamber in turn, before a percussion cap was placed over an external nipple at the rear of each chamber. Measured cap amounts of powder and projectile were made into simple cartridges with combustible cases made of fine animal membrane. The user placed each cartridge into the muzzle of a chamber, powder charge first, with the bullet facing outward. The cartridge case was crushed when seated home in the chamber by the compound rammer—a small press permanently attached to the revolver.

▶ BULLET MOLD
Even though calibers had by now become standardized, it was still almost unheard-of to buy loose bullets. Instead, one bought a bar of lead and made one's own bullets, using the mold supplied with the pistol.

▲ LEAD BULLETS
By 1861, the cylindro-ogival form (above) had replaced the ball to become the standard shape for both rifle and pistol bullets (see pp. 306–07). They were still being made from pure lead, without the addition of a hardening agent such as antimony.

BRITISH PERCUSSION-CAP REVOLVERS

The American approach to revolver making, exemplified by the likes of Samuel Colt, sought to manufacture pistols in large numbers using machines to make interchangeable parts. In contrast, the British gun trade preferred to sustain traditional craft skills in the making of revolvers. By the mid-19th century, British companies were producing a variety of efficient revolvers, from those developed from earlier "pepperbox" (multiple-barrel) designs (see p.86), to models with sophisticated mechanisms that were either self-cocking (in which the hammer is cocked by pulling the trigger) or double-action (in which the hammer is cocked by single-action or self-cocking mechanisms).



▲ ADAMS DOUBLE-ACTION REVOLVER MODEL 1851

Date	1851
Origin	UK
Barrel	7½in (19cm)
Caliber	.50in (12.7mm)

This revolver—Robert Adams's first—is also called the Adams and Deane Model (they were in partnership at the time). The entire frame, barrel, and butt were forged out of a single iron billet, making the gun extremely strong. Adams's lock was later replaced by a superior design by a young army officer, F. B. E. Beaumont. The Beaumont-Adams was adopted by the British Army in 1855.

▲ TRANSITIONAL BAR-HAMMER REVOLVER

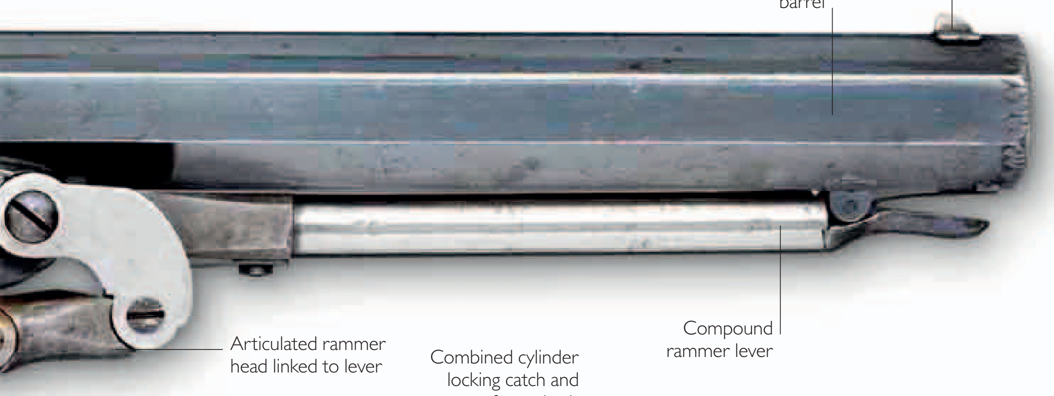
Date	c.1855
Origin	UK
Barrel	5¼in (13.5cm)
Caliber	.4in (10.16mm)

Open-framed "transitional" pistols combined elements of both the pepperbox pistols they superseded and true revolvers. By the late 1850s, there was considerable demand in Britain for cylinder revolvers, but the best of them, by Colt, Deane, or Adams, were very expensive. Cheaper designs such as this open-frame example, with a bar hammer derived from a pepperbox revolver, were less satisfactory, with a tendency to discharge two cylinders at once because of the lack of partitions between the nipples.

▲ KERR DOUBLE-ACTION REVOLVER

Date	1856
Origin	UK
Barrel	5¾in (14.7cm)
Caliber	.44in (11.17mm)

James Kerr, Robert Adams's cousin, equipped his solid-frame revolver with a separate lock and a side-mounted hammer. The lock was held by two screws and could be easily removed. If a component broke, any gunsmith would have been able to repair it.



◀ JOSEPH LANG TRANSITIONAL REVOLVER

Date	1855
Origin	UK
Barrel	6in (15.2cm)
Caliber	.44in (11.17mm)

Transitional pistols continued to be produced, mostly in Europe, even after much more sophisticated designs had appeared. This open-frame, single-action revolver is of the type produced by one of the best-known proponents, Joseph Lang of London. Lang was more successful than most gunmakers of the time in solving the problem of propellant gas leaking between chamber and barrel. He designed the revolver in such a way that when the cylinder rotated and each chamber reached the end of the barrel, the mouth of the chamber engaged with the rear end of the barrel, mechanically sealing this connection between the two.

▲ DEANE-HARDING ARMY MODEL

Date	1858
Origin	UK
Barrel	5¼in (13.5cm)
Caliber	.50in (12.7mm)

When Robert Adams broke with his partners in 1853, the elder of the Deane brothers, John, set up his own business. He later began manufacturing a revolver designed by William Harding with a new, simpler type of double-action lock—the forerunner of modern actions. The two-piece solid frame could be dismantled by removing the pin located in the top strap in front of the hammer nose. Considered unreliable, the pistol never achieved lasting popularity.

SAMUEL COLT

GREAT GUNSMITHS

COLT

American manufacturer Samuel Colt (1814–62) built his first revolver in 1831, when he was just sixteen. He perfected the design over a number of years, eventually founding the successful Colt's Patent Fire Arms Manufacturing Company. Colt's designs played a major role in the history of US firearms, leading the change from single-shot pistols to revolvers. As one of the first to make mass production work on a large, commercial scale, Colt also pioneered manufacturing methods that transformed industry worldwide.

In the first half of the 19th century, American inventors made attempts at developing the concept of the revolver, with its rotating cylinder that turns to bring one of several chambers in line with the barrel. Inventor Elisha Collier, who was attracted by the revolver's ability to fire several shots without reloading, designed a flintlock revolver (see p.49) in about 1814. It became popular, especially in Britain, but its unreliable mechanism was a drawback. Samuel Colt was the first to unite the revolver concept with the more reliable percussion-cap mechanism. In the 1830s and early 1840s, Colt made various attempts at manufacturing his revolver, which he patented in 1835. However, the quality of his products was uneven, and none of these enterprises was successful.

MASS PRODUCTION

In 1847, Colt made a new start, renting premises in Connecticut before opening a specially built factory by the Connecticut River in 1855. Here he developed mass production, building each gun from identical parts that could be put together on an assembly line. This kind of manufacturing had already been pioneered by other American industrialists, particularly other firearms producers and Connecticut clockmakers, but Colt was one of the first to adopt it on a large scale. His streamlined production methods enabled the Colt factory to fulfill large orders, not just in the US but also in Europe, where its sales increased during the Crimean War (1853–56).

Making the interchangeable parts for Colt's revolvers involved the development of specialized, state-of-the-art machinery. Colt hired a skilled mechanic and inventor, Elisha K. Root, to oversee his manufacturing process and design the machinery needed. Soon Root was producing a host of mechanized tools, such as milling machines, drill presses, and specially built lathes. In the factory's first year, one observer counted no fewer than 400 different machine tools, most of which carried out processes that had previously been done by hand. This type of highly mechanized production of interchangeable parts was hugely influential in all kinds of industries, including the production of farm machinery, sewing machines, bicycles, steam engines, railroad locomotives, and automobiles. Manufacturers who used it found not only that they kept down their costs, but also that their products were reliable and easy to repair. The mass-production techniques pioneered by Colt transformed not just the firearms business but the whole of industry.

> "**Abe Lincoln** may have freed all men, but **Sam Colt** made them equal."
>
> *POST-CIVIL WAR SLOGAN*

WINNING THE WEST

Colt's mass-produced revolvers were hugely popular. They sold not only to military users, but also to those involved in law enforcement and to individuals for self-defense. The Colt was especially popular among the settlers of the American West, and the most successful model

◄ **CRIME CONFERENCE**
The importance of the Colt company continued through the 20th century. Here, Newton D. Baker (left) attends a Crime Commission meeting in Chicago and examines the weapons used by the city's gunmen and bootleggers.

COLT SECOND MODEL DRAGOON REVOLVER, 1849

COLT NAVY MODEL 1861 REVOLVER

COLT M1911A1

1836 Samuel Colt founds his first company for firearms production.

1847 Colt produces the Walker Colt revolver with Samuel Hilton Walker.

1848 The Colt Dragoon revolver is introduced, initially for the US Army's Mounted Rifles.

1851 Colt opens a factory in England, increasing access to international markets.

1855 Colt incorporates the Colt's Patent Fire Arms Manufacturing Company, based at his newly built Connecticut factory.

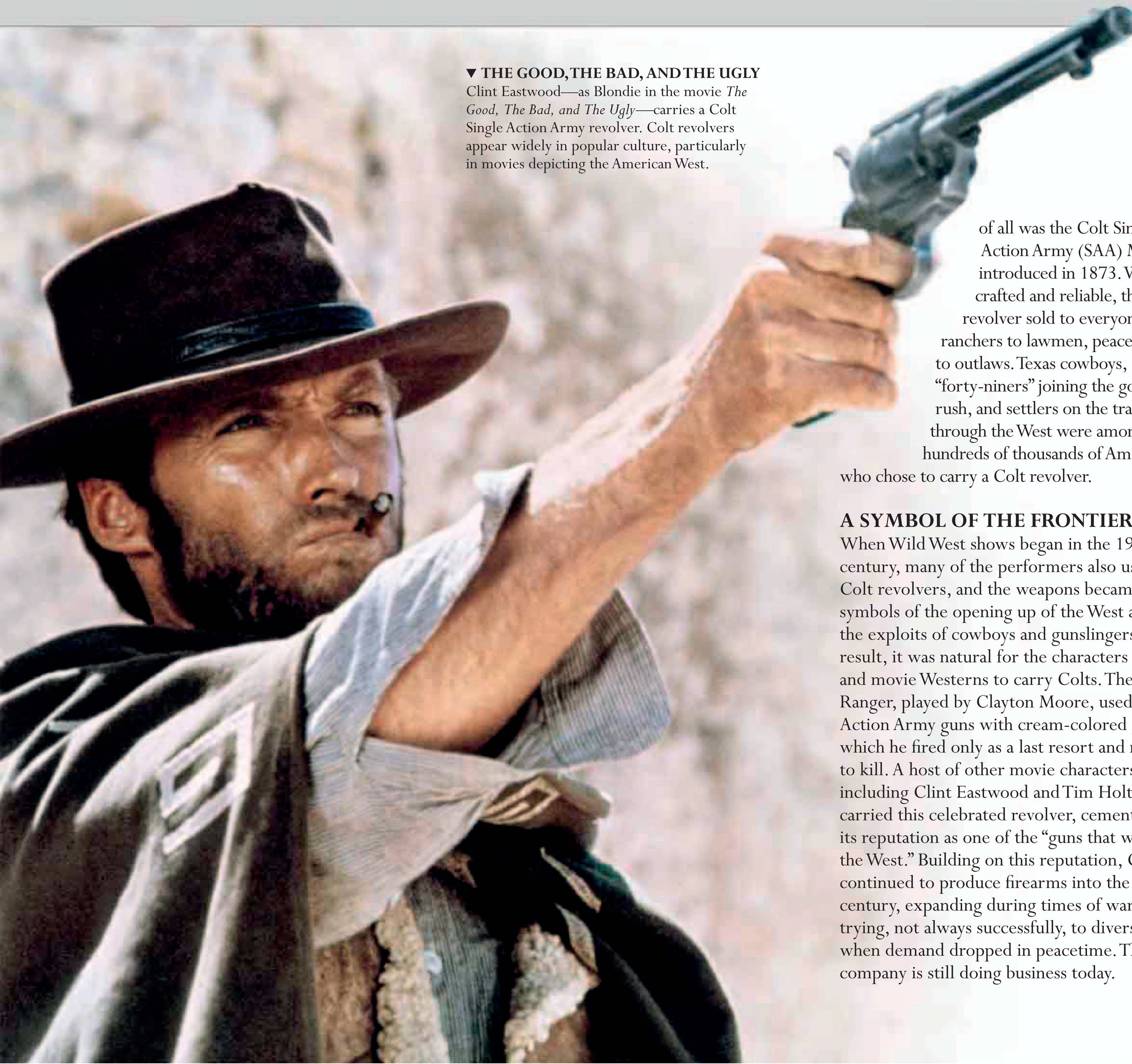
1861 The Colt Navy Revolver is introduced and quickly sees service in the American Civil War.

1863 The Colt Single Action Army Model is introduced. Long-barreled versions produced in 1876 become known as "Buntline Specials," after a legend that author Ned Buntline presented them to lawmen, including Wyatt Earp.

1900 Colt becomes the first American manufacturer of automatic pistols.

1911 Browning designs the Colt M1911, which is adopted by the US Army. In 1924, it is modified into the M1911A1.

1994 After a difficult period involving bankruptcy proceedings, the Colt company is bought by new investors and begins a recovery.



▼ THE GOOD, THE BAD, AND THE UGLY
Clint Eastwood—as Blondie in the movie *The Good, The Bad, and The Ugly*—carries a Colt Single Action Army revolver. Colt revolvers appear widely in popular culture, particularly in movies depicting the American West.

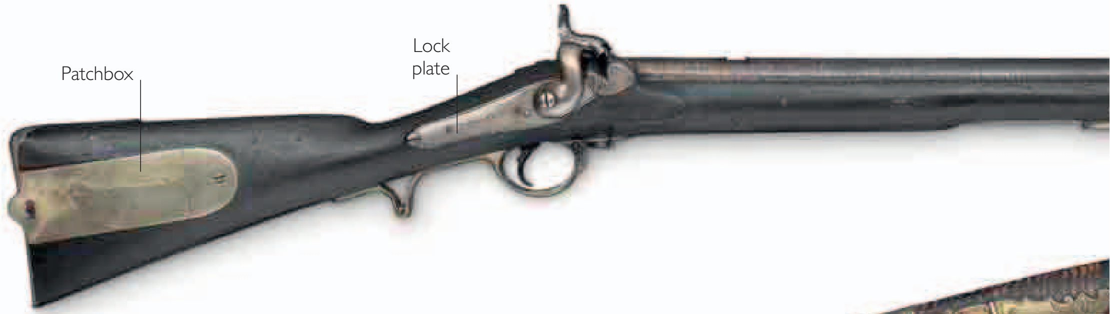
of all was the Colt Single Action Army (SAA) Model, introduced in 1873. Well crafted and reliable, this revolver sold to everyone from ranchers to lawmen, peacemakers to outlaws. Texas cowboys, "forty-niners" joining the gold rush, and settlers on the trail through the West were among the hundreds of thousands of Americans who chose to carry a Colt revolver.

A SYMBOL OF THE FRONTIER

When Wild West shows began in the 19th century, many of the performers also used Colt revolvers, and the weapons became symbols of the opening up of the West and the exploits of cowboys and gunslingers. As a result, it was natural for the characters in TV and movie Westerns to carry Colts. The Lone Ranger, played by Clayton Moore, used Single Action Army guns with cream-colored grips, which he fired only as a last resort and never to kill. A host of other movie characters, including Clint Eastwood and Tim Holt, carried this celebrated revolver, cementing its reputation as one of the "guns that won the West." Building on this reputation, Colt continued to produce firearms into the 20th century, expanding during times of war, and trying, not always successfully, to diversify when demand dropped in peacetime. The company is still doing business today.

MUSKETS AND RIFLES (1831–52)

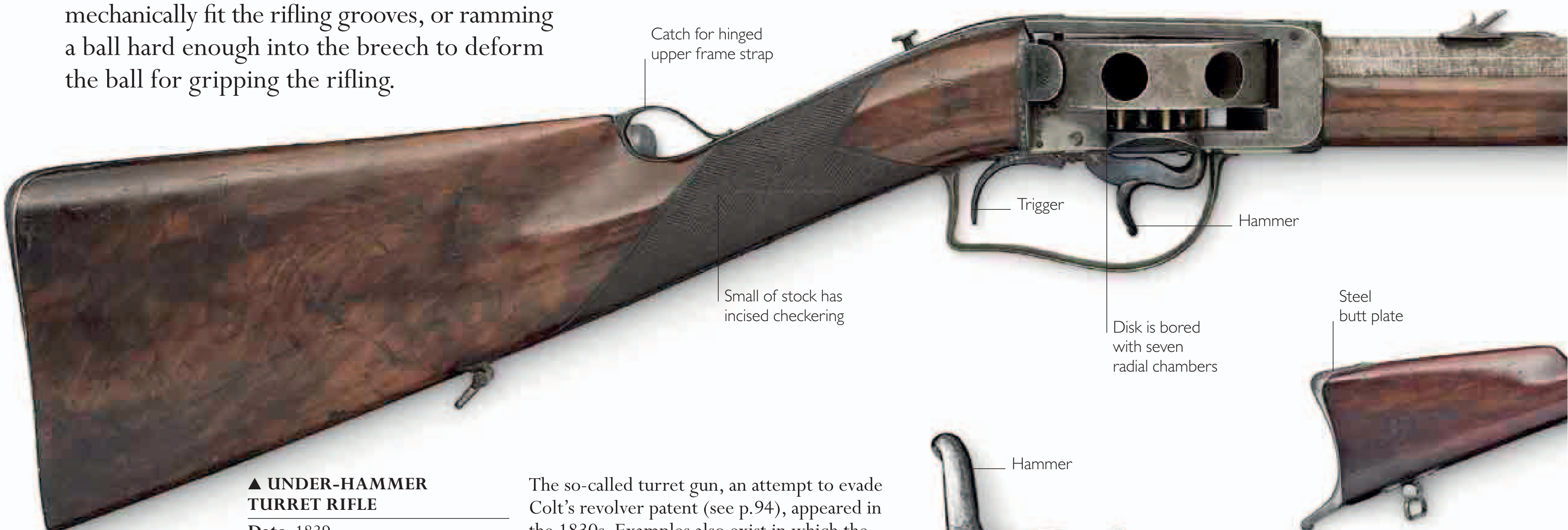
Many flintlock firearms remained in active use well into the 19th century. The iconic Kentucky long rifle was one of many civilian arms that saw sustained use as a flintlock, only gradually being converted to percussion ignition. European countries began to adopt rifles more widely for military use. Loading a rifle via the muzzle remained a problem. Rifles were loaded either using a shaped ball to mechanically fit the rifling grooves, or ramming a ball hard enough into the breech to deform the ball for gripping the rifling.



▲ BRUNSWICK RIFLE

Date	c.1837
Origin	UK
Barrel	32½in (82.5cm)
Caliber	.71in (18.03mm)

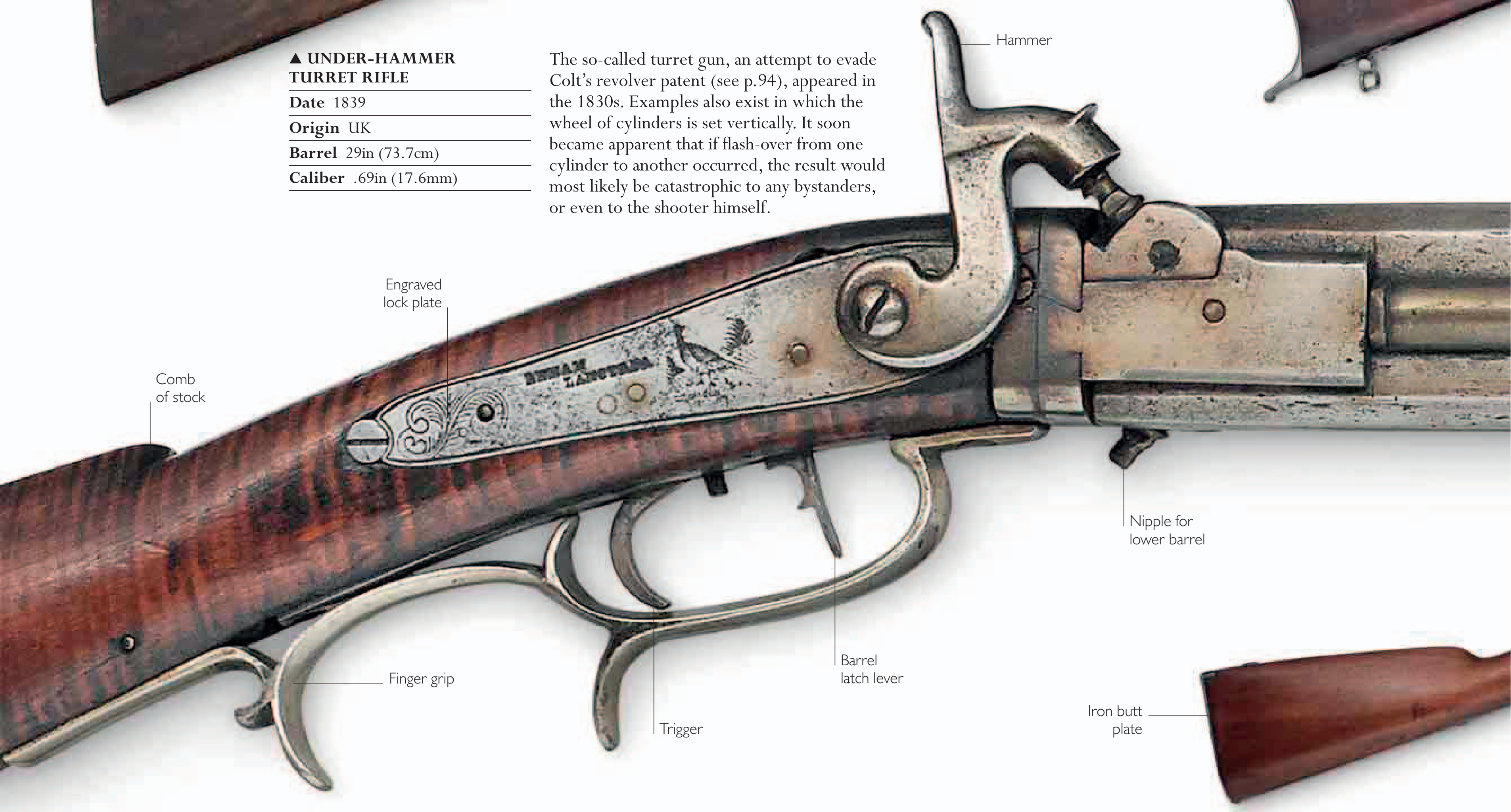
This percussion-cap rifle was introduced into British military service in 1830. It had deep, two-groove rifling and fired a lead ball with an integral band, or belt, around it. This belt fit into the grooves and caused the ball to spin as it was fired (see pp.98–99).



▲ UNDER-HAMMER TURRET RIFLE

Date	1839
Origin	UK
Barrel	29in (73.7cm)
Caliber	.69in (17.6mm)

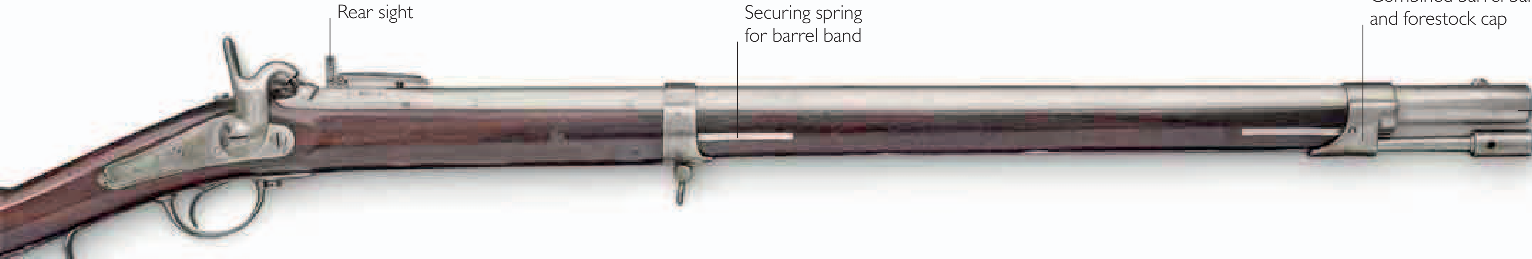
The so-called turret gun, an attempt to evade Colt's revolver patent (see p.94), appeared in the 1830s. Examples also exist in which the wheel of cylinders is set vertically. It soon became apparent that if flash-over from one cylinder to another occurred, the result would most likely be catastrophic to any bystanders, or even to the shooter himself.



▲ KENTUCKY LONG RIFLE

Date	1840
Origin	US
Barrel	44½in (113cm)
Caliber	.46in (11.68mm)

This is a classic example of the American long rifle. The form of the butt and trigger guard were inspired by the shape of 18th-century sporting rifles made by immigrant German gunmakers, but the long barrel became a uniquely American feature.



▲ MOUSQUETON D'ARTILLERIE MLE 1842

Date	1842
Origin	France
Barrel	34in (86cm)
Caliber	.71in (18mm)

First issued to the French Army 20 years earlier and subsequently modified to percussion ignition, the Modèle 1842 received improved rifling and detailed changes to the design of the hammer and nipple. It was produced in a variety of forms, but those for issue to artillerymen had 34-in (86-cm) long barrels, with two barrel bands.

▼ DOUBLE-BARRELED PERCUSSION LONG RIFLE

Date	1845
Origin	US
Barrel	33in (83.8cm)
Caliber	.40in (10.16mm)

This rifle has the elegant lines of the Kentucky rifle (above) but has two barrels. It is built on the Wender system. In this system, the barrels could be rotated by hand. After the upper barrel had been fired, the lower one could be brought up to be fired in turn.

FULL VIEW

▲ US MUSKET MODEL 1842

Date	1842
Origin	US
Barrel	44in (111.7cm)
Caliber	.69in (17.52mm)

A well designed and strongly built musket, this was one of the last smoothbore firearms to be built for American troops before all infantry were issued with muzzle-loading rifles. Its design of lock and robust barrel bands would form the basis for new patterns of US military rifles.

TURNING POINT

PRACTICAL RIFLES

In 1844, Captain Claude-Etienne Minié, a French military officer, developed a bullet that revolutionized firearms, making the rifle as simple to load as the common musket and increasing its firepower. Soon nearly every soldier in every nation had in his hands for the first time a weapon of almost undreamed of power, range, and accuracy. The first use of rifles on a large scale was in the Crimean War (1853–56), and it was there that the modern sniper emerged. A few years later, the use of rifles on an even larger scale helped make the American Civil War (1861–65) the deadliest in the country's history. In a short span of time, the "Minnie ball" bullet had dramatically transformed warfare.

▲ **MINIÉ BULLET**
Featuring a cavity in the base equipped with an iron cup, the original Minié bullets were plain, and tapered from base to point. Later versions, such as this one, had a cylindrical portion and grooves that were greased to lubricate the barrel, making it easier to clean. The bullet shown here is the American "Minnie ball."

The problem with rifles in the days of muzzle-loading had always been loading a ball that fit tightly enough to engage the rifling (see p.28). With a musket, the lead ball was a loose fit. With a rifle, the ball was wrapped in a patch made from greased paper or thin linen, which could be forced into the rifling grooves. After firing, gunpowder would leave thick residues in the grooves. The problematic process of loading rifles thus became even more difficult, and British riflemen in the Napoleonic Wars were issued with mallets to drive the ball down the bore after many shots had been fired.

» BEFORE

Smoothbore muskets fired lead balls that were loose-fitting and might have been accurate only for an aimed shot of up to 50 yards (46m). They were more effective when used for volley-fire by ranks of men firing together, but beyond 300 yards (270m), an opponent could consider himself fairly safe, especially if moving.

• **A ROUND MUSKET BALL**, such as one made of lead, was a loose fit in the gun's bore. When fired, it would ricochet off the wall of the bore, its final direction depending upon the last point of contact.

LEAD MUSKET BALL

• **A LINEN OR PAPER PATCH** enveloping the round ball was an improvement. The ball would grip the grooves in the rifled barrel, making it spin and travel fairly accurately in flight. However, it was difficult to load.

• **THE BRUNSWICK BALL** was an example of a bullet designed to overcome existing problems. It was made to match the rifling and theoretically slide into the bore. The ball had a raised belt that fit into the two, deep rifling grooves in the Brunswick rifle. Brunswick balls could be damaged or deformed if knocked together in a pouch. Trying to align them correctly in the heat of battle also made loading difficult.

BRUNSWICK BALL

EARLY RIFLE SOLUTIONS

One route to overcoming this problem resulted in various breech-loading systems, some more successful than others. A famous example of a breech-loader was the Ferguson rifle. However, it was expensive to make and despite its superior design, only 100 units were manufactured. Other methods of loading used projectiles preformed to match the rifling. Loading rifles, however, continued to be difficult. Often, the force required to ram the ball down the bore was great enough to render the shooter's hands unsteady for accurate firing.

British officer John Jacob's rifles used four deep grooves and bullets with ribs to match. English engineer Sir Joseph Whitworth's rifle had spiral, hexagonal bores and used bullets made appropriately. Both were accurate and Whitworth's rifles were prized by sharpshooters in the American Civil War. However, they were too complex for general issue.

THE MINIÉ REVOLUTION

The solution to these problems lay in a simple bullet devised by Minié, based on his modification of a bullet created a few years earlier by fellow Frenchman Captain Henri-Gustave Delvigne. This new bullet could work with any conventional rifle. It could slide easily down the bore of a gun and at the instant of explosion, an iron cup in the bullet's base was driven into the cavity inside it, expanding the skirt of the bullet to grip the rifling grooves.

The muzzle-loading rifle evolved to become more effectual, and gradually warfare was transformed. Where once infantry could be safe beyond a distance of 300 yards (270m) from an

▸ **USING MINIÉ BULLETS**
At Fredericksburg, Virginia, in 1862, during the Civil War, the Union Army (seen here) and the Confederate defenders (entrenched outside the city) battled for weeks, many using rifles with Minié bullets.

"… **conical** ball… **pass through** the bodies of **two men** and lodge in the body of a **third**…"

ATTRIBUTED TO **GEORGE MACLEOD, CRIMEAN WAR SURGEON**

enemy, now danger lay up to a distance of 1,000 yards (914m) or more. In the US, the new Model 1855 Springfield rifle employed the Minié bullet, while in Britain, the first rifle to use the new bullet on a large scale was the Enfield Pattern 1853 (see pp.100–01). In the Crimean War, it was discovered that with these rifles, for the first time, infantry could outgun artillery, picking off the gunners from a safe distance. A few years later, almost a million Pattern 1853 rifles would be shipped to serve both sides in the American Civil War. Battles, once close-quarter volleys followed by tides of bayonet or cavalry charges, now became long-range engagements from entrenched positions, against which a cavalry charge was almost suicidal. Judgment of distance and setting of sights now became paramount in making the rifle, in the hands of well-trained infantry, the new god of the battlefield.

KEY **FIGURE**

CLAUDE-ETIENNE MINIÉ

(1804–79)

Claude-Etienne Minié served as captain with the French Chasseurs (light infantry) in North Africa. He was frustrated with the shortcomings of the muskets issued to his troops. Following his invention of the Minié bullet, he was awarded 20,000 French francs and made an instructor at the Vincennes military establishment. In 1858, he retired as colonel, later becoming a military instructor for the Khedive of Egypt, and then manager at the Remington Arms Company, US.

AFTER

The Minié bullet was critical in spurring on the development of long-range shooting. New military training regimes were needed. National Rifle Associations, such as those formed in Britain and the US, encouraged long-range target shooting as sport. Military sharpshooters became snipers—unseen long-range killers adding new levels of terror to an already fearsome business.

- **MILITARY TACTICS** had to be revised in the face of long-range accuracy, since close-range combat would increase the likelihood of soldiers being killed.
- **INDIVIDUAL SHARPSHOOTERS** and snipers picking off specific targets replaced the military tradition of "firing by numbers," or volley-fire.
- **DEADLY TEAMS OF SNIPERS** and "spotters" evolved; the spotters used telescopes to identify targets and passed details to the snipers.
- **HIGHER-VELOCITY BULLETS** inflicted greater damage than earlier bullets. Instead of repairable wounds to arms and legs, amputations became common.
- **NEW SNIPER RIFLES** in the 20th century, firing a .50in machine-gun cartridge, made it possible to aim at and hit human targets at ranges of more than 1 mile (1.7km), far greater than the ½-mile (0.9-km) range of an early muzzle-loading rifle.

.50IN BMG CARTRIDGE, 1910

SHOWCASE

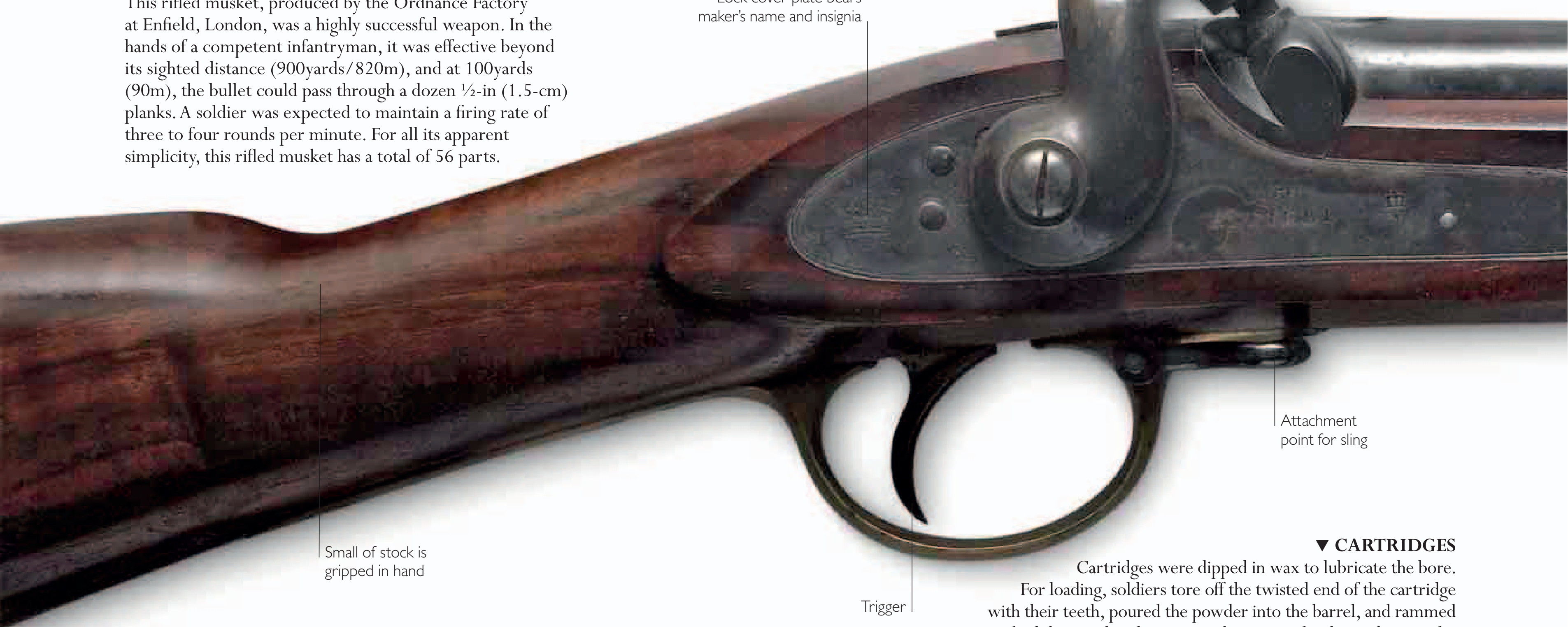
ENFIELD RIFLED MUSKET

Adding grooves to a musket's bore, or replacing its smoothbore barrel with a rifled one, helped convert muskets into rifled weapons, or rifles. With the perfection of the expanding bullet (see pp.98–99), it became possible to issue rifles to all troops, not just to sharpshooters, because rifles could now be loaded as fast as muskets. The British Army adopted a key rifle in 1853. This gun—the Pattern 1853 Rifled Musket—remained in service until 1867.

ENFIELD RIFLED MUSKET	
Date	1853
Origin	UK
Barrel	33in (83.8cm)
Caliber	.57in (14.65mm)

FULL VIEW

▼ PATTERN 1853 RIFLED MUSKET
This rifled musket, produced by the Ordnance Factory at Enfield, London, was a highly successful weapon. In the hands of a competent infantryman, it was effective beyond its sighted distance (900yards/820m), and at 100yards (90m), the bullet could pass through a dozen ½-in (1.5-cm) planks. A soldier was expected to maintain a firing rate of three to four rounds per minute. For all its apparent simplicity, this rifled musket has a total of 56 parts.



▼ CARTRIDGES
Cartridges were dipped in wax to lubricate the bore. For loading, soldiers tore off the twisted end of the cartridge with their teeth, poured the powder into the barrel, and rammed the lubricated end, carrying the projectile, down the muzzle. Rumors that cow or pig fat were used in the wax offended Hindu and Muslim soldiers because they were forbidden to eat beef or pork respectively; this is one suggested cause of the Indian Mutiny of 1857.

◀ BAYONET
The socket bayonet, with its triangular-section blade, protruded almost 18in (46cm) beyond the muzzle. It alone required 44 separate manufacturing operations.

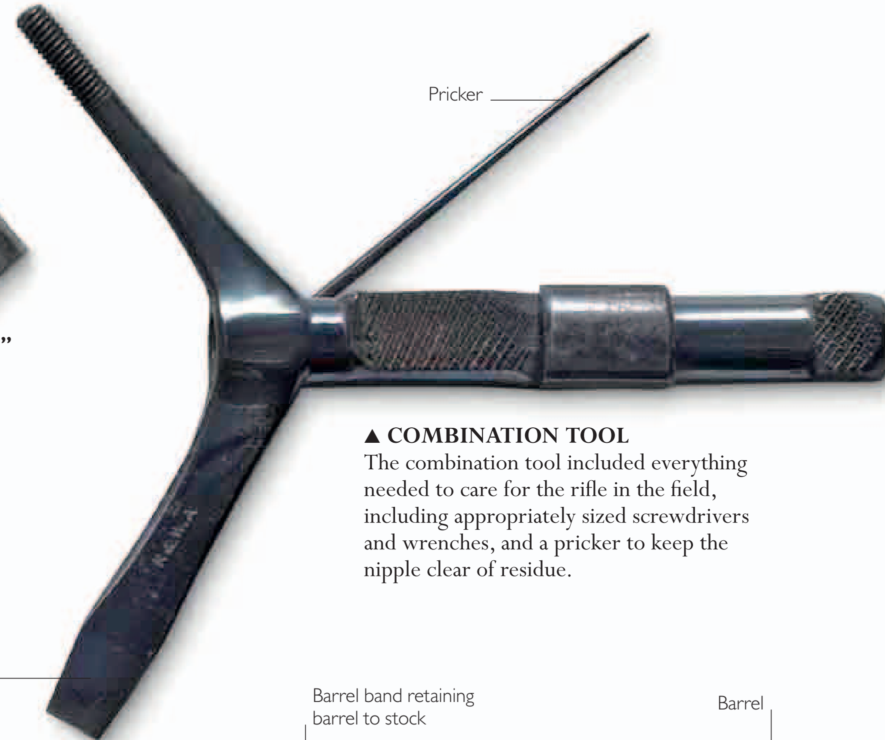
TOMPION (MUZZLE PLUG)

SCREW-THREAD BALL REMOVER

BALL REMOVER

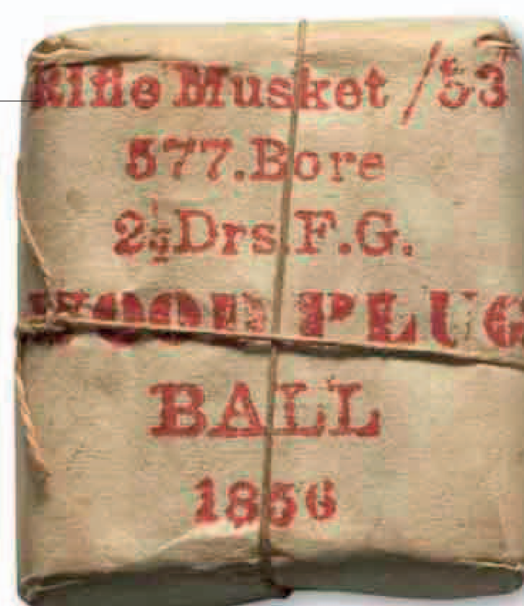
"WORM"

▲ RAMROD ACCESSORIES
Ramrod accessories included a tompion (muzzle plug)—for preventing dust from entering the barrel—and the "worm" and ball removers that could be attached to the ramrod to remove dud cartridges and faulty balls respectively.



▲ COMBINATION TOOL
The combination tool included everything needed to care for the rifle in the field, including appropriately sized screwdrivers and wrenches, and a pricker to keep the nipple clear of residue.

▲ RAMROD
In addition to being used to ram wadded cartridge paper onto the charge and ball, the ramrod served as a cleaning rod. It was threaded to take the double-helix "worm" (above) used to extract dud cartridges.



▶ AMMUNITION
The Pattern 1853 Rifled Musket was loaded with 2½ drams (4.43g) of gunpowder and a 530-grain (34.35g) bullet of .56in (14.42mm) caliber, which expanded to take the rifling of the barrel, whose bore was .57in (14.65mm) in diameter. Charge and bullet were packed into cartridges and issued in packets of 10, with a dozen percussion caps.

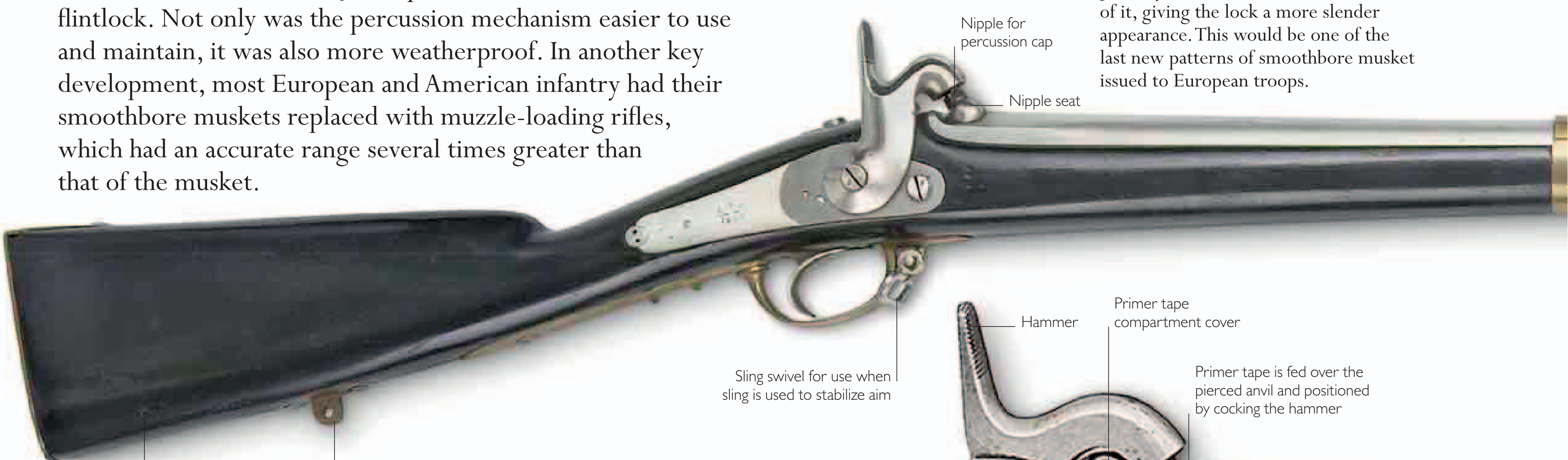
MUSKETS AND RIFLES (1853–70)

Percussion ignition, whether using caps (see pp.80–81) or other devices, was a major improvement over the cumbersome flintlock. Not only was the percussion mechanism easier to use and maintain, it was also more weatherproof. In another key development, most European and American infantry had their smoothbore muskets replaced with muzzle-loading rifles, which had an accurate range several times greater than that of the musket.

▼ FUSIL REGLEMENTAIRE MLE 1853

Date	1853
Origin	France
Barrel	40½in (103cm)
Caliber	.71in (18mm)

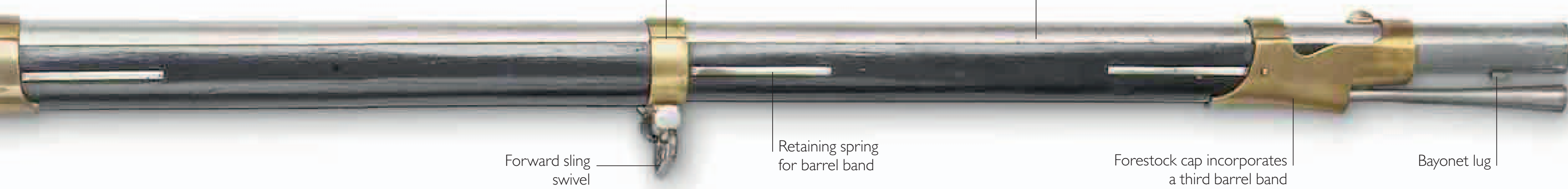
For its final smoothbore musket, France maintained its established form of percussion firearms. This musket had a small spherical nipple seat on top of the breech of the steel barrel. It was fired by a strong and simple back-action lock—a percussion-cap variant in which the mainspring inside the lock plate lay behind the hammer, not in front of it, giving the lock a more slender appearance. This would be one of the last new patterns of smoothbore musket issued to European troops.

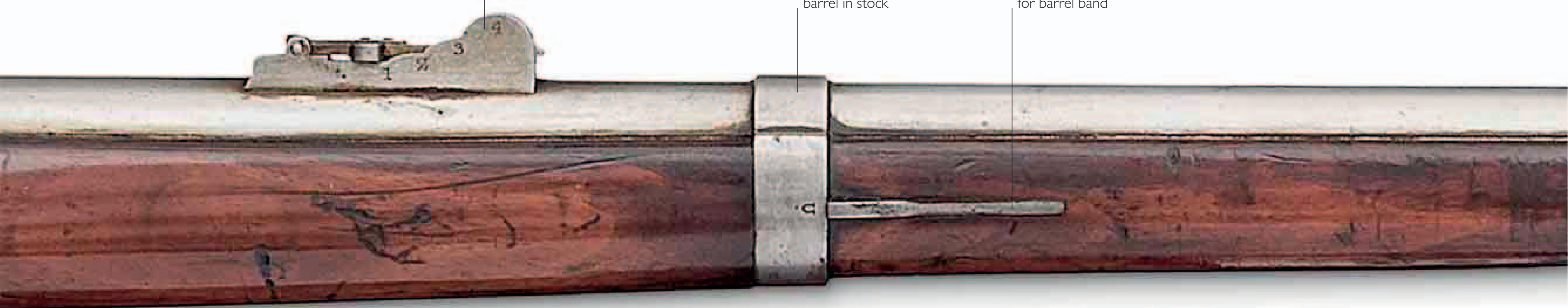


▲ WHITWORTH RIFLE

Date	1856
Origin	UK
Barrel	36in (91.45cm)
Caliber	.45in (14.3mm)

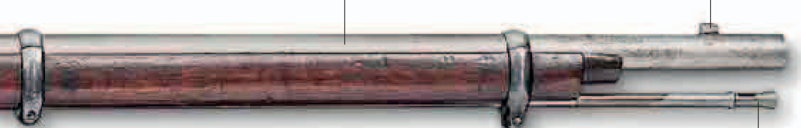
Sir Joseph Whitworth (see p.98) produced a rifle for a British Army trial with a hexagonal bore that fired a hexagonal bullet. It proved to be accurate over 1,500 yards (1.4km), but it was four times the price of an Enfield Model 1853 (see pp.100–01), and never adopted by the army.





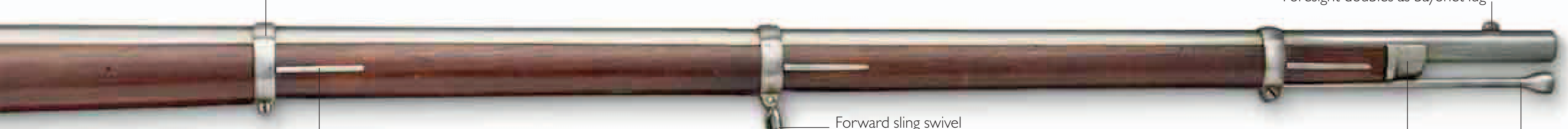
▲ SPRINGFIELD MODEL 1855	
Date	1855
Origin	US
Barrel	40in (101.5cm)
Caliber	.58in (14.7mm)

The first regulation American percussion rifle was the Model 1841 Mississippi Rifle, with a .33-in (83.8-cm) barrel. It was later given a longer barrel and modified to use Maynard's tape primer (see p.81), fed from a roll housed inside the lock (instead of individual copper caps placed over the nipple) becoming the Model 1855 rifle.



▼ SPRINGFIELD MODEL 1863 TYPE II	
Date	1863
Origin	US
Barrel	40in (101.5cm)
Caliber	.58in (14.7mm)

The Springfield Model 1855 (above), with its tape primer system, was unsatisfactory and replaced by the M1861, which was itself not entirely free of faults, notably in the hammer and nipple. The Model 1863 saw the problems cured and other refinements made. The Type II was the last muzzle-loading weapon issued to the US Army.



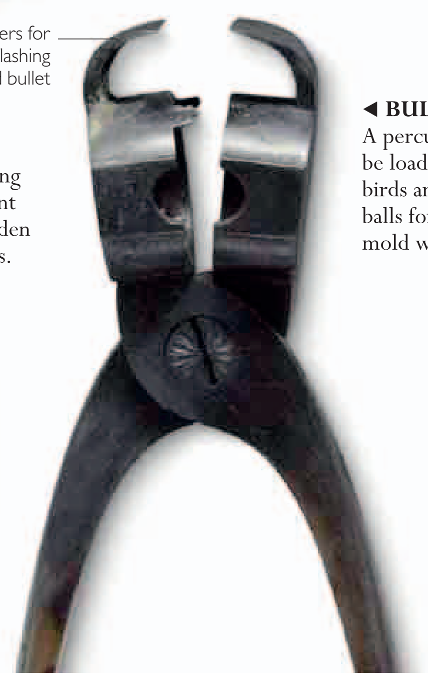
SHOWCASE

LE PAGE SPORTING GUN

Pierre le Page set up in business as a harquebusier in Paris, perhaps as early as 1716, and was later appointed gunmaker to the king. He was succeeded by his nephew Jean in 1782, who was retained by the Emperor Napoleon to refurbish weapons from the royal gun-room for his own use. Jean's son Henri took over the firm in 1822, by which time Napoleon had died in exile. This sporting gun was made to commemorate the return of his ashes to France in 1840.

LE PAGE SPORTING GUN	
Date	1840
Origin	France
Barrel	31½in (80cm)
Caliber	.84in

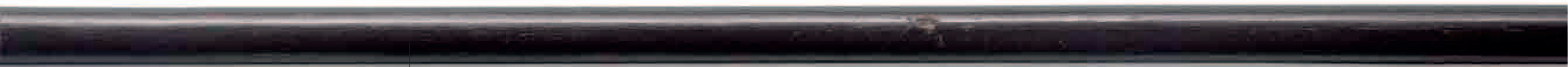
▼ LE PAGE SPORTING GUN
While the technical quality of the gun is excellent, its appeal lies in its decoration. The scroll-work on the small of the stock is enhanced by steel wire, while the metalwork is engraved with scenes from Napoleon's life and the names of some of his battles.



▼ ACCESSORIES BOX
This is a turned rosewood box intended for storing small accessories such as charge-drawing "worms" and spare percussion nipples. The joint between the lid and the body of the box is hidden in a groove within the decorative turned bands.

◀ BULLET MOLD
A percussion sporting gun could be loaded with pellets, for hunting birds and wildfowl, but also with balls for to hunt large game. This mold was used to make such balls.

▶ WAD PUNCH
Wadding, usually made of paper, was rammed into the barrels after the powder, but before the bullets, using this punch. Because it was essential that the wads precisely fit the barrels, a wad cutter was included with the gun's tools.



Rosewood ramrod has a double-helix "worm" attached at the end

▲ RAMROD
The gun's ramrod doubled as a cleaning rod, and could be equipped with a "worm" (see p.101) to allow a dud charge to be withdrawn.

Hooks engage with a bar at the standing breech to secure barrels into stock

Rib engraved with Le Page's name and the names of Napoleon's battles

Nipple for percussion cap

TOP VIEW OF BARRELS

Forestock cap

Barrel retained by pin

◀ POWDER HORN
It was customary to use animal horn to hold the powder, as it was light and strong. The nozzle was equipped with a measuring device.

Powder measure

Cutoff shutter lever

Sling attachment point

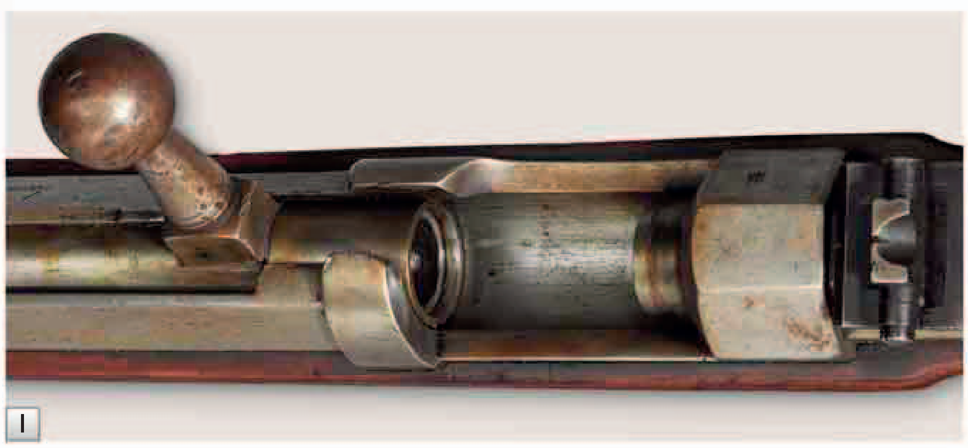
◀ PERCUSSION-CAP DISPENSER
This was designed to dispense percussion caps directly to the nipples of the gun. The alternative (using a can of loose caps) was both awkward and time-consuming.

PISTOLS IN PAIRS
In the 18th and early 19th centuries, cased pairs of pistols were popular accessories for gentlemen. Each case contained tools to load and clean the pistols, which could be used for target shooting or dueling.

VISUAL TOUR

DREYSE NEEDLE-FIRE RIFLE

German gunsmith Johann Nikolaus von Dreyse invented the first rotating bolt for loading a rifle at the breech (see p.304). It sealed the breech much more securely than previous breech-loaders did and ensured that the energy of the expanding gas propelled the bullet forward. The rifle was also revolutionary in using a long, thin firing pin to pierce a "self-consuming" paper cartridge, both drawn from the designs of Jean Samuel Pauly, Dreyse's employer.



▶ BOLT AT REAR (BREECH OPEN)
Bolt action provides the rifle with an effective opening breech mechanism. The bolt was connected to a needle-shaped firing pin (opposite). Before the bolt could be unlocked, the firing pin would be retracted using the catch at the rear of the bolt. The bolt would then be rotated using the handle and pulled rearward, opening the breech. Once the breech was open, a cartridge was placed into it to load the gun.

▶ BOLT AT FRONT (BREECH CLOSED)
The bolt was closed by pushing the handle forward and rotating it. Doing this sealed the breech and also cocked the gun ready for firing. This gun fired paper cartridges that were not only self-contained (containing primer, charge, and bullet) but also "self-consuming." The cartridges would combust fully, leaving behind no shell or residue to eject, allowing the weapon to be reloaded very efficiently.

DREYSE NEEDLE-FIRE RIFLE

Date 1841

Origin Germany

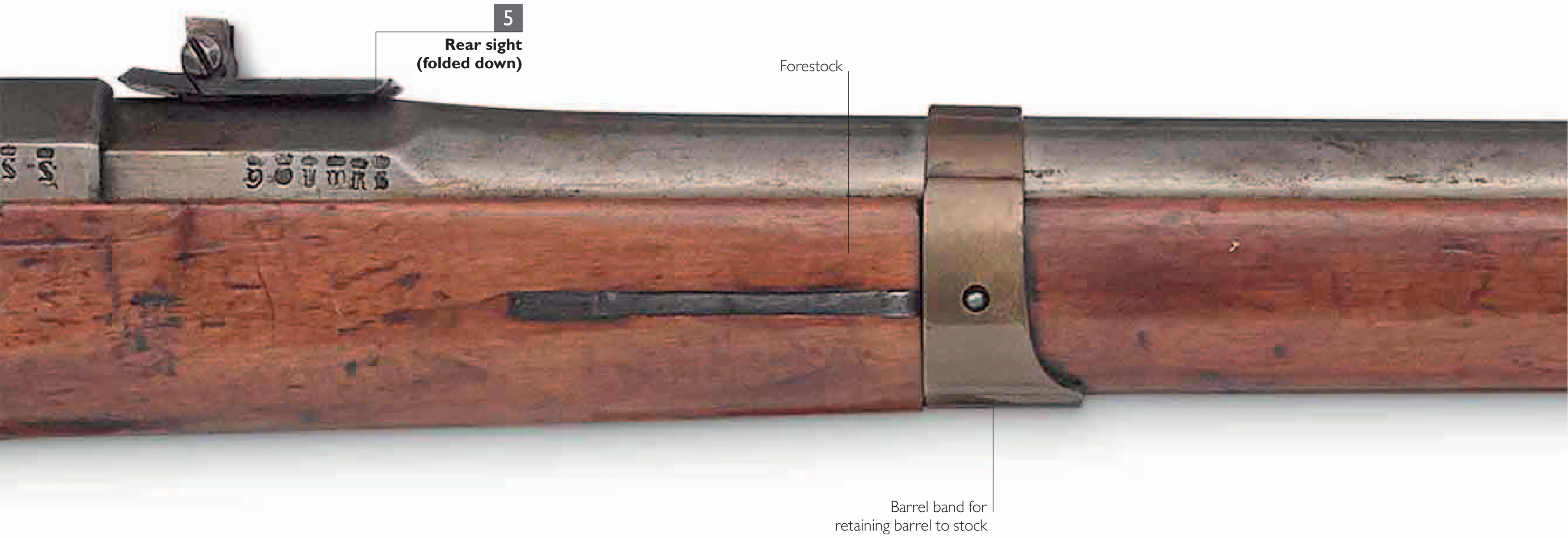
Barrel 34in (86.5cm)

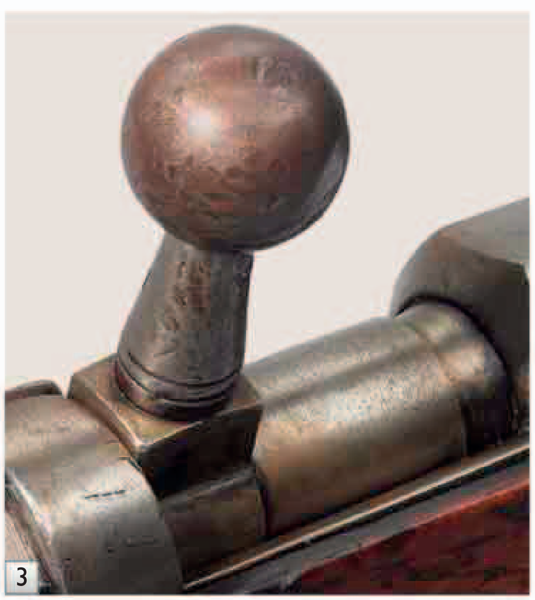
Caliber .60in (15.2mm)

Named after its needle-like firing pin, this revolutionary gun introduced bolt action (see p.304) in breech-loading rifles. Bolt-action rifles would lead to the development of repeaters and most automatic weapons. The Dreyse rifle helped to establish Prussia's military supremacy over its neighbors for more than two decades. It could be loaded lying down or kneeling behind cover, unlike muzzle-loaders, which had to be loaded standing up. Bolt action also provided the Dreyse rifle with a higher rate of fire than the muzzle-loaders.

FULL VIEW (RIGHT)

FULL VIEW (LEFT)





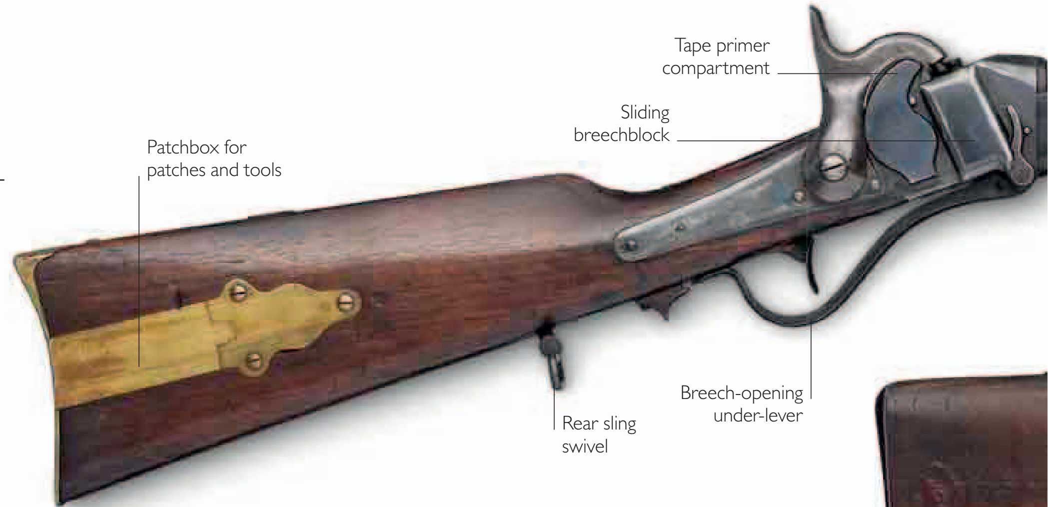
▲ BOLT HANDLE
The bolt was turned and moved with this lever, opening and closing the breech for loading. The bolt handle was placed on the right-hand side of the gun, a design feature that would come to be seen on most bolt-action rifles.

▲ FIRING PIN
This long pin is hidden within the bolt housing. On pulling the trigger, the firing pin pierced the case of the paper cartridge to strike a percussion cap buried within the gunpowder charge, at the bullet's base. Ignition of the cap detonated this charge inside the cartridge, firing the bullet. The cartridge residue burned away upon firing to leave an empty breech.

▲ REAR SIGHT
The rifle has a V-shaped rear sight, located in front of the bolt housing. It was used together with the foresight for aiming the gun.

BREECH-LOADING CARBINES

Muzzle-loading carbines were impractical to use on horseback as it was difficult to load them while riding. This was also a problem for muzzle-loading rifles, but infantry could manage these relatively inexpensive weapons. As a result, many military authorities recognized the potential benefits of a breech-loading carbine, and carbines became one of the first military arms to be converted to breech-loading. In the 1850s and 1860s, many types of breech-loading mechanism were developed. The availability of percussion ignition (see pp.80–81) technology and improved manufacturing methods fuelled a rapid increase in the conversion of carbines in the mid-19th century. These weapons fired a fully combustible paper cartridge carrying the powder charge and bullet.



▲ SHARPS CARBINE

Date	1848
Origin	US
Barrel	18in (45.5cm)
Caliber	.52in

This breech-loader used a sliding breechblock to load a combustible cartridge, which was ignited by a tape primer (see p.81) or, in later models, a percussion cap.

▼ GREENE CARBINE

Date	1855
Origin	US
Barrel	22in (56cm)
Caliber	.54in

The Greene Carbine, produced in small numbers for the British Army during the Crimean War (1853–56), lost out to its rivals due to its cumbersome mechanism. The barrel had to be rotated through a quarter-turn: this unlocked the breech, which was then free to swing out so that a new cartridge could be introduced.

▲ CALISHER AND TERRY CAPPING BREECH-LOADING CARBINE

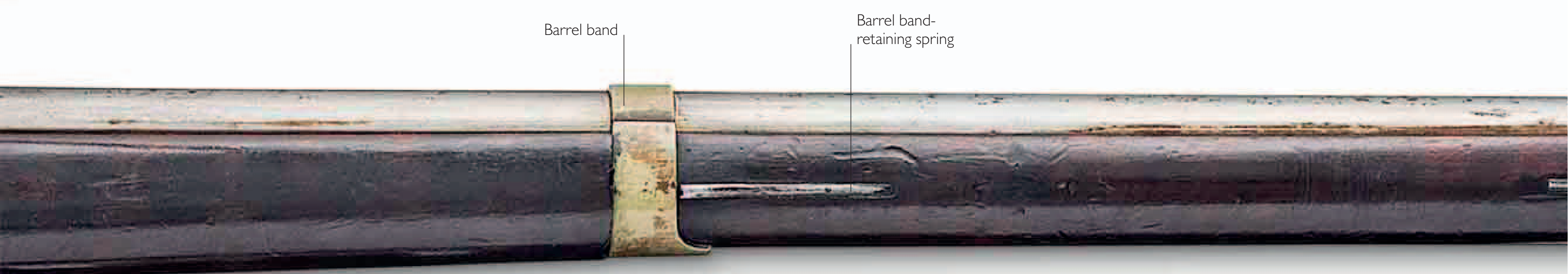
Date	1861
Origin	UK
Barrel	20in (51.2cm)
Caliber	.54in

The Calisher and Terry carbine was the first bolt-action weapon adopted by the British Army. Its paper cartridge included a greased felt wad, which remained in the breech after firing and was pushed into the barrel by the insertion of the next round, lubricating and cleaning the bore when it was fired. In a trial, one carbine fired 1,800 rounds without requiring additional cleaning.

▲ WESTLEY RICHARDS "MONKEY TAIL" CARBINE

Date	1866
Origin	UK
Barrel	18in (45.5cm)
Caliber	.45in

Birmingham gunmakers Westley Richards produced two carbines for the British Army. This one had a front-hinged, tilting breech with a long, curved lever, which is how the weapon got its nickname.



FULL VIEW

▲ CHASSEPOT PERCUSSION CARBINE

Date	1858
Origin	France
Barrel	28¼in (72cm)
Caliber	13.5mm

In the mid-1850s, gunmakers at the French Imperial Armories began experimenting with bolt-action, percussion-cap breech-loaders. Alphonse Chassepot produced a design using a rubber washer to seal the breech. He subsequently replaced the hammer with a needle striker within the bolt, which was accepted for use by the French Army as the Modèle 1866.

TURNING POINT

SELF-CONTAINED CARTRIDGES

In the early 19th century, the discovery of chemical primers and the invention of percussion ignition led to an even greater advance. It became possible to combine the key elements required for a gun to fire—primer, propellant, and projectile—into a single unit, the self-contained, or unitary, cartridge. Following a period of experimentation, the solid-drawn, center-fire metallic cartridge evolved in the 1870s, triggering a new era in firearms technology. The subsequent development of repeating rifles, self-loading pistols, and machine-guns ultimately culminated in the weapons seen today.

▲ **METALLIC CARTRIDGE**
All metallic cartridges, such as this .44in-40 Winchester cartridge, contain three main elements within a metal shell. These are a propellant (gunpowder), projectile (bullet), and chemical primer.

Although the percussion cap containing chemical primer (see pp.80–81) made muzzle-loaders far more reliable, inserting gunpowder and ball separately down the muzzle, and then adding a primer, was a laborious process. Early attempts to unite a breech-loading system with percussion-cap ignition resulted in the creation of some breech-loading guns in the mid-19th century. These guns suffered from the problem of leakage of gas at the breech because the paper or linen cartridge used did not form a gas-tight seal. However, the door to successful breech-loading guns had already been opened in the early 19th century with the invention of a "self-contained" cartridge.

UNITARY CARTRIDGES

Patented by gunsmith Jean Pauly in France in 1812, the first self-contained cartridge had a paper casing and a metal base. It worked perfectly in careful hands but it was not rugged enough for military use. In the following years, the cartridge was reinvented in several ways to improve the ruggedness, the ease of loading, and ignition, and the gas seal. Pauly's ex-employee Casimir Lefaucheux created a "pin-fire" cartridge of cardboard and brass in 1836, in which a metal pin struck and ignited the chemical primer in the cartridge. In 1841, another of Pauly's former employees, Nikolaus von Dreyse, created a cartridge with a combustible paper case. They both worked and had limited success, but they had too many drawbacks for widespread adoption.

In 1846, Parisian gunsmith Benjamin Houllier took a major step by creating a cartridge case pressed from a disc of copper or brass. Its all-metal, single-piece design properly sealed the breech. American Benjamin Tyler Henry used the same construction, but added a hollow rim filled with chemical primer, creating the first rim-fire cartridge in 1860.

BEGINNINGS OF CENTER-FIRE

Rim-fire cartridges had to be handled carefully, because they were liable to accidental discharge and the rim could burst in use. A major breakthrough—the center-fire cartridge—held the chemical primer in a percussion cap fixed in the center of the cartridge's base. Designed in Britain by Colonel Boxer, the cartridge did not need to be aligned while loading, as with pin-fires, and could be reloaded easily, unlike rim-fires. However, it had a complex composite case. US inventor Hiram Berdan developed a one-piece brass case, which was to become the standard for most cartridges in the future. By the late 1870s, center-fire metallic cartridges, similar to today's, had taken hold.

» BEFORE

Before the advent of the self-contained cartridge, the loading of a gun required a user to place the correct charge of propellant in the barrel, along with a projectile and some wadding to hold the propellant and projectile in place, in the correct sequence. Next, he had to employ an external means of ignition, as there was no primer inside the barrel.

EARLY PAPER CARTRIDGE

- **SINGLE-SHOT WEAPONS** were the norm of the day.
- **PAPER CARTRIDGES** contained the correct charge of gunpowder and a projectile. They needed to be torn open before loading a gun.
- **AN INCORRECT LOADING SEQUENCE** would leave the gun useless until it could be unloaded and then reloaded correctly.
- **AN INCORRECTLY RAMMED PROJECTILE**, one not placed firmly on top of the gunpowder, could cause the gun barrel to burst. The same could happen if a loaded gun was accidentally reloaded.
- **GAS LEAKAGE** was a problem with early breech-loading guns, which used cartridges made of paper and other combustible material. Leakage reduced the pressure of the exploding gas that propelled the projectile.

EARLY BREECH-LOADING PAPER CARTRIDGE

> "… the invention of **paramount value**, appears to me to be this **cartridge**…"
>
> *CAPTAIN O'HEA,* ***THE JOURNAL OF THE SOCIETY OF ARTS*** **(1867)**

Unitary metallic cartridges transformed conflicts in the late 19th century. They played a key role in the Battle of Hoover's Gap—a decisive engagement of the Tullahoma Campaign in the American Civil War (1861–65). The Union Army was outnumbered by Confederate forces, which were in a strong defensive position. Marching rapidly into Hoover's Gap, the Union forces surprised the Confederates who scattered initially. In the battle that ensued, the Confederate Army regrouped and charged at the Union soldiers. Despite facing a volley of gunfire, the Confederate soldiers continued to advance, not expecting the Union rifles to be reloaded quickly. However, the Union soldiers were armed with new Spencer repeating rifles loaded with .56in-caliber rim-fire cartridges. These weapons could fire more than 14 rounds per minute and proceeded to cut down almost one-quarter of the Confederate Army.

In the Anglo–Zulu War (1879), a small number of British soldiers used the new technology in a similar way. Armed with Martini-Henry rifles loaded with Boxer cartridges, they repelled a vast Zulu army against all odds, because they were able to reload and fire swiftly in the heat of battle. Armed with superior guns and ammunition, European powers scrambled to make forays into Africa at the turn of the 20th century.

These conflicts exemplified the advantages of the metallic cartridge, without which self-loading and automatic firearms would not have seen the light of day.

KEY **FIGURE**

Hiram Berdan

(1824–93)

Engineer and inventor Hiram Berdan was a colonel of the United States Volunteer Sharpshooter Regiments during the American Civil War. A sought-after weapons designer, he was commissioned by the Russian Army to update its infantry firearms. He created the Berdan cartridge, which would go on to become the standard for metallic cartridges seen today.

AFTER »

Once the idea of self-contained ammunition had taken hold, cartridges and their associated firearms underwent a long process of evolution, eventually resulting in the invention of repeating rifles (see p.116) and magazine feeding systems.

- **EARLY CENTER-FIRE CARTRIDGES**, such as the .450in Martini Henry Boxer cartridge, were composite assemblies. The flimsy bodies were easily distorted and forcible extraction, in the heat of battle, could pull off the disk forming the rim. These problems were overcome as the composite assembly cartridges were replaced by solid-drawn cartridges.

.450IN MARTINI HENRY BOXER CARTRIDGE

- **MUZZLE-LOADERS WERE CONVERTED** into breech-loading weapons to utilize metallic cartridges. This spurred the refinement of breech-loading systems, resulting in the growth of more efficient breech-loading weapons, and eventually, self-loading firearms.

- **THE DURABILITY** of solid-drawn metallic cartridges allowed them to be loaded from magazines on guns. Repeating weapons designed to accept cartridges in magazines developed rapidly, leading to the firearms of today.

◄ DEFENDING RORKE'S DRIFT
In the defense of Rorke's Drift (1879) in the Anglo-Zulu War, fewer than 150 British soldiers defended themselves against an overwhelming force of 4,000 Zulu warriors. The use of Martini rifles and coiled brass-cased cartridges enabled the British forces to load and fire quickly, saving them from almost certain slaughter. Some soldiers can be seen handling the cartridges in the picture.

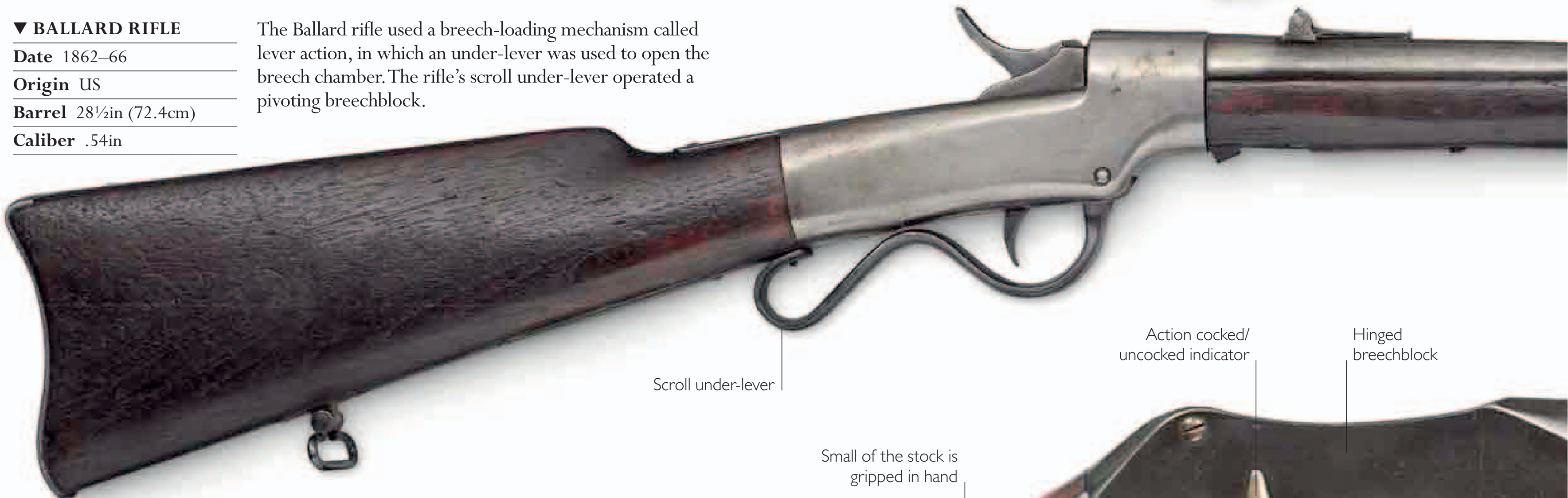
SINGLE-SHOT BREECH-LOADING RIFLES

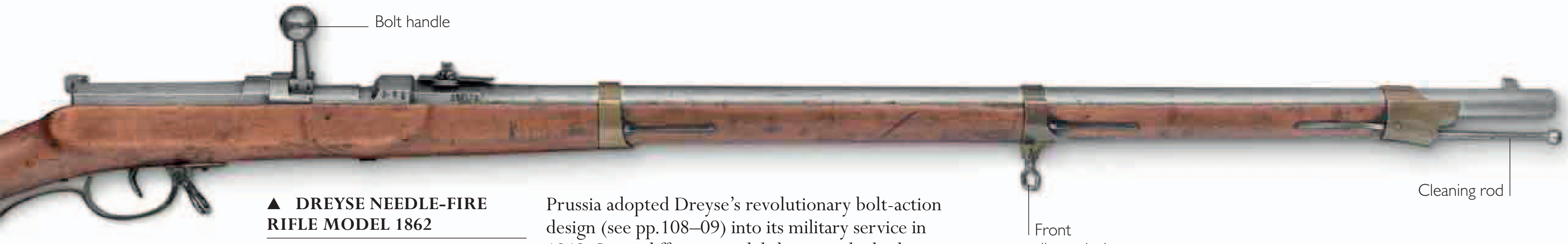
For many years, military authorities throughout the Western world had appreciated the benefits of breech-loading firearms. Muzzle-loading muskets and rifles were difficult to reload while a soldier was lying prone, and were also usually slower to load than a well-designed breech-loader. Breech-loading mechanisms continued to evolve. Many rifles began to be loaded at the breech using bolt action (see p. 304), which would influence the future development of these arms. In the 19th century, a number of breech-loading weapons were taken into military service in Europe and North America. Many were efficient conversions of existing muzzle-loading rifles and would have a long service life.

▼ BALLARD RIFLE

Date	1862–66
Origin	US
Barrel	28½in (72.4cm)
Caliber	.54in

The Ballard rifle used a breech-loading mechanism called lever action, in which an under-lever was used to open the breech chamber. The rifle's scroll under-lever operated a pivoting breechblock.





▲ DREYSE NEEDLE-FIRE RIFLE MODEL 1862

Date	1868
Origin	Germany
Barrel	32in (81.2cm)
Caliber	15.43mm

Prussia adopted Dreyse's revolutionary bolt-action design (see pp.108–09) into its military service in 1848. Soon, different models began to be built, each one for a different branch within the army, such as line infantry or cavalry. The Model 1862 was an infantry rifle first manufactured in 1862, but this particular piece was built in 1868.

▼ PEABODY-MARTINI RIFLE

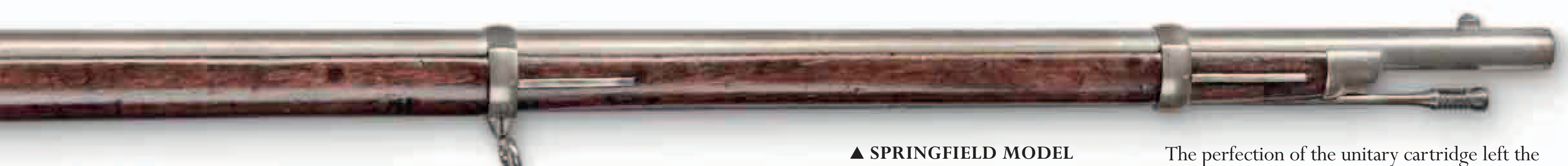
Date	c.1870
Origin	US
Barrel	30in (76cm)
Caliber	.45in

This lever-action military rifle was designed by Henry O. Peabody and produced by the Providence Tool Company of Providence, Rhode Island. It is equipped with a safety catch. Many units were bought by the government of Turkey for the Russo–Turkish War (1877–78).

▲ MAUSER MODEL 1871 RIFLE

Date	1872 onward
Origin	Germany
Barrel	32½in (83cm)
Caliber	11 × 60mm

Many single-shot breech-loading rifles of the time employed combustible cartridges. German manufacturer Waffenfabrik Mauser began modifying Dreyse guns, such as the Model 1862 (above), to accept brass cartridges, but Peter Paul Mauser produced a new design with a bolt-action breech mechanism stronger than that of the Dreyse rifle. It was modified to take metallic cartridges (see pp.112–13) rather than fully combustible paper ones, and could therefore fire more powerful ammunition (cartridges with a larger powder charge). Effective out to a range of 875 yards (800m), the *Infanteriegewehr* (infantry rifle) M71 established Mauser's preeminence among suppliers of military rifles.



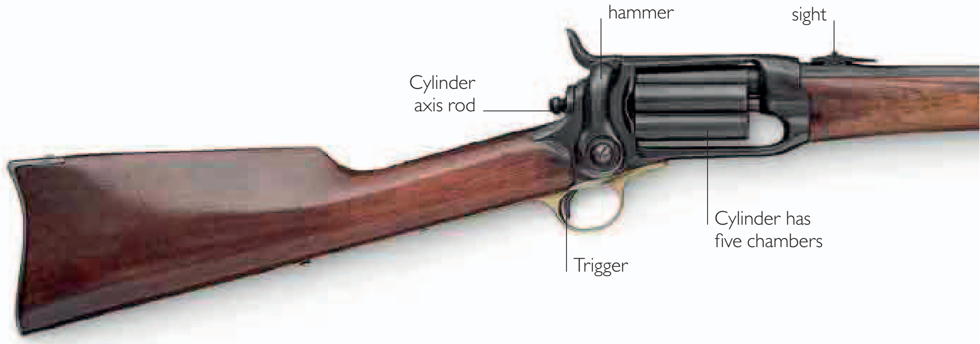
▲ SPRINGFIELD MODEL 1866 RIFLE ALLIN "TRAPDOOR" CONVERSION

Date	1874
Origin	US
Barrel	32½in (83cm)
Caliber	.45in

The perfection of the unitary cartridge left the world's armies with a dilemma: what should they do with their millions of redundant muzzle-loaders? The US Army modified its rifled muskets by milling out the top of the barrel, creating a chamber for the cartridge, and installing a front-hinged breech cover, or "trapdoor," incorporating a firing pin.

MANUALLY OPERATED REPEATING RIFLES

There had been attempts to produce "repeater," or multiple-shot, rifles and muskets as early as the 16th century. Notwithstanding the success enjoyed by the percussion revolvers of Colt and others (see pp.88–93), it took the unitary cartridge containing primer, charge, and projectile in one package (see pp.112–13) to make the repeating rifle a satisfactory reality in the mid-19th century. Contained in magazines carrying set numbers of cartridges, the ammunition of a repeating rifle was fed to its breech as part of the single action that cleared the chamber of a spent cartridge case, cocked the action, and readied the gun for firing.



▲ COLT REVOLVING RIFLE

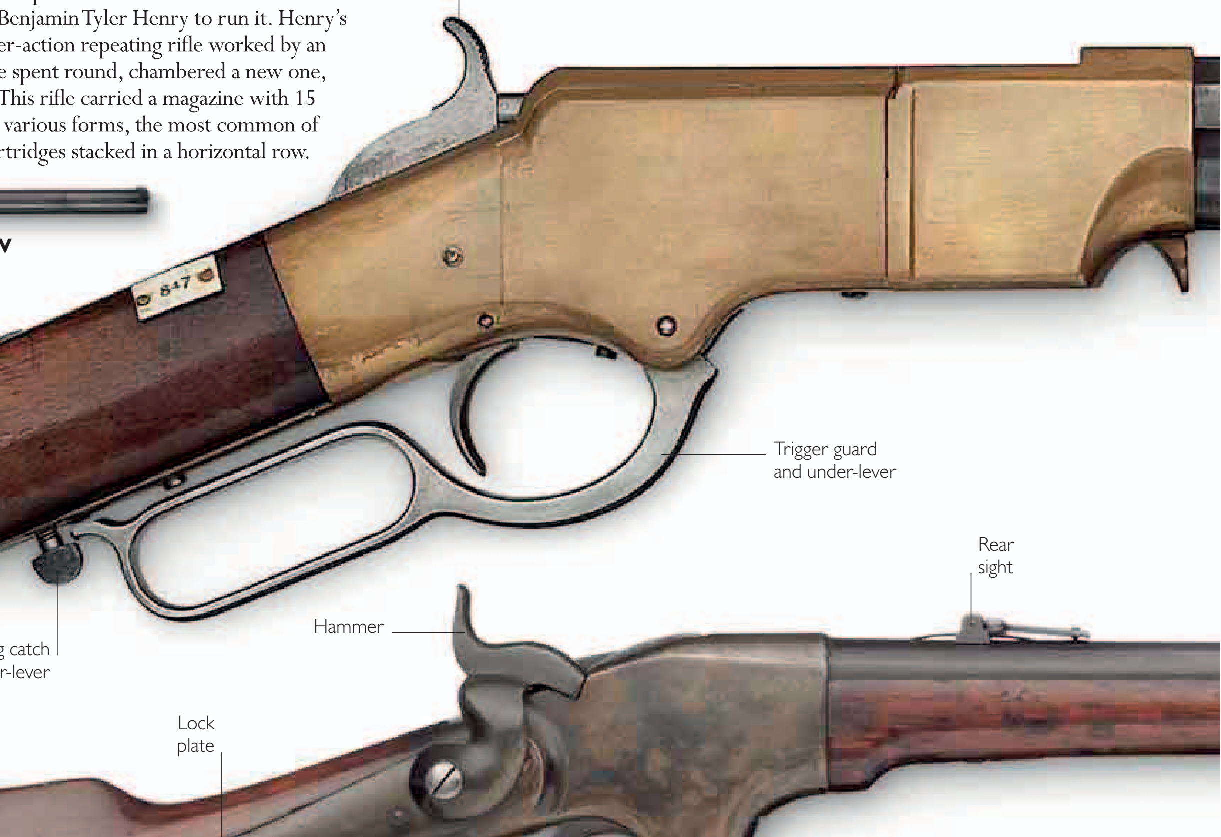
Date	1855
Origin	US
Barrel	26¾in (68.2cm)
Caliber	.56in

Of Colt's earliest revolving rifles (see pp.122–23), this one made a considerable impact, even though its loading procedure was cumbersome. The cylinder was removed, powder packed into the five chambers, a bullet packed on top, and the chambers sealed with wax in order to protect against the possibility of igniting all the chambers at once.

▼ HENRY MODEL 1860

Date	1860
Origin	US
Barrel	20in (51cm)
Caliber	.44in rim-fire

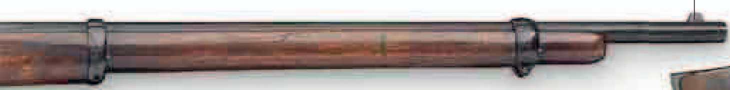
When Oliver Winchester set up the New Haven Arms Co. (see p.119), he brought in Benjamin Tyler Henry to run it. Henry's first act was to design a lever-action repeating rifle worked by an under-lever that ejected the spent round, chambered a new one, and left the action cocked. This rifle carried a magazine with 15 rounds. Magazines evolved various forms, the most common of which was tubular, with cartridges stacked in a horizontal row.



▲ SPENCER RIFLE

Date	1863
Origin	US
Barrel	28¼in (72cm)
Caliber	.52in

The lever-action Spencer, which had a tubular seven-round magazine in its butt, was the world's first practical military repeating rifle. It was adopted by the Union Army in the American Civil War.



▲ SPENCER CARBINE MODEL 1865

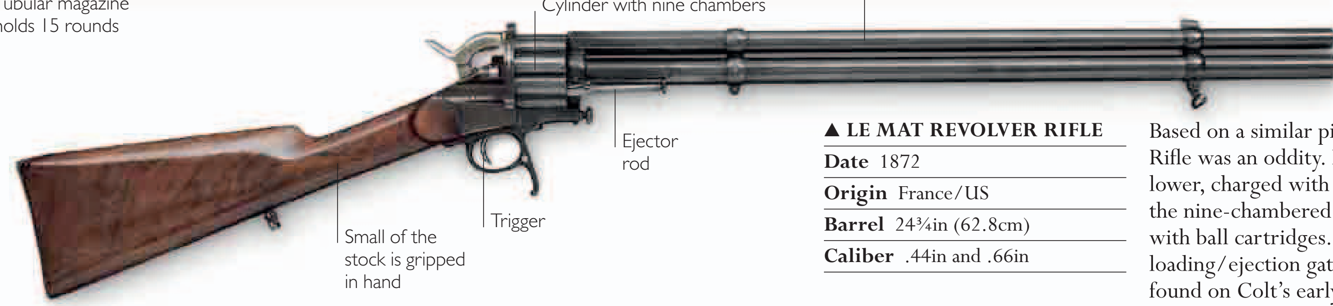
Date	1865
Origin	US
Barrel	20in (51cm)
Caliber	.50in

For this lever-action model, gunmaker Christopher Spencer amended the design of his original repeating rifle and carbine to eliminate minor faults. This 1865 carbine had six-groove rifling. It was also made under contract by the Burnside Rifle Company. The gun carried a tubular magazine in its butt. Some other guns of the time carried another common magazine type—the box form, in which cartridges were stacked one above the other.

▲ WINCHESTER MODEL 1866 CARBINE

Date	1866
Origin	US
Barrel	23in (58.5cm)
Caliber	.44in rim-fire

The principal shortcoming of the Henry Model 1860 (left) lay in the way its tubular magazine was charged. In 1866, an improvement was introduced to allow reloading via a port on the receiver, which doubled the rifle's rate of fire to 30 rounds a minute. The ammunition used by this rifle and the Model 1860 was a rim-fire cartridge in which the projectile and propellant were contained in the cartridge case and the primer was carried in its rim (see p.112).



▲ LE MAT REVOLVER RIFLE

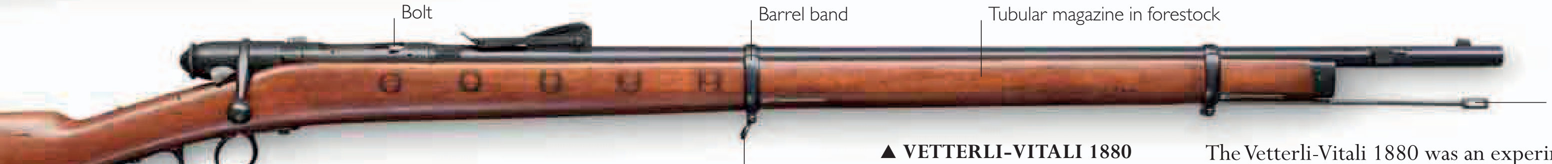
Date	1872
Origin	France/US
Barrel	24¾in (62.8cm)
Caliber	.44in and .66in

Based on a similar pistol, the Le Mat Revolver Rifle was an oddity. It boasted two barrels; the lower, charged with shot, acted as the axis pin for the nine-chambered cylinder, which was charged with ball cartridges. The gun was equipped with a loading/ejection gate and rod, similar to those found on Colt's early brass-cartridge pistols.

◀ WINCHESTER MODEL 1876

Date	1876
Origin	US
Barrel	28in (71cm)
Caliber	.45in

Popular with frontier hunters, this lever-action model was designed to take a powerful .45in-75 caliber cartridge. In total, it took four types of high-powered cartridges reaching up to .50in-95 Express—a powerful cartridge with high-velocity propellant. Manufacturers had begun to use precise caliber designations for their cartridges—.50in is the caliber and 95 refers to the weight of charge in grains.



▲ VETTERLI-VITALI 1880

Date	1880
Origin	Italy
Barrel	34in (86cm)
Caliber	10mm

The Vetterli-Vitali 1880 was an experimental bolt-action rifle fitted with a tubular magazine and was an adaptation of earlier single-shot Italian rifles. Vetterli-Vitali eventually became better known for its box magazine system, which was introduced in 1886.

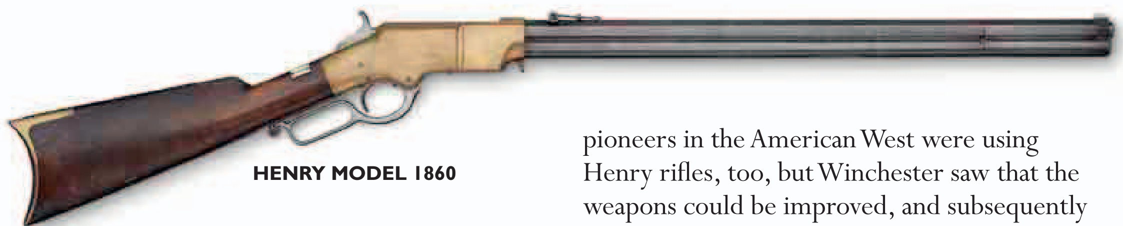
OLIVER WINCHESTER

GREAT GUNSMITHS

WINCHESTER

The repeating rifle was an American invention—created initially in the 1840s by inventors Walter Hunt and Lewis Jennings. It was the Winchester Repeating Arms Company, owned by Oliver Winchester, that developed the idea, manufactured the firearms, and sold them both to American pioneers and hunters, and to armies all over the world. Known for producing high-quality firearms, this company was highly successful, especially in the period between the American Civil War and World War I.

In 1857, entrepreneur Oliver Winchester found himself in control of the Volcanic Arms Company after many of the other investors pulled out. The repeating firearms produced by the company were impressive compared to the single-shot weapons that were then the norm, but they were not successful, mainly because the cartridges they fired lacked power. Winchester saw the need to improve the company's products and hired Benjamin Tyler Henry to develop a new repeating rifle. Patented in 1860, just before the outbreak of the Civil War, the weapon was the first practical lever-action gun (see p.116), and, when it came on to the market a year into the war, it made Winchester's name.



HENRY MODEL 1860

THE WINCHESTER AT WAR

During the Civil War, the US federal government bought about 2,000 of Winchester's firearms, which were then known as Henry rifles, after their designer. Individual soldiers purchased still more, realizing that the increased firepower provided by the repeating action gave them a better chance in battle. Soon, pioneers in the American West were using Henry rifles, too, but Winchester saw that the weapons could be improved, and subsequently introduced the Model 1866 (see p. 117), which had a better loading system and a wooden forestock to protect the user from the hot barrel. These improved rifles helped spread Winchester's fame far beyond the US, particularly when they were used in large numbers by the Ottoman Turks in the Russo–Turkish War of 1877–78. During this conflict, the repeating rifles helped the Turks at the

> "… that damned **Yankee rifle** that they load on Sunday and fire all week…"
>
> *ATTRIBUTED TO* **CONFEDERATE SOLDIERS**

▼ RUSSO–TURKISH WAR
Russian riflemen (on the right) are seen here firing on Ottoman Turkish troops armed with swords at the battle of Stara Zagora, Bulgaria, in July 1877, during the Russo–Turkish War. Their guns were single-shot, however, and the Turkish forces also had Winchester repeating rifles, with which they eventually defeated the Russians.

WINCHESTER MODEL 1876

WINCHESTER MODEL 1894

1860 The Henry rifle, designed by Benjamin Henry, is made by the New Haven Arms Company, under Oliver Winchester and John M. Davies.
1866 After the reorganization of the company as the Winchester Repeating Arms Company, the Winchester Model 1866 is launched.
1873 Winchester's first center-fire cartridge is used in the successful Model 1873.
1876 To celebrate the US Centennial, Winchester introduces the Model 1876, designed to take full-powered center-fire cartridges.
1883 Winchester begins to work in partnership with firearms designer John Browning.
1894 The Model 1894 is launched; it will eventually become one of the best-selling hunting rifles of all time.
1903 The company begins to produce the first of a series of self-loading rifles.
1914 Winchester produces firearms for the British government during World War I, including the Pattern 1914 Enfield rifle.
1931 After suffering poor sales during the postwar period and the Great Depression, the company goes into receivership.

siege of Plevna. They were outnumbered four to one but inflicted huge losses on the Russians because of the superior firepower of their Winchesters. Many European armies adopted repeating rifles in the years following the Russo–Turkish War.

ONE IN A THOUSAND

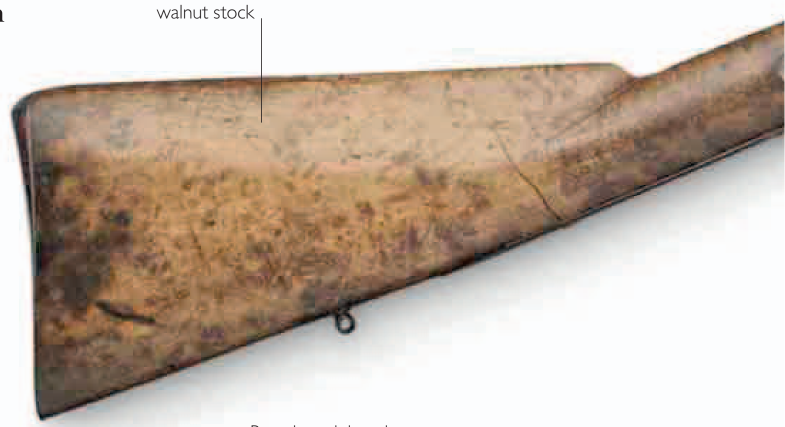
Further improvements to the line followed, including the Model 1873 and the Model 1876 (see p.117), the first Winchester rifle to be specially designed to fire full-powered center-fire cartridges for superior stopping power. It was the Model 1873 that made Winchester firearms especially popular in the American West, both for hunting and defense. Hunters found that they could bring down a buffalo at 200 yards (180m), and with a weapon as powerful as this they also believed that they could protect themselves and their families in the tough and dangerous frontier country. The Model 1873 also heralded an ingenious marketing campaign that showcased the high quality of many of the company's products. From 1875, Winchester tested its rifle barrels during manufacturing and selected the most accurate to be equipped with set triggers and engraved with the legend "One in a thousand." These weapons were sold at a premium price of $100 and were prized for their accuracy; they are still valued highly by collectors today.

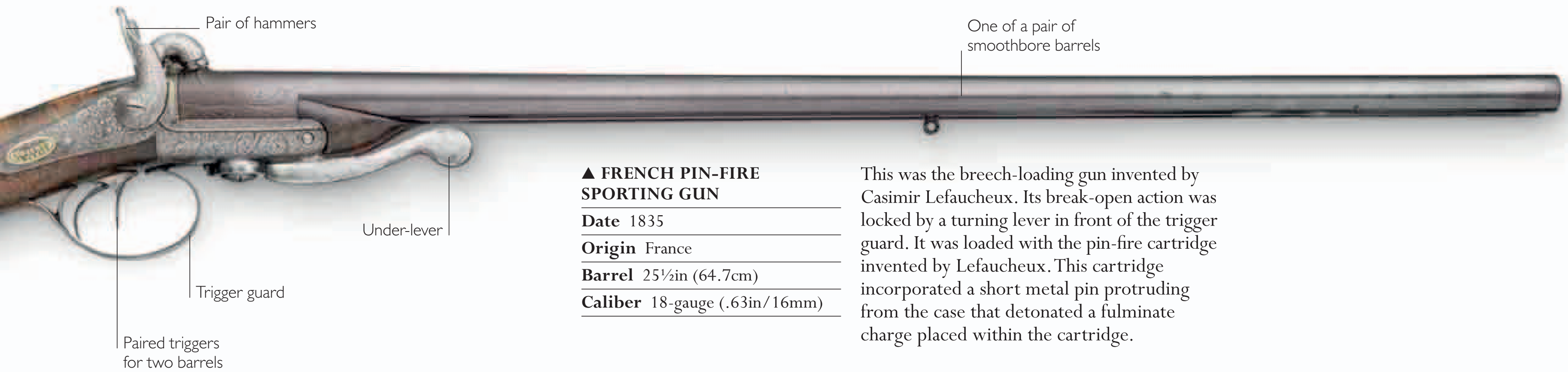
To reinforce the link between Winchester products and the American West, the company introduced the slogan, "Winchester: the gun that won the West" from 1919. Many pioneers carried Winchester rifles and this phrase certainly helped strengthen the link between Winchester and American history, underpinning the company's reputation as it continued to produce rifles, shotguns, and other firearms into the 20th century.

▶ **WINCHESTER '73**
James Stewart holds a Winchester rifle in the film *Winchester '73*. The movie in part tells the story of what happens when a "One in a thousand" Winchester passes from one owner to another.

BREECH-LOADING SHOTGUNS

In 1835, a French inventor named Casimir Lefaucheux made a breakthrough in sporting gun design with his patent for a pin-fire cartridge (see p.112) and a gun with a break-open design (its barrels hinged downward for loading at the breech). Hinged barrels became almost universally adopted for sporting guns, although gunmakers created many designs for locking the breech. The pin-fire cartridge was eventually replaced by a center-fire cartridge (see pp.112–13). Guns using pin-fire cartridges typically had distinctively long hammers that needed to strike down onto each cartridge's pin. The use of center-fire cartridges meant that a gun's hammers could be made smaller. Gunmakers also realized that the opening of the breech could be used to cock the gun, and "hammerless" shotguns began to appear before the end of the 19th century. Shotguns generally lacked sights, since they were fired by accurate pointing rather than deliberate aiming.





▲ FRENCH PIN-FIRE SPORTING GUN

Date	1835
Origin	France
Barrel	25½in (64.7cm)
Caliber	18-gauge (.63in/16mm)

This was the breech-loading gun invented by Casimir Lefaucheux. Its break-open action was locked by a turning lever in front of the trigger guard. It was loaded with the pin-fire cartridge invented by Lefaucheux. This cartridge incorporated a short metal pin protruding from the case that detonated a fulminate charge placed within the cartridge.

◀ ENGLISH PIN-FIRE SHOTGUN

Date	c.1860
Origin	UK
Length	30in (76.2cm)
Caliber	12-gauge (.73in/18.54mm)

Casimir Lefaucheux's pin-fire system remained popular with shotgun-armed hunters (particularly in Britain and France), even after it had been outmoded by the center-fire cartridge. This example, with back-action locks and a side-mounted breech-locking lever, is finely finished, but with little in the way of decoration. It was the work of Samuel and Charles Smith of London.

FULL VIEW

▲ ENGLISH SHOTGUN

Date	1880s
Origin	England
Barrel	30in (76.2cm)
Caliber	Not known

This gun, built by gunmaker Thomas Horsley of York, is one of the earliest sporting arms to employ center-fire cartridges. Similar to the pin-fire sporting guns shown above, it had strikers operated by external hammers, two triggers for quick barrel selection, and a break-open under-lever set beneath the trigger guard. The external hammers were each drawn back by hand, and when a trigger was pulled, it connected with the outer part of the striker, which struck the center-fire cartridge in the breech.

▲ HOLLAND AND HOLLAND SHOTGUN

Date	1878
Origin	England
Barrel	30in (76.2cm)
Caliber	12-gauge (.73in/18.54mm)

Holland and Holland is known for the superb quality of its bird-hunting shotguns. This hammerless shotgun with an under-lever has a classic English-style stock—it has no pistol grip. It also has an unusual breech-loading mechanism—its under-lever not only opened and closed the breech, but also cocked the enclosed box-lock action.

SPORTING RIFLES

Sporting rifles were made in fascinating varieties, influenced by many factors. These included popular regional styles, new technologies, and the size and nature of the game the rifle was used to hunt—from birds and rabbits to deer and elephants. The taste and budget of the owner also affected the design of these rifles. Sporting rifles were often more technically sophisticated than contemporary military arms, since they were not going to be subjected to a harsh environment or extended use on the battlefield.

▲ COLT PATERSON REVOLVING RIFLE

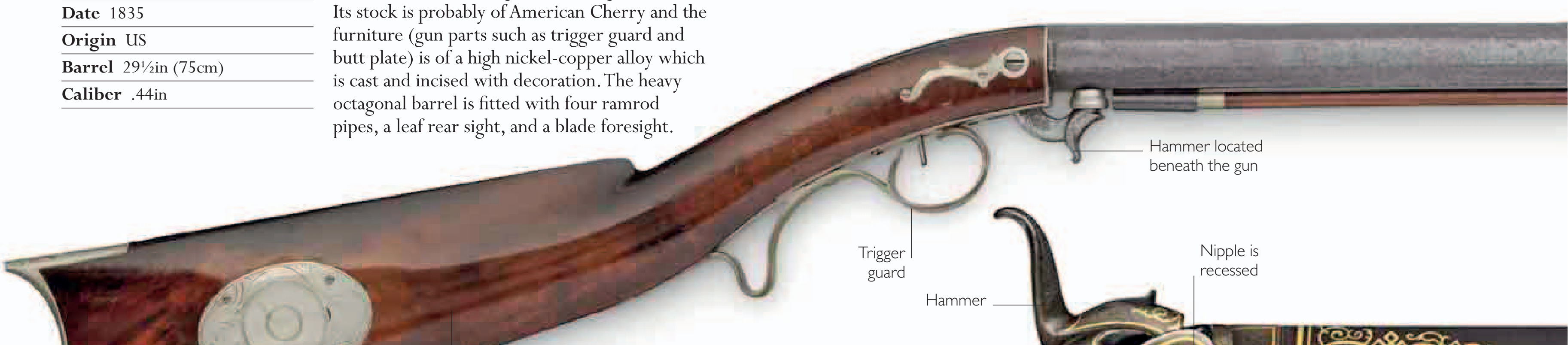
Date	1837
Origin	US
Barrel	32in (81.3cm)
Caliber	.36in

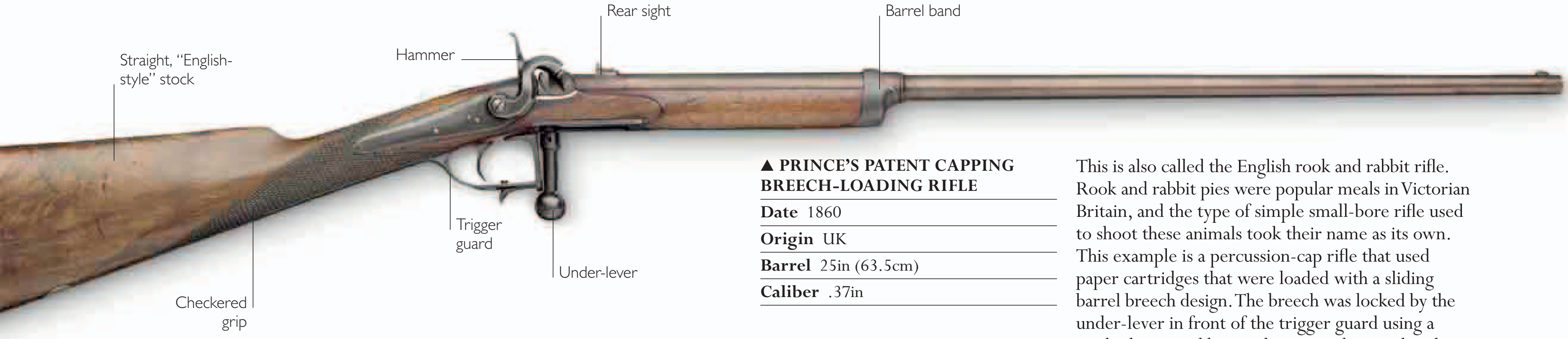
Samuel Colt's first factory in Paterson, New Jersey, produced revolving rifles as well as pistols. However, it had limited facilities and went bankrupt. Paterson-built Colt rifles, such as this first-pattern concealed-hammer eight-shot rifle, are extremely rare. This muzzle-loading revolving rifle used percussion caps.

▼ PERCUSSION UNDER-HAMMER RIFLE

Date	1835
Origin	US
Barrel	29½in (75cm)
Caliber	.44in

This under-hammer rifle by Vermont gunmaker Nicanor Kendall was a percussion-cap muzzle-loader. Its stock is probably of American Cherry and the furniture (gun parts such as trigger guard and butt plate) is of a high nickel-copper alloy which is cast and incised with decoration. The heavy octagonal barrel is fitted with four ramrod pipes, a leaf rear sight, and a blade foresight.

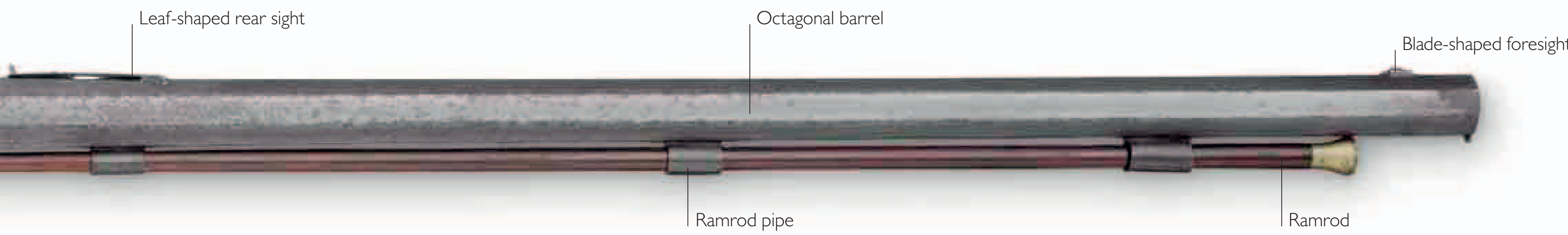


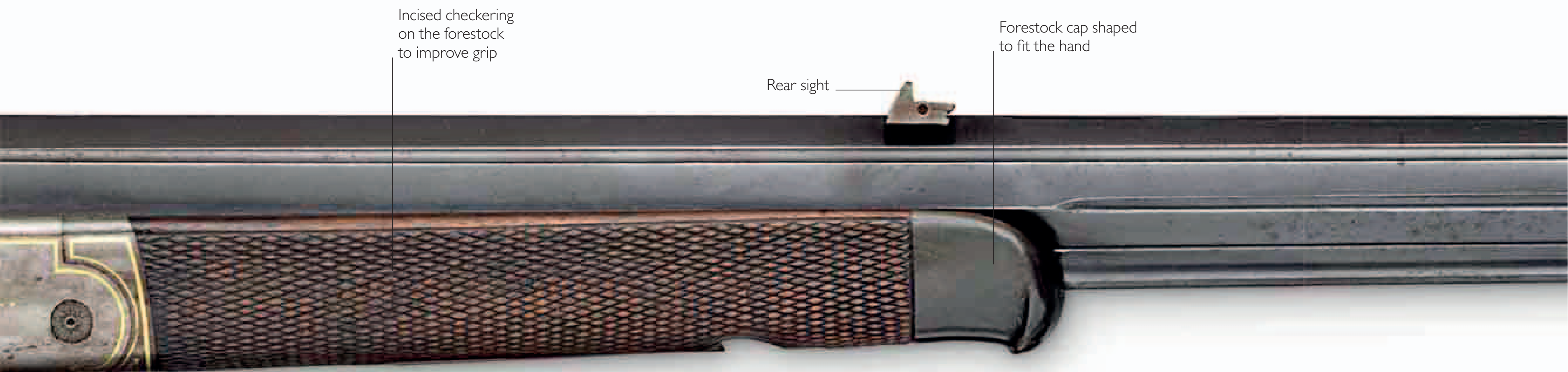


▲ PRINCE'S PATENT CAPPING BREECH-LOADING RIFLE

Date	1860
Origin	UK
Barrel	25in (63.5cm)
Caliber	.37in

This is also called the English rook and rabbit rifle. Rook and rabbit pies were popular meals in Victorian Britain, and the type of simple small-bore rifle used to shoot these animals took their name as its own. This example is a percussion-cap rifle that used paper cartridges that were loaded with a sliding barrel breech design. The breech was locked by the under-lever in front of the trigger guard using a method patented by London gunmaker Frederick Prince in 1855.





▲ GERMAN UNDER-LEVER RIFLE

Date	1880
Origin	Germany
Barrel	25½in (63.5cm)
Caliber	.45in

Even after the perfection of the bolt-action magazine rifle, there were those who refused to embrace the new technology. Hunters, particularly of big and dangerous game, preferred to trust the simplicity of a break-open design, such as this center-fire rifle.

▲ ENGLISH DOUBLE-BARRELED HAMMER RIFLE

Date	1870s
Origin	England
Barrel	24in (61cm)
Caliber	10-gauge (.78in/19.81mm)

This fine Holland and Holland rifle has external hammers that were cocked by hand, ornate scroll-work decorating the lock plates, double triggers for quick barrel selection, and a checkered forestock characteristic of many English side-by-side guns. This gun fired center-fire cartridges.

METALLIC-CARTRIDGE PISTOLS (1853–70)

Pistol cartridges with metallic cases became practical through Lefaucheux's pin-fire design (see p.112). They were improved by Smith and Wesson's rim-fire cartridge (see pp.128–29) in 1860, and again by center-fire cartridges in the 1870s. In the US, manufacture of revolvers capable of using these cartridges was impeded by a patent taken out by Rollin White in 1859, later acquired by Smith and Wesson, which prevented others from making "bored-through" cylinders. These cylinders were bored all the way through for loading a cartridge from the rear, the cartridge case sealing the breech in the process. Once this patent expired in 1869, percussion revolvers were converted to utilize metallic cartridges, and new pistols were built to use them.

▶ COLT NAVY CONVERSION

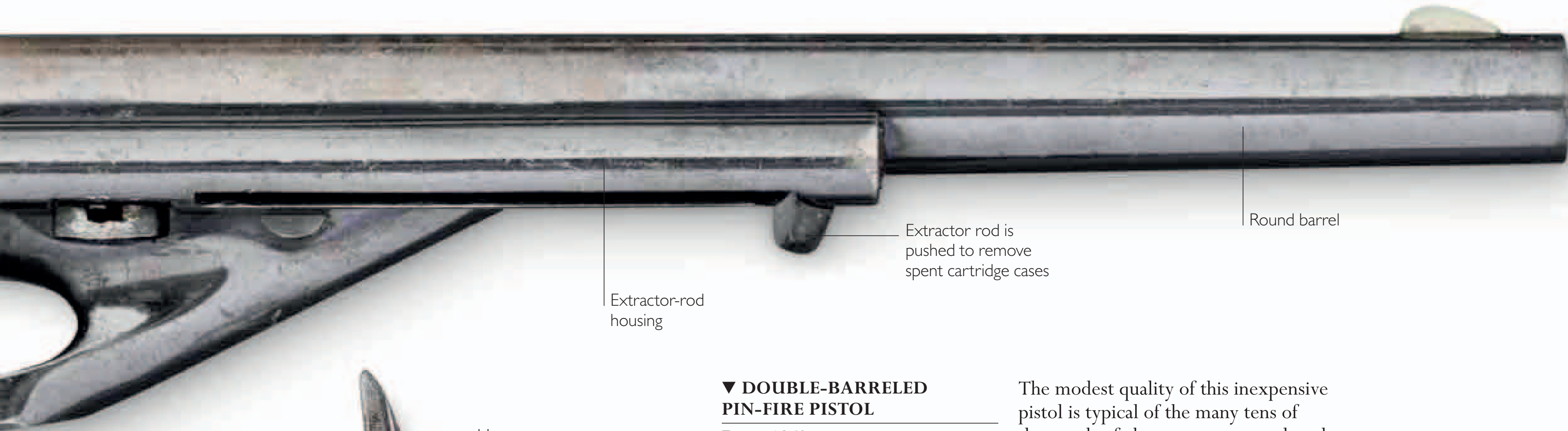
Date	1861
Origin	US
Barrel	7½in (19cm)
Caliber	.36in

Colt replaced its angular 1851 Navy revolver (see p.88) with a new, streamlined version ten years later. This example has been converted to accept brass cartridges after the fashion of the Single Action Army (see p.95); many percussion revolvers were adapted in this way.

▲ LEFAUCHEUX PIN-FIRE REVOLVER

Date	1853
Origin	France
Barrel	5¼in (13.5cm)
Caliber	12mm pin-fire

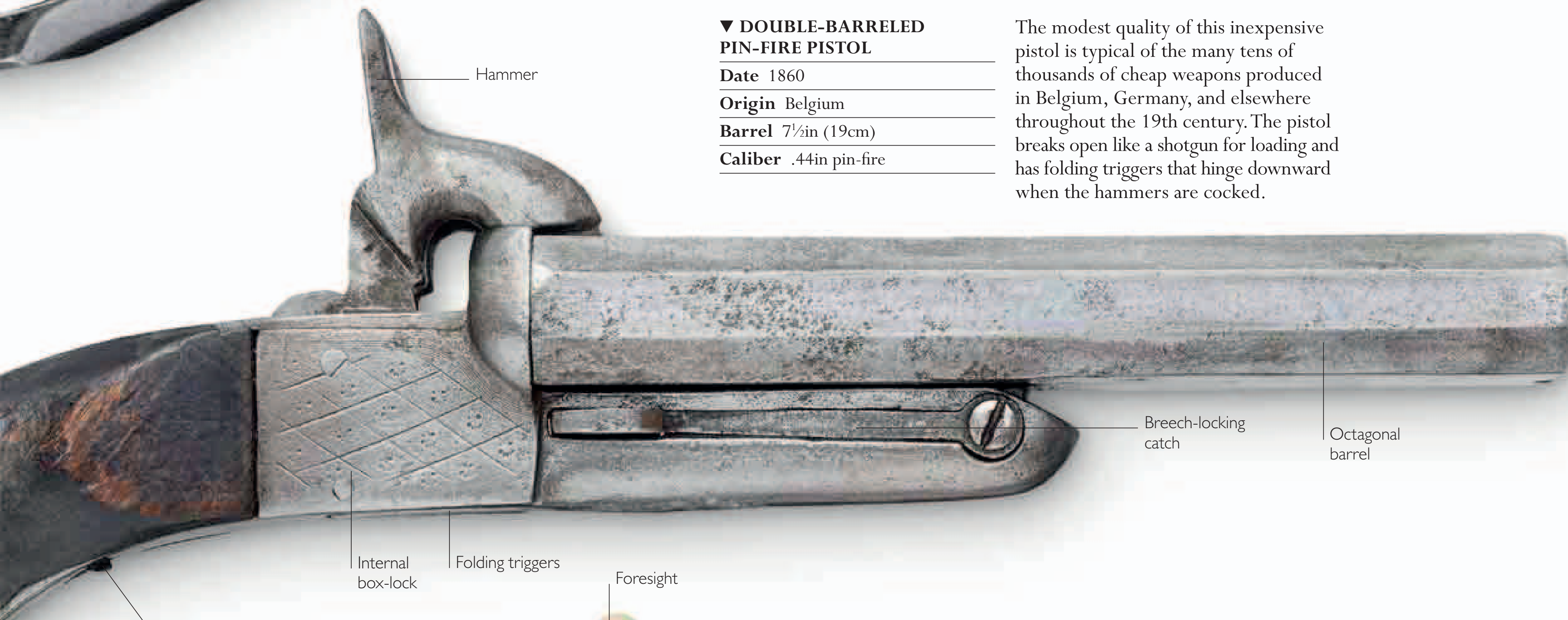
Eugène Lefaucheux produced a six-shot, double-action revolver in 12mm caliber for his father's 1835 pin-fire cartridge. This is a Cavalry model of 1853. An Army model, without a steadying spur, was also produced.



▼ DOUBLE-BARRELED PIN-FIRE PISTOL

Date	1860
Origin	Belgium
Barrel	7½in (19cm)
Caliber	.44in pin-fire

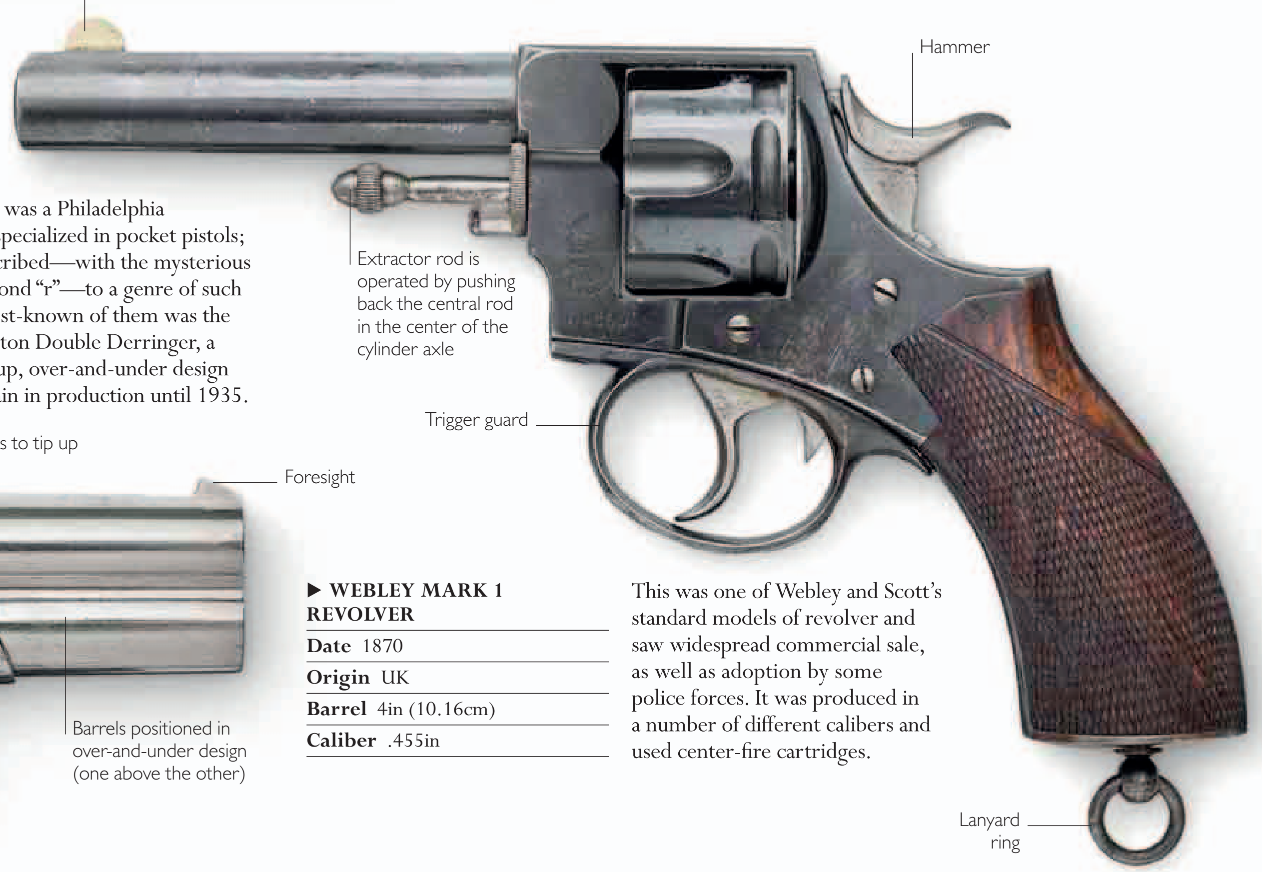
The modest quality of this inexpensive pistol is typical of the many tens of thousands of cheap weapons produced in Belgium, Germany, and elsewhere throughout the 19th century. The pistol breaks open like a shotgun for loading and has folding triggers that hinge downward when the hammers are cocked.



▼ REMINGTON RIM-FIRE DOUBLE-BARRELED DERRINGER

Date	1865
Origin	US
Barrel	3in (7.6cm)
Caliber	.41in rim-fire

Henry Deringer was a Philadelphia gunmaker who specialized in pocket pistols; his name was ascribed—with the mysterious addition of a second "r"—to a genre of such weapons. The best-known of them was the rim-fire Remington Double Derringer, a top-hinged, tip-up, over-and-under design that was to remain in production until 1935.



▶ WEBLEY MARK 1 REVOLVER

Date	1870
Origin	UK
Barrel	4in (10.16cm)
Caliber	.455in

This was one of Webley and Scott's standard models of revolver and saw widespread commercial sale, as well as adoption by some police forces. It was produced in a number of different calibers and used center-fire cartridges.

METALLIC-CARTRIDGE REVOLVERS (1871–79)

With the production of robust and reliable metallic cartridges, gun manufacturers could develop and improve upon all kinds of pistols and other guns to use them effectively. Revolvers continued to improve and were made in considerable variety. Some, like Colt and Remington revolvers, had fixed cylinders loaded through a rear gate, while others had cylinders that swung out sideways, or, like those made by Smith and Wesson, had frames that hinged open.

◄ SMITH AND WESSON NO. 3 RUSSIAN MODEL

Date 1871
Origin US
Barrel 8in (20.3cm)
Caliber .44in S and W Russian

Smith and Wesson won a contract to supply the Russian Army with 20,000 units of its No 3 pistol, chambered for a special cartridge. These were the most accurate revolvers of their day.

▲ COLT SINGLE-ACTION ARMY (SAA) MODEL 1873

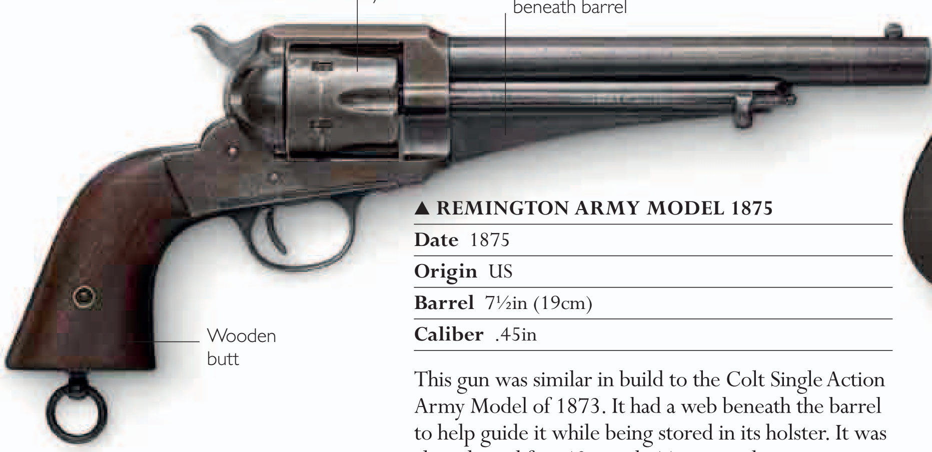
Date 1873
Origin US
Barrel 7½in (19cm)
Caliber .45in

The Colt SAA ("Peacemaker") (see p.95) married the single-action lock of the old Dragoon model to a bored-through cylinder in a solid frame, into which the barrel was screwed.

▲ DUTCH M1873 ARMY REVOLVER

Date 1873
Origin Netherlands
Barrel 6¼in (16cm)
Caliber 9.4 × 21mm rim-fire

Two models of the M1873 were made for the Dutch Army. The earlier model had an octagonal barrel, while the later one had a round barrel.



▲ REMINGTON ARMY MODEL 1875

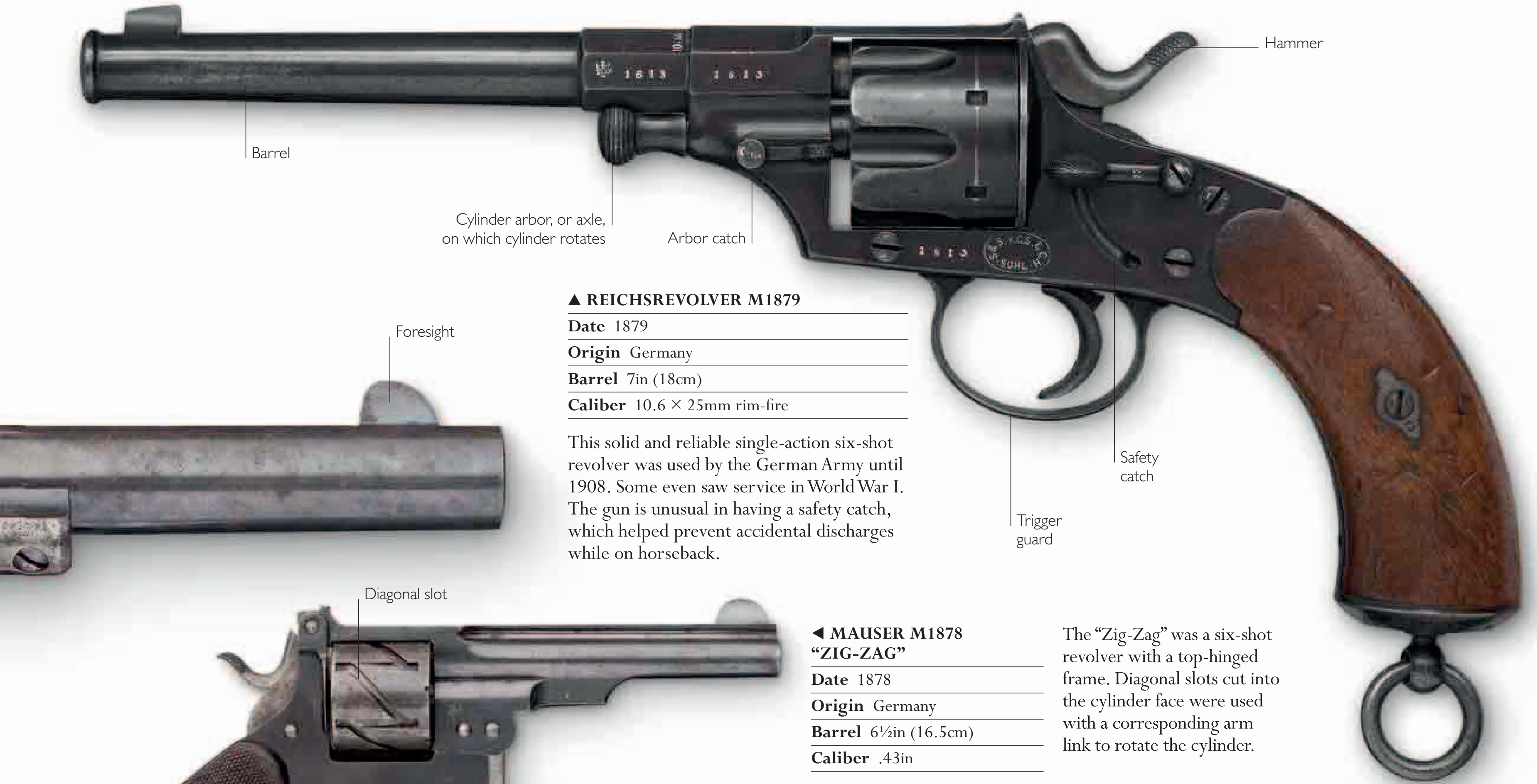
Date 1875
Origin US
Barrel 7½in (19cm)
Caliber .45in

This gun was similar in build to the Colt Single Action Army Model of 1873. It had a web beneath the barrel to help guide it while being stored in its holster. It was also adapted for .40in and .44in cartridges.

▲ COLT LIGHTNING DOUBLE ACTION

Date 1877
Origin US
Barrel 5½in (14cm)
Caliber .38in

The Lightning was Colt's first double-action handgun. It was a small-frame revolver chambered for .38in cartridges, although Colt also produced an accompanying weapon, the Thunderer, in .44in caliber to cater to those preferring a heavier punch. Although the Lightning had some quality issues, sales were still respectable, and the total production run reached 166,000 guns.



▲ **REICHSREVOLVER M1879**

Date	1879
Origin	Germany
Barrel	7in (18cm)
Caliber	10.6 × 25mm rim-fire

This solid and reliable single-action six-shot revolver was used by the German Army until 1908. Some even saw service in World War I. The gun is unusual in having a safety catch, which helped prevent accidental discharges while on horseback.

◀ **MAUSER M1878 "ZIG-ZAG"**

Date	1878
Origin	Germany
Barrel	6½in (16.5cm)
Caliber	.43in

The "Zig-Zag" was a six-shot revolver with a top-hinged frame. Diagonal slots cut into the cylinder face were used with a corresponding arm link to rotate the cylinder.

▲ **WEBLEY-PRYSE NO. 4 REVOLVER**

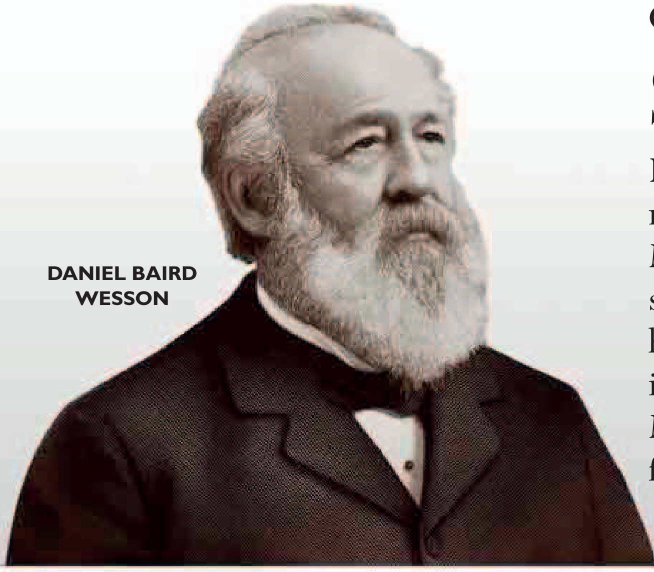
Date	1877
Origin	UK
Barrel	6¼in (16cm)
Caliber	.45in

In 1876, Charles Pryse designed a tip-down, break-open revolver with a rebounding-hammer action. It also featured simultaneous extraction of spent cartridges. Although uncommon in revolver design, automatic ejection of cartridges was desirable in military revolvers, which often needed to be reloaded quickly. This Fourth Model Webley-Pryse, recognizable by its fluted cylinder, was made in calibers ranging from .32in to .577in.

▼ **COLT FRONTIER DOUBLE ACTION**

Date	1878
Origin	US
Barrel	5½in (14cm)
Caliber	.44in/.45in

After introducing the double-action Lightning (left) in 1877, Colt came up with a double-action version of the SAA "Peacemaker" (also left) in .44in and .45in calibers.



DANIEL BAIRD WESSON

GREAT GUNSMITHS

SMITH AND WESSON

Horace Smith and Daniel Baird Wesson were two of history's most influential gunmakers. Their first major achievement was the Model 1, a revolver that was simple to use because it did away with separate powder, ball, and percussion cap—to load it, all that the user had to do was to drop self-contained metal cartridges (see pp.112–13) into the cylinder. This remarkable revolver, and the larger-caliber Model 2, established Smith and Wesson as one of the best-known firearms manufacturers in the United States.

Gunmakers Horace Smith and D. B. Wesson first collaborated in the early 1850s, when they worked on the production of a repeating pistol operated by lever action (see p.114) and based on an earlier design by Hunt and Jennings. The weapon had impressive fire power, earning it the name "Volcanic," but it proved unreliable. Its cartridges sometimes got stuck in the barrel and occasionally several of the volatile cartridges went off at once. Wesson devised an improved, self-contained metal cartridge for the gun, but the weapon still lacked a way of extracting the cartridge cases with ease and sales did not improve. When the main investor pulled out, the business was bought by Oliver Winchester, who went on to develop his successful repeating rifle. Smith left the business, as eventually did Wesson.

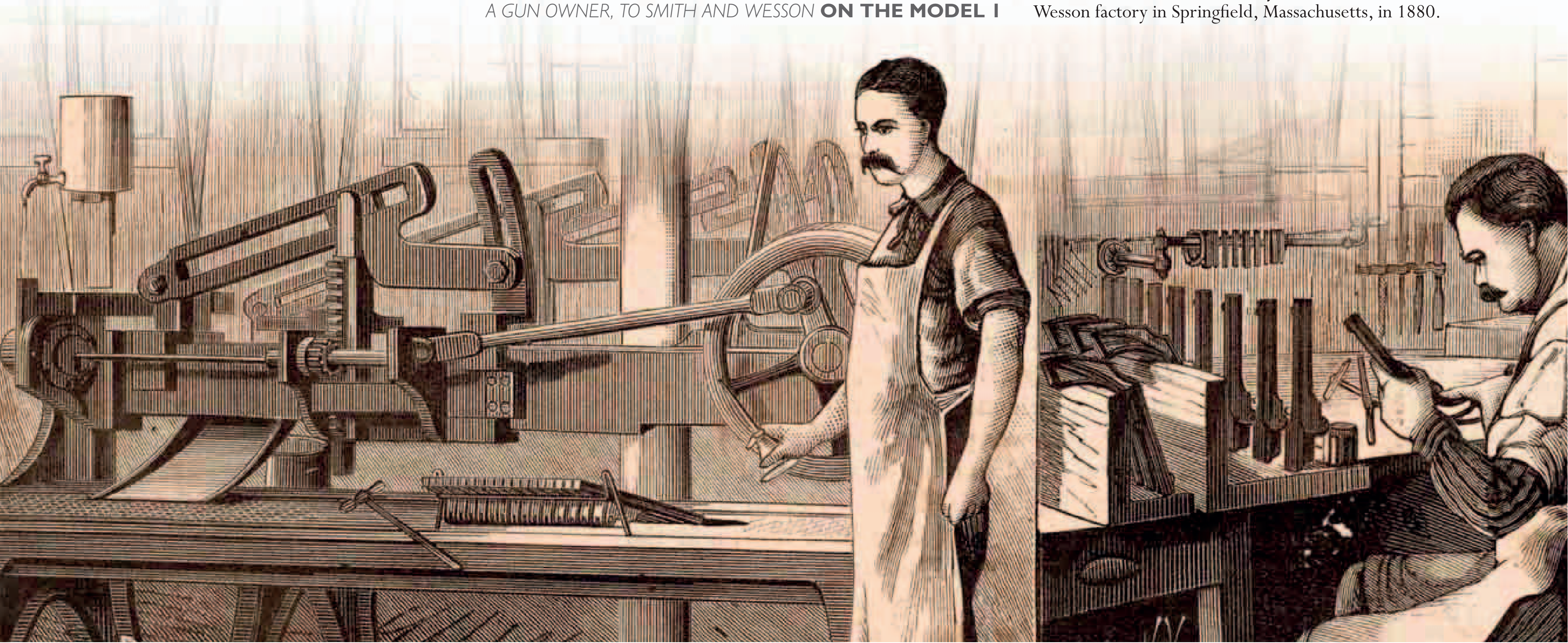
COMBINING INNOVATIONS

By 1856, Samuel Colt's patent on the revolver, which he took out in 1835, was about to run out and Wesson wanted to design a revolver that fired the self-contained metal cartridge. Horace Smith was impressed with Wesson's plans and teamed up with him once again. The metal cartridge needed a bored-through revolver cylinder, allowing cartridges to be loaded from the rear. The bored-through cylinder had already been patented by a gunsmith named Rollin White, so Smith and Wesson made a deal with him. They licensed his patent, agreeing to pay White a royalty on each pistol they sold. White retained the patent and remained responsible for defending his patent rights should any other manufacturer try to produce a revolver with a similar cylinder. The Smith and Wesson Model 1, a seven-shot revolver incorporating White's cylinder and firing Wesson's self-contained .22in rim-fire cartridge, was launched in 1857. It became popular, heralding the end of percussion arms. Soon other manufacturers

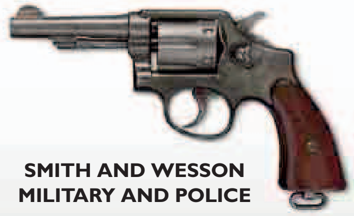
"The **Pistol**... proves to be one of the most powerful weapons I ever saw."

FROM A LETTER WRITTEN IN 1862 BY C. F. ACHENBACK, A GUN OWNER, TO SMITH AND WESSON **ON THE MODEL 1**

▼ **SMITH AND WESSON FACTORY**
A worker operates a rifling machine while others assemble revolver barrels and cylinders at the Smith and Wesson factory in Springfield, Massachusetts, in 1880.



SMITH AND WESSON MODEL 3



SMITH AND WESSON MILITARY AND POLICE

SMITH AND WESSON MODEL 29

1852 Horace Smith and D. B. Wesson form their first partnership to produce a lever-action pistol, but this venture is not successful financially.
1856 Smith and Wesson form their second company to manufacture the Model 1 revolver.
1869 The Model 3 is introduced, selling in large numbers in Russia and elsewhere.
1875 An order from the US military leads to the Schofield revolver, named for the locking system devised by Major George W. Schofield.
1898 When the Spanish-American War comes to an end, the US Army sells off many surplus Schofield revolvers, bringing these onto the civilian market.
1913 The company introduces its first center-fire semiautomatic pistol, the Model 1913.
1919 Smith and Wesson produce a variant of the successful Military and Police revolver with a baton extension for police use.
1955 The Model 29, chambered for the .44in Magnum cartridge, is launched.
1971 Clint Eastwood sports a Model 29 in the film *Dirty Harry*, hugely increasing its popularity.

tried to make similar firearms, and so White had to defend his patent in court. While the inventor was embroiled in his legal battle, Smith and Wesson developed the Model 2, a similar design but with a larger .32in caliber, which was more suitable for use in combat. The launch of the Model 2 in 1861 coincided with the start of the American Civil War, and Smith and Wesson found that there was a huge demand for the new revolver—by 1865, the two gunmakers were rich men. When the war ended, many soldiers took home their weapons, and soon Smith and Wesson firearms were in use all over the American West.

NEW MARKETS

After the Civil War, there was a steep decline in demand for firearms in the US. Models 1 and 2 had sold in hundreds of thousands, but in 1867, the company sold only 15 guns per month. Smith and Wesson began looking for new markets. The company started to sell guns in large numbers overseas, notably to Russia, where the 1869 Model 3 proved successful. The company also sold the Model 3 to the US Cavalry, who used a modified version that was easier to load while riding. In 1874, Horace Smith retired, selling his share of the company to Wesson. In the late-19th century, Wesson produced guns that proved especially attractive in another key market—police forces. A number of police departments bought Smith and Wesson firearms, such as the .38in Safety Hammerless of the 1880s. In 1899, Wesson brought out the revolver that was the most enduring of all Smith and Wesson's products—the Military and Police revolver. Prized for its power, accuracy, and ease of loading, the Military and Police revolver sold in huge numbers to law-enforcement agencies all over the world. Modified in various ways, it remains in production and was used very widely until police and military units replaced it with semiautomatic weapons. It has been estimated that around 6 million Military and Police revolvers have been produced, and large numbers are still in use, including many by target shooters. This unique record easily makes it the 20th century's best-selling center-fire revolver. Smith and Wesson is also known for introducing Magnum cartridges to handguns. These cartridges are very powerful and generate a lot of recoil. Popular examples are the .357in and .44in cartridges. The company continues to build on its heritage, carrying its innovations into the 21st century.

▲ AUSTRALIAN POLICE
A police officer from Victoria, Australia, fires a .40in-caliber Smith and Wesson automatic pistol. Such weapons were chosen by his force in 2009 to replace older revolvers.


US

CIVIL WAR ARTILLERY
A great variety of artillery—smoothbore and rifled—saw service during the American Civil War (1861–65). Here, Union officers gather around a 3-inch Ordnance Rifle, the most widely used type of rifled artillery of the conflict.

MUZZLE-LOADING ARTILLERY

Despite having been the earliest form of gunpowder weapon, muzzle-loading artillery remained a potent force until the very last years of the 19th century. Strong and mechanically uncomplicated smoothbore weapons, these muzzle-loaders fired round shot made of lead or iron. In the late 1850s, muzzle-loading artillery began to evolve into refined rifled steel weapons able to fire aerodynamic projectiles—huge shells capable of penetrating the thickest armor plate.

▲ CHINESE 32-POUNDER

Date	1841
Origin	China
Length	9ft (2.74m)
Caliber	7.5in (190mm)
Range	Just over 1 mile (1.8km)

Engravings on the breech indicate that this imposing bronze 32-pounder was cast in August 1841, during the reign of Chinese Emperor Daoguang (1820–50), for coastal defense duties.

▼ INDIAN BRONZE 24-POUNDER GUN

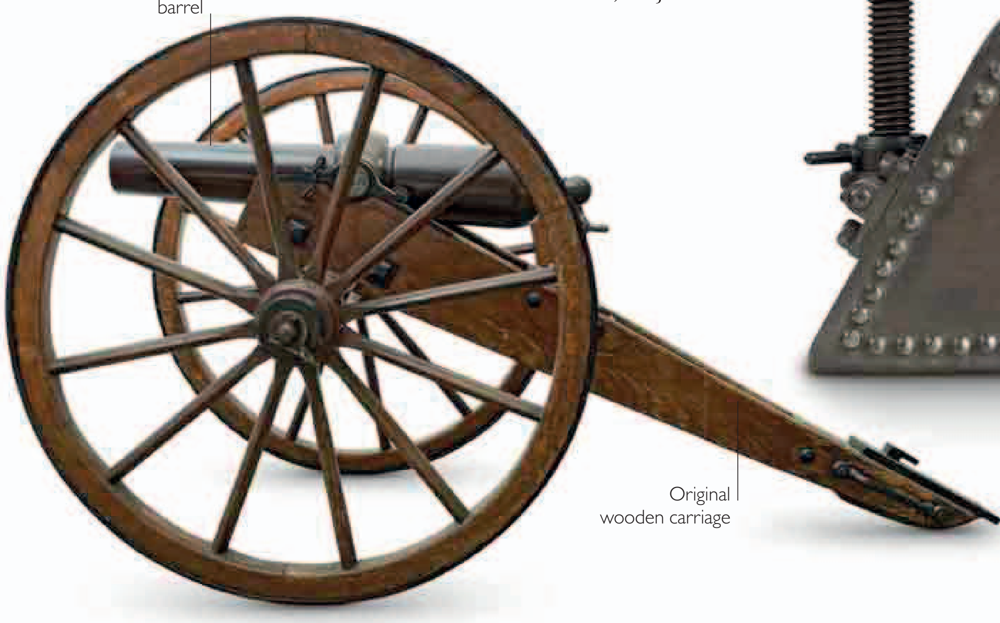
Date	Late 18th century
Origin	India
Length	10¾ft (3.27m)
Caliber	5.66in (142.2mm)
Range	Just over 1 mile (1.8km)

This gun barrel represents the many older pieces kept in regular and effective use in many parts of the world well into the 19th century. It is decorated on the muzzle and barrel with motifs resembling tiger's stripes. Tigers' heads also form the muzzle, the cascable button, and the ends of the trunnions.

▼ BLAKELY 2.75-IN RML MOUNTAIN GUN

Date	1865
Origin	UK
Length	(Barrel) 3¼ft (1m)
Caliber	2.75in (69.85mm)
Range	Just over 1 mile (1.8km)

In mountainous terrain, armies required lighter, more maneuverable field guns, and mountain guns were developed to meet this need. This rifled muzzle-loader, or RML gun, manufactured by the innovative Blakely Ordnance Company, has a steel barrel with six-groove rifling and reinforcement at the breech in the form of an additional steel tube, or "jacket."



▲ **BRITISH 9-POUNDER RML FIELD GUN**

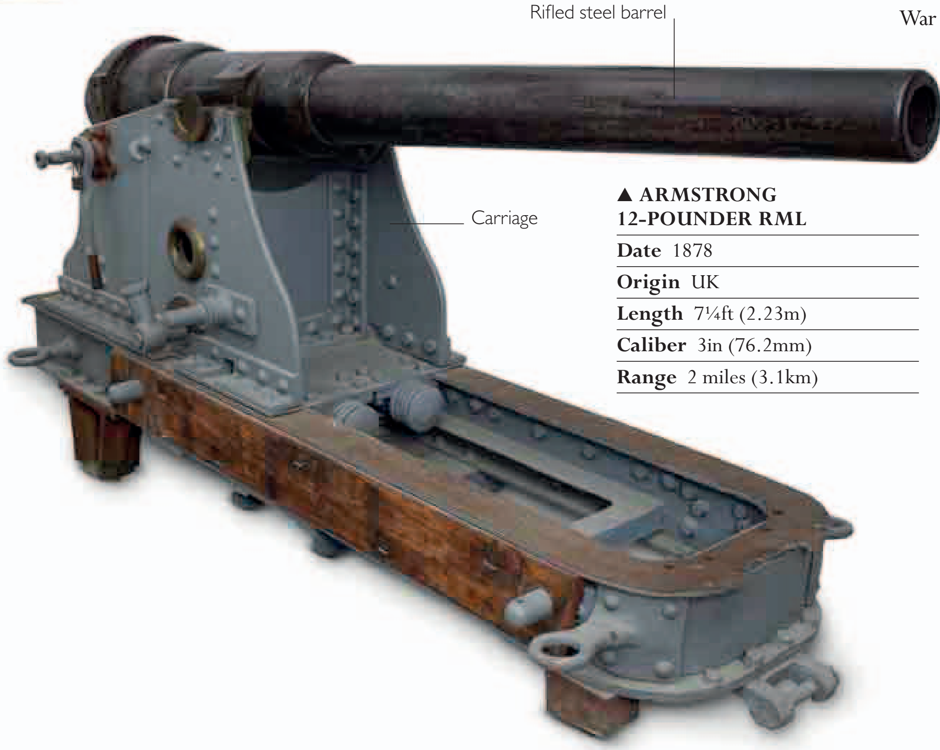
Date	1876
Origin	UK
Length	(Barrel) 5¾ft (1.79m)
Caliber	3in (76.2mm)
Range	1¾ miles (2.7km)

Field guns like this muzzle-loading rifled 9-pounder played an important role in both sieges and field battles in the British Army's overseas engagements of this period, such as the Second Anglo–Afghan War of 1880.

▲ **MODEL ARMSTRONG 17.72-IN 100-TON GUN**

Date	1877
Origin	England
Length	31ft (9.44m)
Caliber	17.72in (450mm)
Range	3.7 miles (6km)

This is a model of one of the large 100-ton RML guns built by Sir William Armstrong. Eight were fitted to two Italian battleships, and others were installed in British batteries on Gibraltar and Malta.



▲ **ARMSTRONG 12-POUNDER RML**

Date	1878
Origin	UK
Length	7¼ft (2.23m)
Caliber	3in (76.2mm)
Range	2 miles (3.1km)

This steel 12-pounder was manufactured by Armstrong in Newcastle, northern England, for use on an armed merchant ship. It fired 12-lb (5.4-kg) projectiles.

BREECH-LOADING ARTILLERY

New materials began to be used to build artillery—muzzle-loaders as well as rarer breech-loaders—in the second half of the 19th century, revolutionizing artillery design. Cast-iron and bronze barrels were replaced by stronger ones of wrought iron and steel. There were also improvements in gunpowder manufacture which translated into longer range, more accuracy, and greater penetration. This was especially important in the days of the development of ironclad warships. Breech-loaders had always proved more practical than muzzle-loaders on ships (see p.14). Breech-loading also meant that naval guns could now have long barrels, since it was no longer necessary to load at the muzzle, and this helped significantly to increase their range.

▶ ARMSTRONG RBL 12-POUNDER

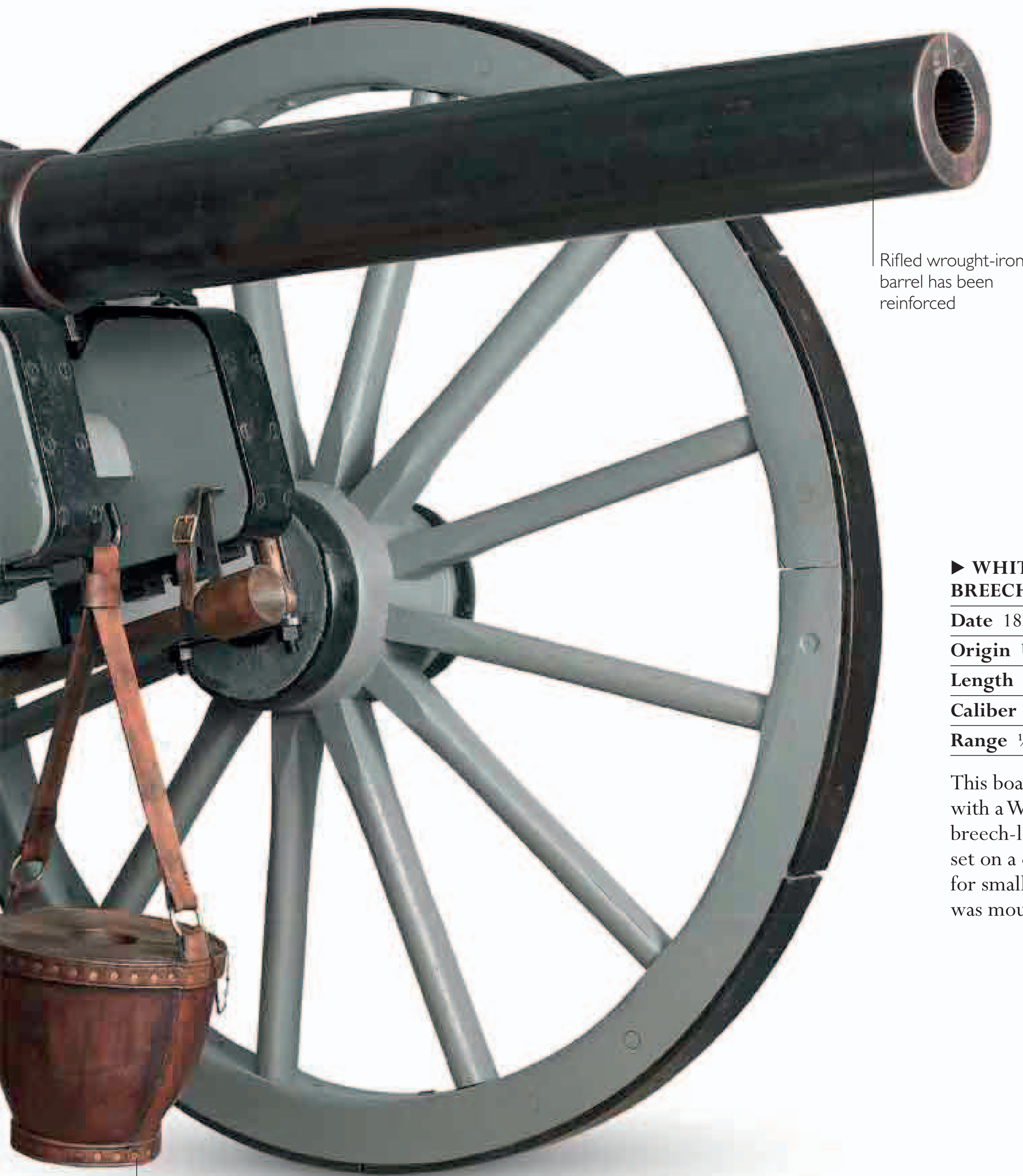
Date	1859
Origin	UK
Length	(Barrel) 7ft (2.13m)
Caliber	7.62cm
Range	2 miles (3.1km)

This Armstrong rifled breech-loader, or RBL gun, required a crew of nine men to operate it. The gun that entered British Army service (shown here) in 1859 had a 7-ft (2.13-m) barrel, while the British Royal Navy used a 6-ft (1.83-m) barrel version. In 1863, the shorter version became standard.

▼ ARMSTRONG RBL 40-POUNDER

Date	1861
Origin	UK
Length	9¾ft (3m)
Caliber	12cm
Range	1½ miles (2.5km)

The Armstrong 40-pounder was used by the British Royal Navy as a broadside gun (a gun used in a battery on one side of a ship), and by the army as a defensive gun in military forts. It saw action in the Royal Navy's bombardment of Kagoshima, Japan, in August 1863.



▶ WHITWORTH 45-MM BREECH-LOADING BOAT GUN

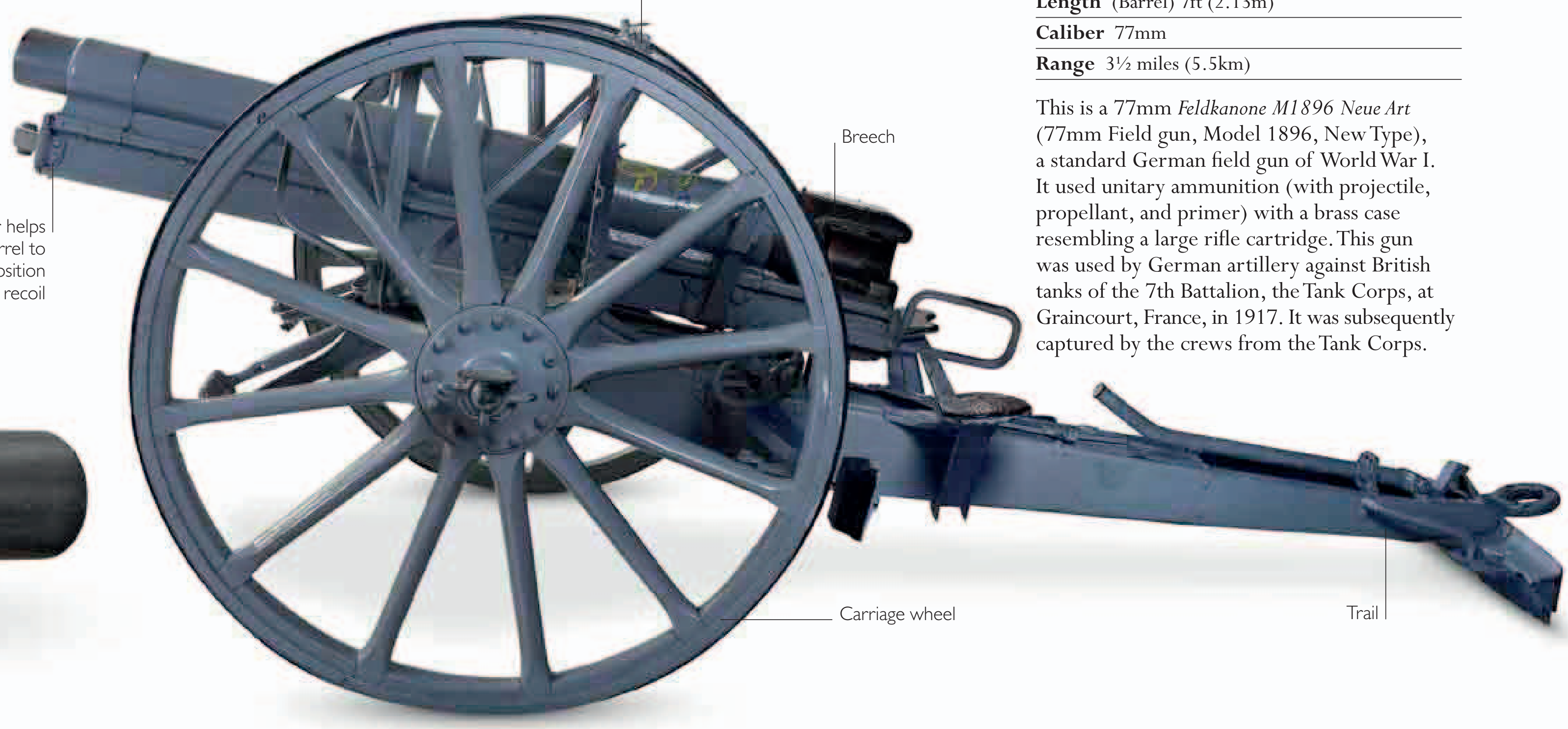
Date	1875
Origin	UK
Length	3ft (0.94m)
Caliber	45mm
Range	¼ mile (0.3km)

This boat gun had hexagonal rifling with a Whitworth sliding-lock breech-loading mechanism. It was set on a cone mounting mostly used for small naval guns. This example was mounted on an armed yacht.

▼ MODEL 1896 FIELD GUN

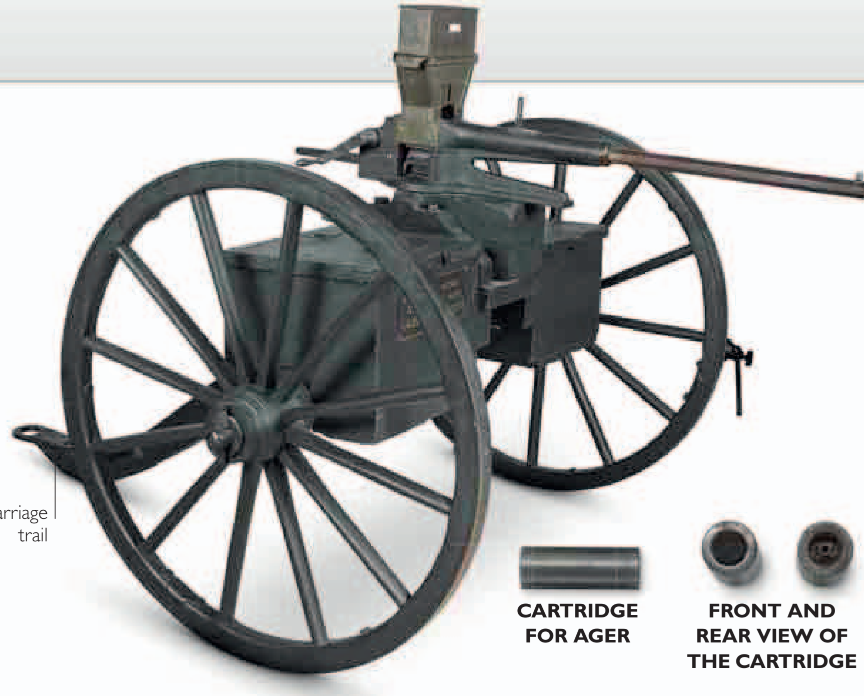
Date	1896
Origin	Germany
Length	(Barrel) 7ft (2.13m)
Caliber	77mm
Range	3½ miles (5.5km)

This is a 77mm *Feldkanone M1896 Neue Art* (77mm Field gun, Model 1896, New Type), a standard German field gun of World War I. It used unitary ammunition (with projectile, propellant, and primer) with a brass case resembling a large rifle cartridge. This gun was used by German artillery against British tanks of the 7th Battalion, the Tank Corps, at Graincourt, France, in 1917. It was subsequently captured by the crews from the Tank Corps.



EARLY MACHINE-GUNS

By the time of the American Civil War (1861–65), there was widespread military interest in the potential benefit offered by rapid-fire weapons during combat. Two designers in particular, Wilson Ager and Richard Gatling, developed guns which offered considerable potential. Ager and Gatling's early "machine-guns" used a primitive type of cartridge in the form of reloadable steel tubes fitted with percussion caps, and consequently suffered from ammunition problems. However, the development of reliable unitary, metallic-cased center-fire cartridges (see pp.112–13), carrying propellant, projectile, and primer in one package, enabled these guns, and a number of other effective hand-cranked repeating guns, to achieve high rates of fire.



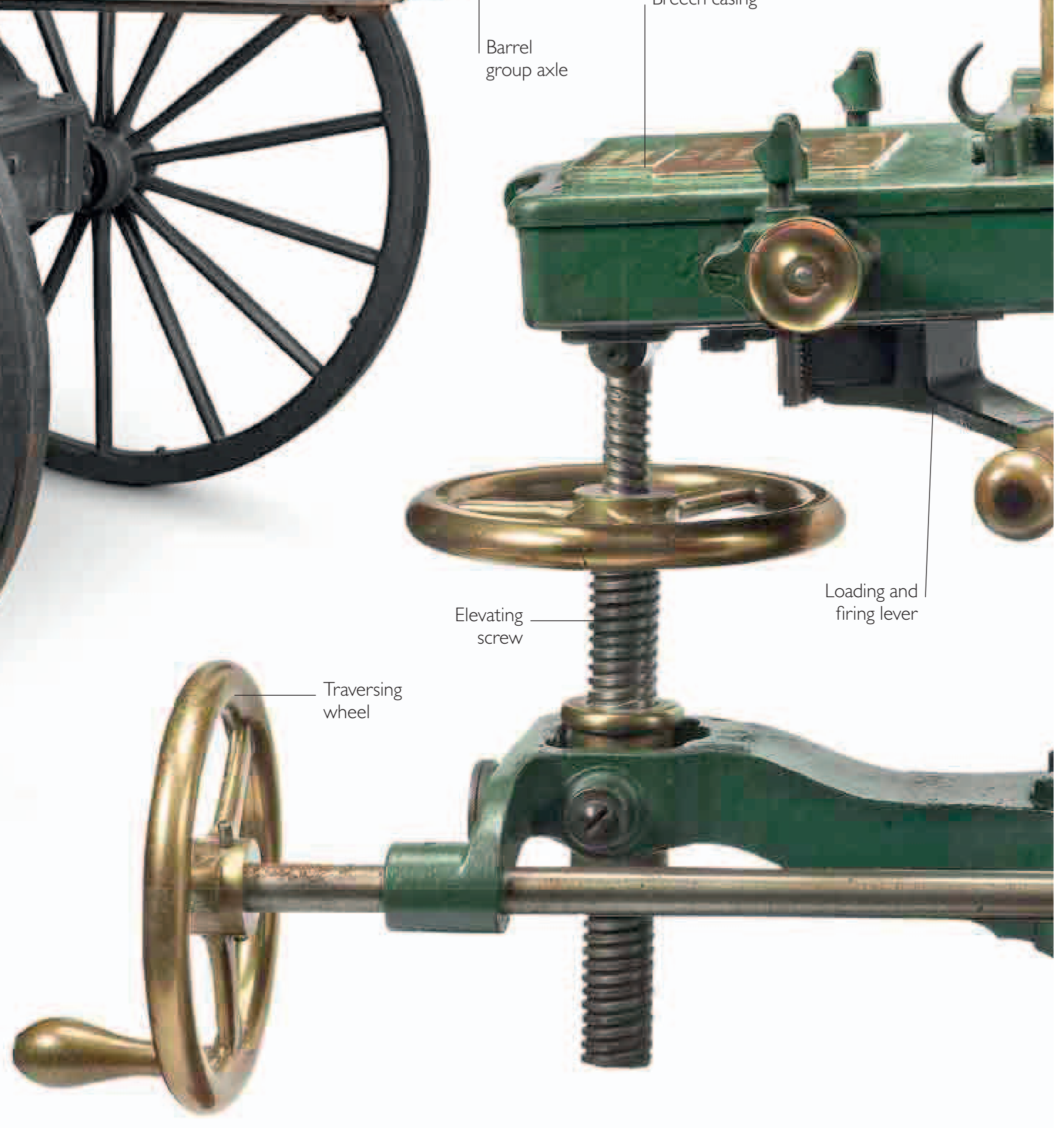
CARTRIDGE FOR AGER

FRONT AND REAR VIEW OF THE CARTRIDGE

▲ AGER MACHINE-GUN

Date	c.1860
Origin	US
Length	(Barrel) 3ft (.88m)
Caliber	.58in

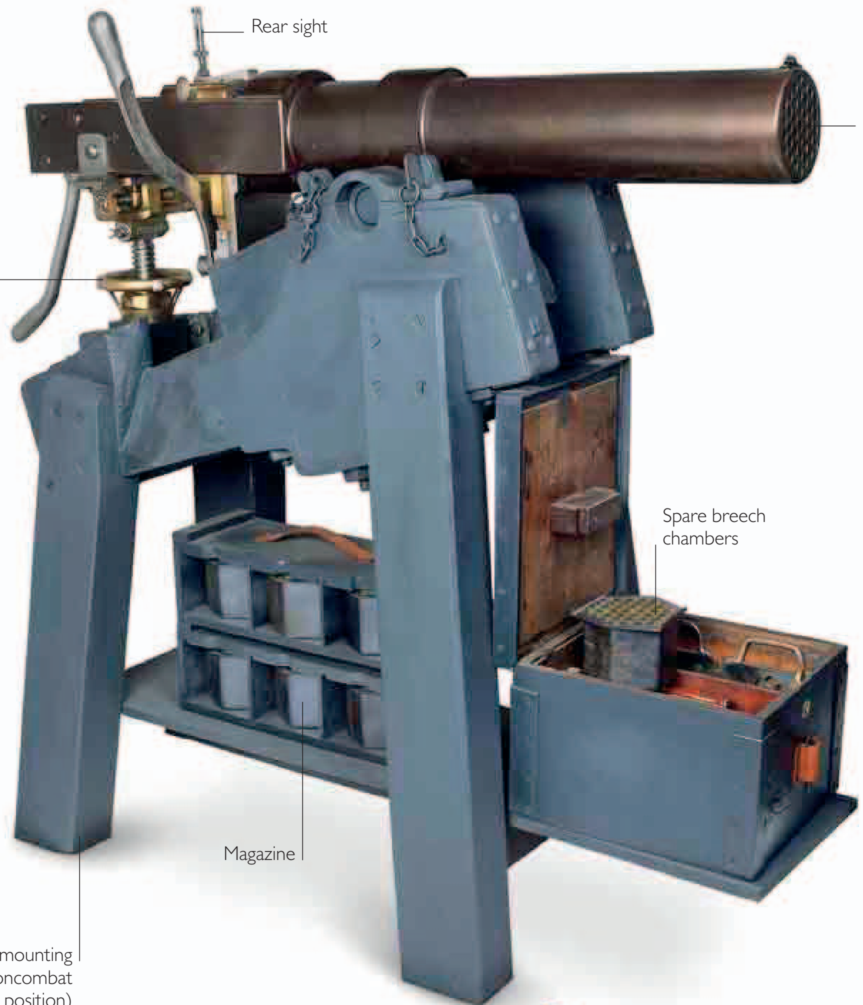
This gun was developed by Wilson Ager, and advertised by him as "an army in six square feet" because of its ability to fire 120 rounds per minute. Sixty guns were ordered for the Union Army, but barrel overheating problems meant the guns saw little use.



▲ EARLY GATLING CONVERTED TO METALLIC CARTRIDGE

Date	c.1862
Origin	US
Length	(Barrel) 4½ft (1.4m)
Caliber	.50in

Richard Jordan Gatling patented his hand-cranked, multi-barrelled gun in 1862, and first used reloadable steel cartridges fired by percussion caps. Problems with misfires were common. In order to solve these issues, this early machine-gun was eventually modified to utilize the improved unitary cartridges.



▶ DE REFFYE MITRAILLEUSE VOLLEY GUN

Date	1869
Origin	France
Length	5¾ft (1.76m)
Caliber	13mm

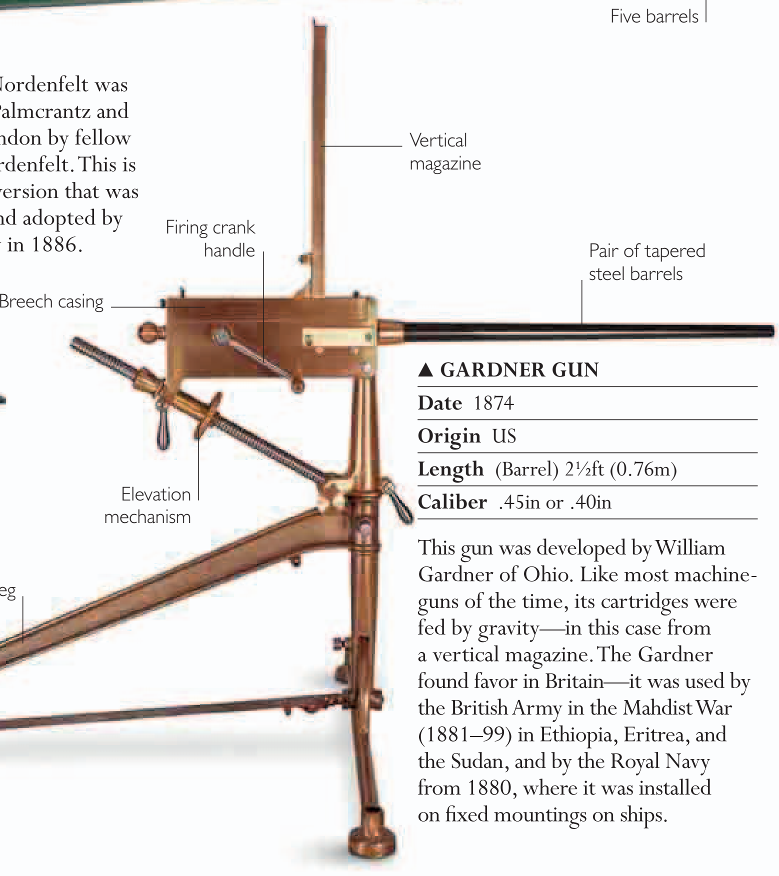
Developed by Joseph Montigny of Belgium and improved by French ordnance engineer Commandant de Reffye, this gun was used in the Franco–Prussian War (1870–71). The original was a 25-barrel weapon, while this is a 37-barrel modification. In combat, the Mitrailleuse would have been mounted on a wheeled carriage (not the display mounting shown here).

▲ NORDENFELT GUN

Date	1873
Origin	UK
Length	¼ft (1.28m)
Caliber	.45in

The hand-cranked Nordenfelt was designed by Helge Palmcrantz and manufactured in London by fellow Swede Thorsten Nordenfelt. This is a five-barrel, .45in version that was produced in 1873 and adopted by Britain's Royal Navy in 1886.

FULL VIEW



▲ GARDNER GUN

Date	1874
Origin	US
Length	(Barrel) 2½ft (0.76m)
Caliber	.45in or .40in

This gun was developed by William Gardner of Ohio. Like most machine-guns of the time, its cartridges were fed by gravity—in this case from a vertical magazine. The Gardner found favor in Britain—it was used by the British Army in the Mahdist War (1881–99) in Ethiopia, Eritrea, and the Sudan, and by the Royal Navy from 1880, where it was installed on fixed mountings on ships.

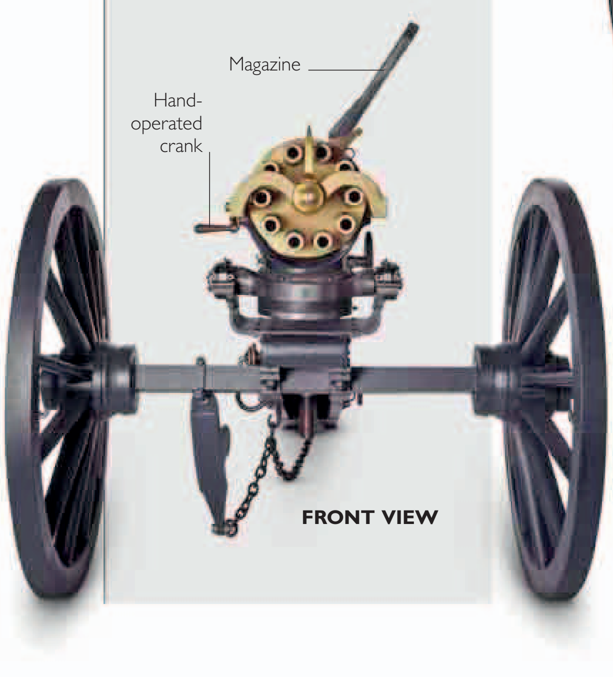
VISUAL TOUR

GATLING GUN

By the second half of the 19th century, improvements in engineering had made it possible to manufacture reliable rapid-fire weapons. This gun, patented by Richard Gatling in 1862, employed multiple barrels, as would all early machine-guns (see pp.136–37). It was first developed during the American Civil War and was deemed a success.

▸ PROTOTYPE MACHINE-GUN
The gun's barrels—at first six, later 10 (as shown here)—were arranged around a cylindrical shaft. A hand-operated crank made the barrels revolve, and cartridges dropped into place from above as each barrel came around. A firing pin then struck and fired the bullet; the barrel turned and the process was repeated. As each barrel descended, its spent case was ejected. This is a prototype of one of Gatling's guns. It fired 400 rounds per minute.

GATLING GUN	
Date	1865
Origin	US
Barrel	26½in (67.3cm)
Caliber	.45in, .65in, or 1in

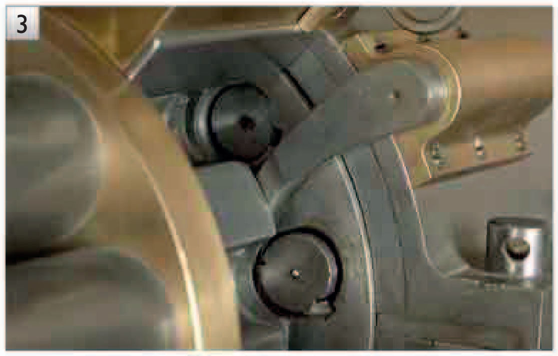


FRONT VIEW

◀ FORESIGHT AND BARRELS
The foresight enabled the gun to be kept on target. Ten barrels meant that each barrel fired only once in 10 rounds. Although each barrel would heat up considerably, the gun was able to achieve a higher rate of fire without serious overheating than was possible with a single-barreled gun.

▶ MAGAZINE SLOT
The 40-round magazine was constructed with a groove to help prevent the gun from jamming.

▶ ANTI-ROTATION PAWL
The anti-rotation pawl is the curved lever at the rear of the opening containing the channels for the breech bolts—one for each of the 10 barrels. The anti-rotation pawl was fitted to prevent the group of barrels being rotated in the wrong direction.



▶ WHEEL HUB
To make transportation easier, a towing ring was secured to the wheel hub by a cotter (a wedge-shaped fastener).

▲ ELEVATING GEAR
This wheel was used to raise and lower the barrels of the gun.

◀ TRAVERSING HANDSPIKE
Stored on the right side of the carriage trail, the handspike was used for additional grip when maneuvering the gun carriage. It is not visible on the main picture of the gun.

LUGER ARTILLERY PISTOL

A WORLD IN CONFLICT

1880–1945

Designers and manufacturers in Europe and North America continued to develop new and ever more efficient military firearms. The 1880s and 1890s saw the arrival of the modern machine-gun, smokeless powder, the first self-loading military rifle, self-loading pistols, and artillery of the types that would be responsible for the carnage of World War I. In the years between the world wars, and during World War II, many new types of rapid-fire, higher-velocity, and longer-range firearms were created and adopted into service throughout the Western world.

TURNING POINT

SMOKELESS POWDER

In 1884, the French chemist Paul Vieille invented a new propellant—"smokeless powder." Unlike gunpowder—the propellant used universally up to this point—smokeless powder did not obscure the battlefield or give away a concealed shooter's position. Being smokeless also meant that it left little residue to clog the barrels and actions of guns. Also, crucially, it burned more slowly and generated greater power. These advantageous properties combined to have a profound effect on the development of firearms. A key step was the creation of the first machine-gun—the Maxim gun (see pp.184–85).

5.56MM-CALIBER CARTRIDGE

▲ **SMOKELESS POWDER**
All modern cartridges, such as this 5.56mm NATO, contain smokeless powder as a propellant. Smokeless powder is composed of a mixture of nitrocellulose and other chemicals. It is shaped into thin flakes before being loaded into the cartridges.

Gunpowder, or black powder, was a mix of saltpeter, sulfur, and charcoal. It produced thick white smoke on burning, obscured targets, and clogged up the barrels and mechanisms of guns. Highly combustible, it could explode when unconfined, leading to accidents. These problems were overcome with Vieille's smokeless powder, with the added bonus of more power.

> "... as they used **smokeless** powder, it was **almost impossible** to see them..."
>
> *THEODORE ROOSEVELT,* **ON THE SPANISH IN THE SPANISH–AMERICAN WAR (1898)**

USING SMOKELESS POWDER

The French government was the first to take advantage of the remarkable ballistic properties of smokeless powder, developing the *Le fusil de 8mm Modèle 1886*—the Lebel rifle—named after the designer of its cartridge, Colonel Nicholas Lebel of France. This true modern rifle used Lebel's 8mm cartridge with a lead bullet encased in a jacket of cupro-nickel or copper, containing the smokeless propellant. It was faster and weighed less than its predecessors. The cartridge had a flat nose so that it would be safe nose-to-tail in the tubular magazine (see p.116) of the Lebel rifle.

NEW WEAPONS

In conjunction with the metallic cartridge (see pp.112–13), smokeless powder spurred the development of powerful firearms, notably machine-guns such as the Maxim gun (see pp.184–85), and new forms of artillery with greatly improved performance. It left little residue, which allowed the bore and workings of guns to be built to a perfect fit, making weapons such as infantry rifles more accurate. There was also less risk of a bullet jamming in the bore, which would be disastrous with a gun firing several rounds per second. Smokeless powder also provided more propulsive force than the same amount of gunpowder, which significantly increased the effective range of weapons as faster projectiles had a flatter trajectory. It burned clean with little smoke, giving shooters a clear field of vision and allowed them to fire shots with a fair amount of accuracy while hidden from view.

By the turn of the century, bullet designs had begun to be refined to exploit the properties of this new propellant. Captain Desaleux's solid brass pointed (spitzer) bullet used smokeless powder and had a tapering "boat-tail," which increased its velocity, giving it a flatter trajectory and improving its long-range performance. It was the first bullet of its type to be placed into service by any army and it heralded the development of modern bullets.

Smokeless powder was seen in action in the battles in and around Colenso (1899–1900) on the Tugela River in the second Anglo–Boer War.

» BEFORE

Gunpowder burned fast, coating the bores and actions of guns with a thick layer of "fouling." Also, when exposed to moisture in the air, this "fouling" corroded the insides of the barrels.

GUNPOWDER

- **DIFFICULTY IN PINPOINTING ENEMIES** on the battlefield through billowing smoke made it difficult to gauge tactics and plan countermeasures.
- **ACCUMULATION OF FOULING**, or residue, in a gun's barrel would make the gun increasingly inaccurate and reduce its range. Severe fouling could jam the gun's action, or cause a bullet to get jammed in its bore.
- **FURTHER DEVELOPMENT** of firearms was impeded by limitations in gunpowder's ballistic and chemical properties.

KEY **FIGURE**

Paul Marie Eugène Vieille
(1854–1934)

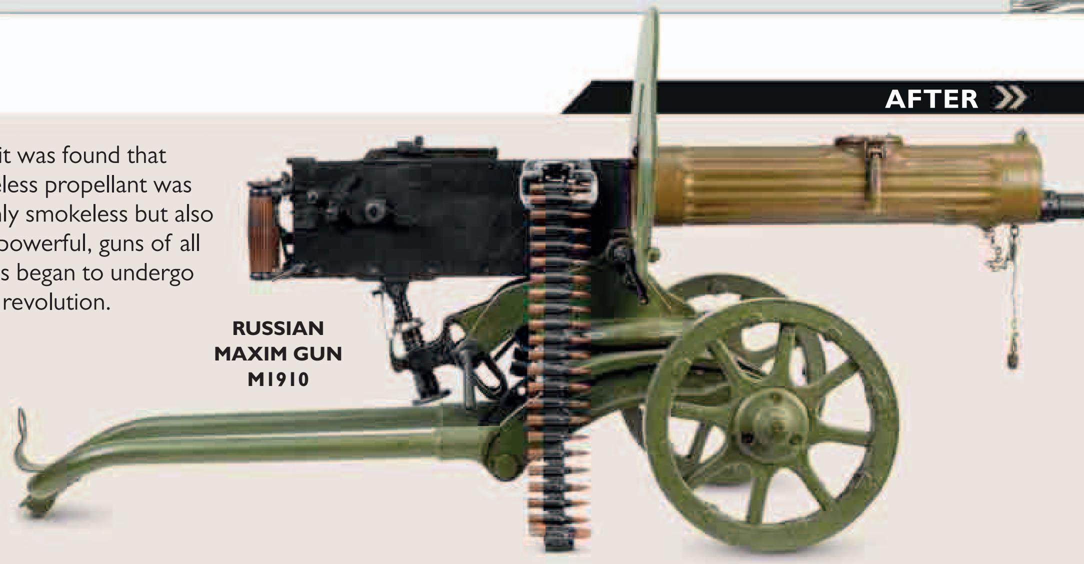
Paul Vieille was a chemistry graduate of Ecole Polytechnique. He became director of the "Laboratoire Central des Poudres et Salpetres" in Paris as well as a member of the French Academy of Sciences. In recognition of his invention of smokeless powder, he was awarded the Leconte prize of 50,000 Francs by the French Academy of Sciences in 1889.

Its use by the Boers was a very important factor in the defeat of the British forces because it was impossible for the British to locate the Boers' weapons. Around the same time, in the Spanish–American War (1898), some of the US troops were still using mainly gunpowder-driven single-shot rifles and struggled against the Spanish, who were armed with magazine-loading rifles and smokeless-powder cartridges. While hidden from view, the Spanish were able to target the US soldiers easily, without giving away their own positions.

Smokeless powder prompted the development of guns large and small with power undreamed of a decade earlier. Long-range rifles and machine-guns became a reality and would change the face of warfare in the decades to come.

AFTER »

Once it was found that smokeless propellant was not only smokeless but also more powerful, guns of all natures began to undergo a new revolution.



RUSSIAN MAXIM GUN M1910

- **RIFLES WITH FAR GREATER POWER** evolved, firing new bullets that traveled much faster, with ranges of 1 mile (1.6km) or more and the ability to inflict much more damage.
- **LONG-RANGE BATTLES** could be fought, and even though visibility was improved in the absence of thick smoke, enemies became more difficult to spot and concealment became more important.
- **A NEW BREED OF FIREARMS** evolved, made possible by smokeless powder. These included the first fully automatic weapon—the Maxim gun.
- **THE INCREASE IN FIREPOWER** combined with simplicity in function and manufacture began the age of modern firearms and artillery, which continues today.

▼ WINNING SAN JUAN HILL
In the Battle of San Juan Hill in the Spanish–American War (1898), American soldiers (in the foreground) suffered heavy casualties under fire from Spanish forces, who stayed hidden with their use of smokeless powder. Tactical errors, however, eventually forced the Spanish to retreat.

MANUALLY OPERATED REPEATING RIFLES (1880–88)

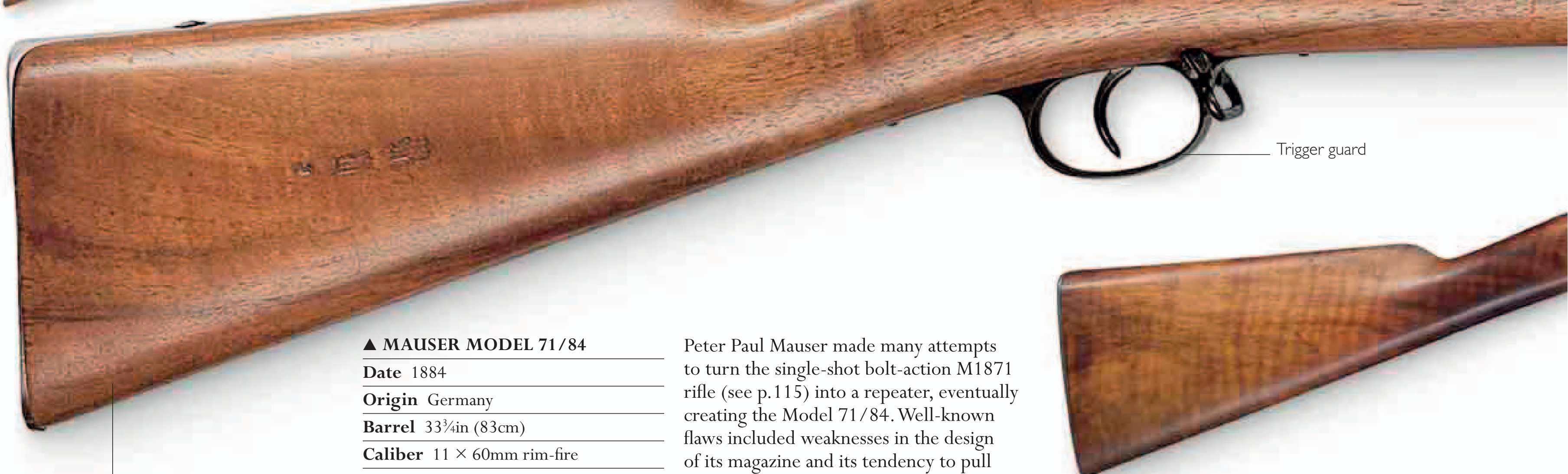
By the end of the 1870s, military authorities in most of Europe and North America had realized the benefits of effective repeating rifles—those that fired multiple rounds from a magazine. Most of them had also recognized that the bolt-action breech mechanism (see p.114) offered the best design for military use, although lever-action rifles continued to be employed. Bolt-action designs were very robust, allowing the use of powerful metallic cartridges, and were not easily put out of action by adverse weather conditions or harsh use. Furthermore, they could be adapted to take different types of magazine. A fascinating variety of tubular and box magazines soon appeared.

▲ **KROPATSCHEK GENDARMERIE CARBINE**

Date	1878–79
Origin	Hungary
Barrel	29in (73.6cm)
Caliber	11mm

Designed by Alfred Ritter von Kropatschek, a general in the Austrian Army, this rifle was adopted by France and Hungary in 1878. It had a tubular brass magazine built within the forestock for holding six cartridges. Tubular magazines would gradually give way to box magazines, which became more popular.

FULL VIEW



▲ **MAUSER MODEL 71/84**

Date	1884
Origin	Germany
Barrel	33¾in (83cm)
Caliber	11 × 60mm rim-fire

Peter Paul Mauser made many attempts to turn the single-shot bolt-action M1871 rifle (see p.115) into a repeater, eventually creating the Model 71/84. Well-known flaws included weaknesses in the design of its magazine and its tendency to pull to the right. This gun eventually fell out of use in 1888.

▲ **INFANTERIE GEWEHR M1888**
Date 1888
Origin Germany
Barrel 29in (74cm)
Caliber 7.92 × 57mm

When it came to replacing the M71/84 (below), the German Army set up a specification commission, but the characteristics of the new 7.92mm ammunition had been misunderstood. The resulting M1888 rifle suffered from many burst barrels. In addition, the box magazine was a poor design; it was never rectified.

▲ **KRAG-JØRGENSEN M1888**
Date 1888
Origin Norway
Barrel 30in (76.2cm)
Caliber 6.5 × 55mm

Many held that the M1888 was obsolete before it was adopted by the Danish Army, because its five-round magazine had to be hand-loaded, one round at a time, and its bolt's single locking-lug limited it to low-velocity ammunition. It came as a surprise, even to its inventors, that it was also adopted by both the US and Norwegian armies.

▲ **LEE-METFORD MARK 1**
Date 1888
Origin UK
Barrel 30¼in (76.9cm)
Caliber .303in

The Lee-Metford began a prestigious lineage of British bolt-action rifles. The name derives from the inventor of its action, James Lee, and the designer of the rifled barrel, William Metford. It featured an eight-round box magazine and was chambered for the powerful .303in cartridge. The rifle also had a set of "Extreme Range Sights" on its left side, optimistically graduated out to 3,500 yards (3,200m).

MANUALLY OPERATED REPEATING RIFLES (1889–93)

By the final decade of the 19th century, the military authorities in all Western countries had adopted bolt-action repeating rifles for their infantry and other forces. These rifles were either of their own design or manufactured for them by major international arms companies. A reduction in caliber, and increase in range and velocity were features of this period. Rifles of this time, however, continued to use standard gunpowder, or "black powder," as the primary propellant. This caused difficulties, such as obscuring of targets and fouling of barrels when a gun was fired. The French Lebel rifle leaped ahead in being the first small-caliber, high-velocity military rifle to use smokeless ammunition.

▲ **CAVALRY CARBINE MODELLO 1891 TS**

Date	1891
Origin	Italy
Barrel	17¾in (45cm)
Caliber	6.5 × 52mm

This gun was often known as the Mannlicher-Carcano. It continued, in modified form, in Italian service until after World War II, and many units were sold to dealers in the US; one found its way to Lee Harvey Oswald, who allegedly used it to kill President John F. Kennedy in 1963.

▲ **SCHMIDT-RUBIN M1889**

Date	1889
Origin	Switzerland
Barrel	30¾in (78cm)
Caliber	7.5 × 55mm

In 1889, Colonel Rudolf Schmidt of the Swiss Army developed a straight-pull bolt-action rifle, similar to the M1895 (see p.149), with a 12-round box magazine. It was accepted as the regulation rifle and remained in service, only slightly modified, until 1931, when its bolt action was rejigged to operate in half the length. The modified version was only discarded in the late 1950s, and a sniper's version was in use until 1987.

▲ MOSIN-NAGANT M91	
Date	1891
Origin	Imperial Russia
Barrel	31½in (80.2cm)
Caliber	7.62 × 54mm

The "3-line," as it was called, was Imperial Russia's first repeater rifle and its first in a modern caliber. The "line" was a measure approximating one-tenth of an inch and refers to its caliber.

▲ STEYR M1893 CAVALRY CARBINE	
Date	1893
Origin	Austria
Barrel	18in (46cm)
Caliber	6.5mm

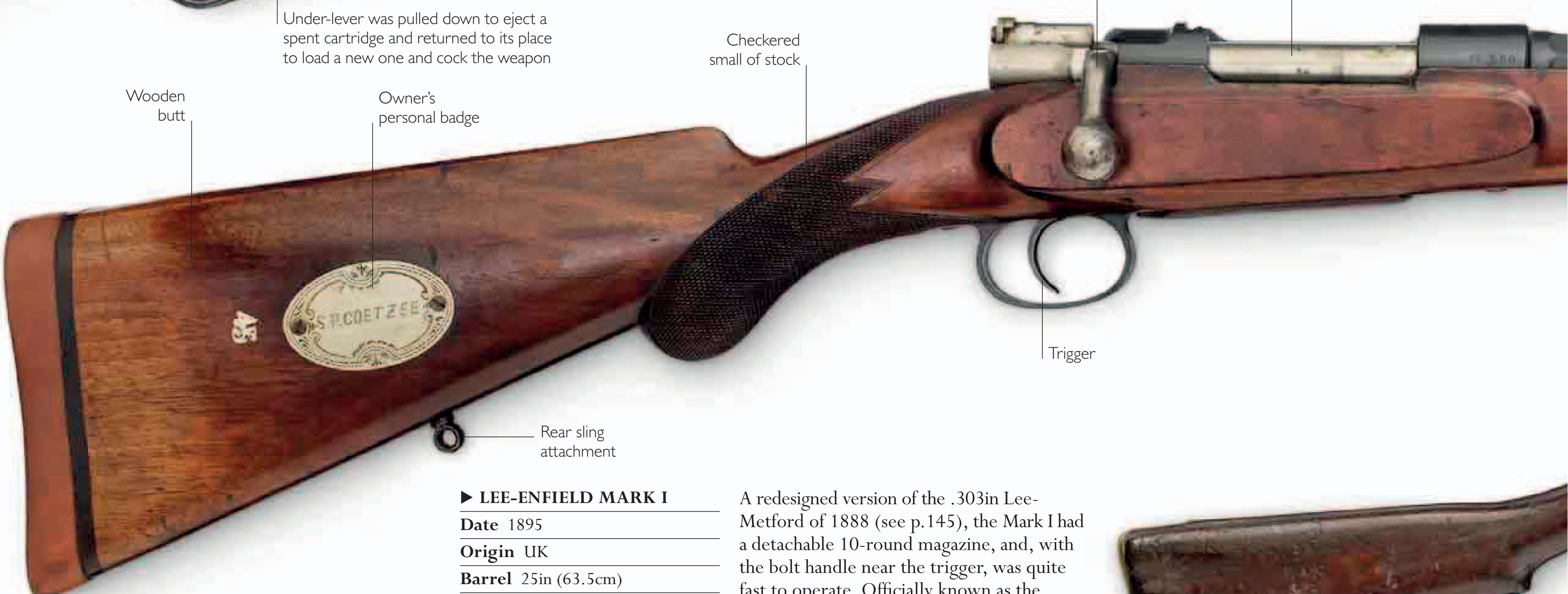
The Austrian national arms factory, Steyr, produced 14,000 carbines of this design for Romania, which were delivered before the outbreak of World War I. Designed by Ferdinand Ritter von Mannlicher, they had a turning bolt, rather than Mannlicher's straight-pull breech mechanism (see p.149), and a single-column five-round box magazine, loaded by clip.

▲ LEBEL MLE 1886/93	
Date	1893
Origin	France
Barrel	31½in (80cm)
Caliber	8 × 50mm

In 1885, Georges Boulanger was appointed to the ministry of war in Paris. One of his first priorities was to introduce a modern rifle. The result was the first rifle firing a small-caliber, jacketed bullet propelled by smokeless powder (invented by Meille in 1884.) Despite being mechanically unsophisticated, it rendered every other rifle in the world obsolete. This modified version followed in 1893.

MANUALLY OPERATED REPEATING RIFLES (1894–95)

Rifle designers constantly sought greater performance, accuracy, and durability, and continued to experiment with designs for breech mechanisms and magazines. Steyr Mannlicher (see pp. 290–91), for example, designed a successful mechanism that required the handle only to be pulled directly backward in order to revolve and unlock the bolt. Meanwhile, in lever-action rifles, Winchester (see pp. 116–17) developed a complex mechanism in which a box magazine descended with the under-lever.



▶ **LEE-ENFIELD MARK I**

Date	1895
Origin	UK
Barrel	25in (63.5cm)
Caliber	.303in

A redesigned version of the .303in Lee-Metford of 1888 (see p. 145), the Mark I had a detachable 10-round magazine, and, with the bolt handle near the trigger, was quite fast to operate. Officially known as the ".303in caliber, Rifle, Magazine, Lee-Enfield," its name was often shortened to MLE, sometimes spoken as "Emily."

▲ MANNLICHER MODEL 1895

Date	1895
Origin	Austria
Barrel	30in (76.5cm)
Caliber	8 × 50mm

The straight-pull bolt-action M1895 was the work of Ferdinand Ritter von Mannlicher, and used a rotating locking lug that turned in a camming (spiraled) groove. Simply pulling the bolt handle straight backward caused the bolt to rotate, unlock and slide back, and open the breech. Pushing the handle forward advanced the bolt, making it pick up a cartridge, before rotating and locking. Ammunition was fed from a fixed box magazine that Mannlicher also designed. The rifle was used widely throughout the Austro-Hungarian Empire.

▼ WINCHESTER MODEL 1895

Date	1895
Origin	US
Barrel	30in (76cm)
Caliber	.30in

Winchester joined the list of manufacturers making repeating rifles, and its repeaters used classic tubular magazines. This lever-action model, however, broke with tradition by having a box magazine. Military sales of the 1895 were strong, particularly to Russia, which bought over 290,000 between 1915 and 1917.

FULL VIEW

▲ MAUSER PLEZIER 1895–97 DELUXE

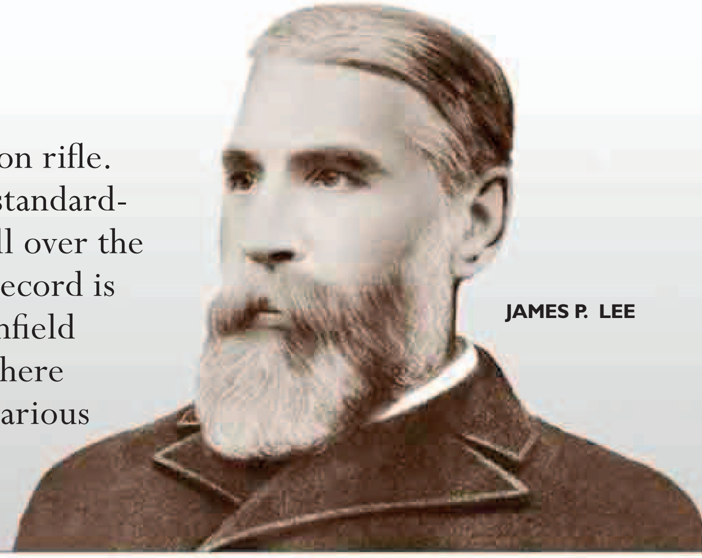
Date	1895–97
Origin	Germany
Barrel	28in (71cm)
Caliber	7 × 57mm

The influential German manufacturer Mauser (see pp.164–65) was a major supplier of rifles to the Boers in South Africa, and a very popular rifle was the Model 1895. Both military rifles and those made up as *Plezier* ("pleasure") sporting rifles saw combat in the hands of the Boers in the Second Boer War (1899–1902).

GREAT GUNSMITHS

LEE-ENFIELD

In 1895, the British Army adopted Lee-Enfield's bolt-action rifle. In various forms, this weapon was to remain the British Army's standard-issue rifle until 1957. It would see action in countless conflicts all over the world and is still used by police in some countries. This unique record is due largely to the brilliance of designer James P. Lee. The Lee-Enfield guns are named after him and the London borough of Enfield, where the original Lee-Enfield rifle was designed and where it and its various derivatives were produced at the Royal Small Arms Factory.



JAMES P. LEE

James P. Lee was a Scottish-born inventor and firearms designer who emigrated to Canada and worked in the US, where he made important advances in rifle and magazine design. His work came to the attention of the British Army in 1888, when they adopted the Lee-Metford rifle, which combined a bolt action designed by Lee and a barrel created by William Ellis Metford. Users were impressed with the Lee-Metford, which had a "cock-on-closing" action that allowed very rapid firing. When the weapon was used with smokeless powder (see pp.142–43), however, the rifling in the barrel wore rapidly. The search was soon on for a replacement.

RAPID FIRE

The problem with the Lee-Metford was that the smokeless propellant generated additional heat and pressure, which damaged the barrel's shallow, rounded rifling. The solution lay in a new type of rifling with a square shape, devised at the Royal Small Arms factory at Enfield. When barrels with

▼ **BRITISH SOLDIERS**
During World War I, hundreds of thousands of British infantrymen, on the Western front and elsewhere, carried Lee-Enfield rifles. Soldiers affectionately referred to their SMLEs as "smellies."

SMLE MARK III WITH WIRE-CUTTER ATTACHMENT

RIFLE NO 5 MARK I "JUNGLE CARBINE"

1879 James P. Lee develops a bolt-action, magazine-fed rifle; successful in its own right, this design attracts the interest of the British Army in 1888.

1895 The British Army adopts the Magazine, Lee-Enfield (MLE) rifle.

1907 The SMLE Mark III is introduced.

1914 British Army Sergeant Instructor Alfred Snoxall sets the world record for rapid fire, with 38 aimed rounds in a minute.

1915 Because the SMLE Mark III is quite complex to manufacture, the simpler SMLE Mark III is developed to fulfill the high rate of demand during World War I.

1939 The No. 4 Rifle is designed to be easy to mass-produce; its spike bayonet is known to soldiers as the "pig-sticker."

1943 A very quiet, suppressed version of the Lee-Enfield rifle, the De Lisle Carbine, is produced for British commando troops during World War II.

1944 The need for a short, lightweight rifle spurs the creation of the Rifle No. 5 Mark I, known as the "Jungle Carbine."

the new-style rifling were combined with Lee's rapid-firing bolt action in 1895, the new Lee-Enfield rifle was born. Lee's cock-on-closing action, in which the forward thrust of the bolt cocks the action, was faster than that of the Mauser Model 1898, which cocked on opening. The Lee-Enfield design also placed the bolt handle over the trigger, near to the user's hand, again making it faster to operate. A detachable 10-round magazine kept the weapon supplied with ammunition. Military commanders were initially sceptical about the removable magazine—they feared that soldiers would lose this vital piece of equipment in the heat of battle, and some early Lee-Enfields had a length of thin chain to keep the magazine tethered to the gun. Subsequent versions had a charger, or "stripper clip," loading system that did away with the need for the detachable magazine, while allowing the operator to load and fire at speed. The rate of fire possible with Lee-Enfield rifles was impressive and surprised Britain's enemies in World War I. There are accounts of German troops attacked by fire from Lee-Enfields mistaking this for machine-gun fire. This was borne out in target shooting, when skilled marksmen could hit a target at 300 yards (270m) more than 30 times a minute, and even inexperienced soldiers could achieve a rapid rate of fire.

VERSATILITY AND USE

The original Lee-Enfields were impressive, but many wanted a more accurate weapon that was also lighter. The manufacturers at Enfield responded with shorter and lighter models offering charger-loading and improved sights. The Army designated these firearms Rifle, Short, Magazine, Lee-Enfield (SMLE rifle for short). The SMLE Mark III,

▲ MODERN CONFLICTS
An Afghan soldier holds a 1902 Lee-Enfield rifle found during a joint US and Afghan Army raid in 2002 in Kunar province, Afghanistan.

introduced in 1907 and used throughout World War I, was the best-known of them. The way these Lee-Enfields combined a user-friendly layout with the ability to fire rapidly piqued the interest of many users, and the guns spread around the British Empire and beyond. Users also realized that the basic design—and later models that were simpler and easier to manufacture—could be modified for a range of uses. Many were converted to .22in caliber so that they could act as training rifles firing inexpensive ammunition. Others, with the addition of features such as cheek pieces and telescopic sights, became sniper rifles. Conversions to automatic or semiautomatic loading were also carried out. Both the versatility of the original rifles and the various conversions have helped to keep the Lee-Enfield popular globally. It is widely used by police forces, for hunting, and for target shooting, and Lee-Enfields (or copies of the weapons) are still found in combat. The history of the Lee-Enfield is one of the greatest success stories in the world of firearms.

> "It was a **rifle light and handy**, accurate at short and at long ranges and... capable of a remarkable rate of fire."

LIEUTENANT-COLONEL LORD COTTESMORE **ON THE LEE-ENFIELD .303IN MAGAZINE RIFLE**

MANUALLY OPERATED REPEATING RIFLES (1896–1905)

Many countries designed and introduced into military service their own varieties of bolt-action repeating breech-loaders. Those of Mauser (see pp. 164–65) from Germany, however, were regarded as especially robust, accurate, and serviceable. Countries sought to purchase their rifles from Mauser, from other manufacturers making Mauser rifles under license, or, as in the case of the US, were sufficiently influenced by the quality of the design that they acquired rights to manufacture their own version.

▲ MAUSER MODEL 1896

Date 1896

Origin Germany

Barrel 29¼in (74cm)

Caliber 6.5 × 55mm

Waffenfabrik Mauser began exporting rifles to China in 1875; then came the Mauser-Koka, for Serbia; the Belgian M1889; the Turkish M1890; the Argentine M1891; and the Spanish M1893. The world's armies seemed to be beating a path to Mauser's door. Mauser began manufacturing the Model 1896 for Sweden in 1895. Licensed Swedish production of the rifle continued until 1944.

▼ ARISAKA MEIJI 30

Date 1897

Origin Japan

Barrel 31½in (79.8cm)

Caliber 6.5 × 50mm

At the conclusion of its war with China in 1895, the Japanese Army decided to adopt a modern rifle in a small caliber. Designed by Colonel Nariakira Arisaka, this gun was chambered for a 6.5mm semi-rimmed round and used a turning bolt of the Mauser pattern with forward-locking lugs. It came into service in the 30th year of the Emperor Meiji.

▼ MAUSER MODEL 1898

Date 1898

Origin Germany

Barrel 29¼in (74cm)

Caliber 7.92 × 57mm

By the time of the *Gewehr* (rifle) 98, Mauser had solved virtually every problem known to beset the bolt-action magazine rifle. It added a third rear-locking lug to reinforce the two forward-mounted lugs, as well as improving gas sealing and refining the magazine. If the rifle had a fault, it lay in the design of its bolt handle, which projected outward and tended to catch on clothing.

◀ MAUSER MODEL 1893

Date 1900

Origin Germany

Barrel 29¼in (74cm)

Caliber 7 × 57mm

The Mauser 1893 was the seminal Spanish Mauser rifle of the late 1800s. Such was its effectiveness during the Spanish–American War that it pushed the US toward development of the Springfield rifle (below). The 1893 was fed from a five-round integral box magazine. The example shown here was manufactured in 1900.

◀ SPRINGFIELD MODEL 1903

Date 1903

Origin US

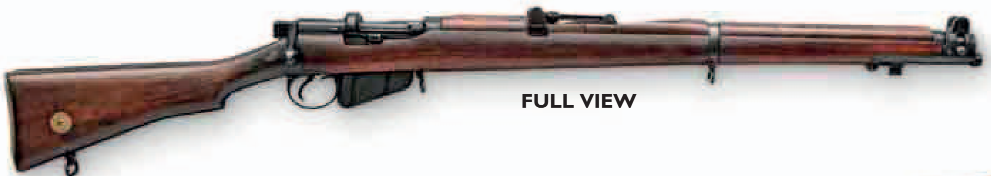
Barrel 24in (61cm)

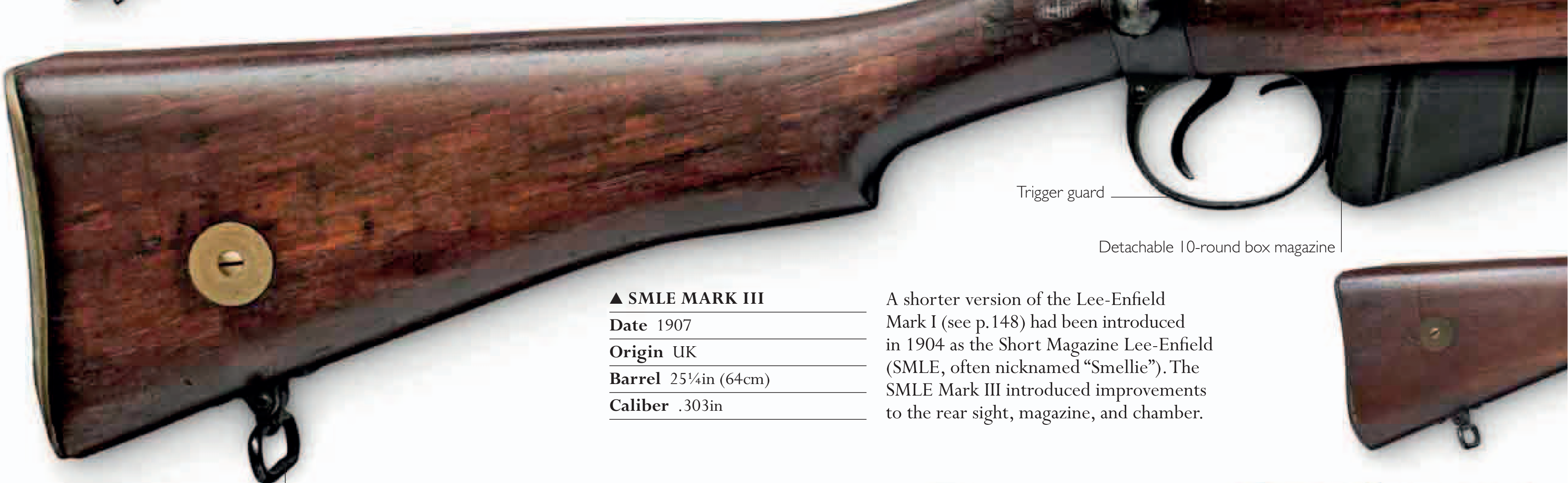
Caliber .30in-03

Impressed by the Mauser rifles US troops encountered during the war against Spain, the United States Ordnance Department looked to replace its Krag rifles (see pp.62–63). Negotiating a license to build a Mauser design of its own, the result was the .30in Rifle, Magazine, M1903. The example shown here has an experimental 25-round magazine.

MANUALLY OPERATED REPEATING RIFLES (1906–16)

By the end of the 19th century, bolt-action repeating rifles were in almost universal military use, but each country sought to refine and improve its own rifle. France, for example, replaced the outmoded Lebel rifle with a more modern, but still flawed, design in the form of the Berthier. The British Lee-Enfield Mark I rifle was shortened to make it handier. Although France and Britain planned more refined smaller-caliber rifles, the arrival of World War I meant that the standard caliber of .303in was retained. Even before the outbreak of war in 1914, however, the trend toward shorter-barreled rifles.

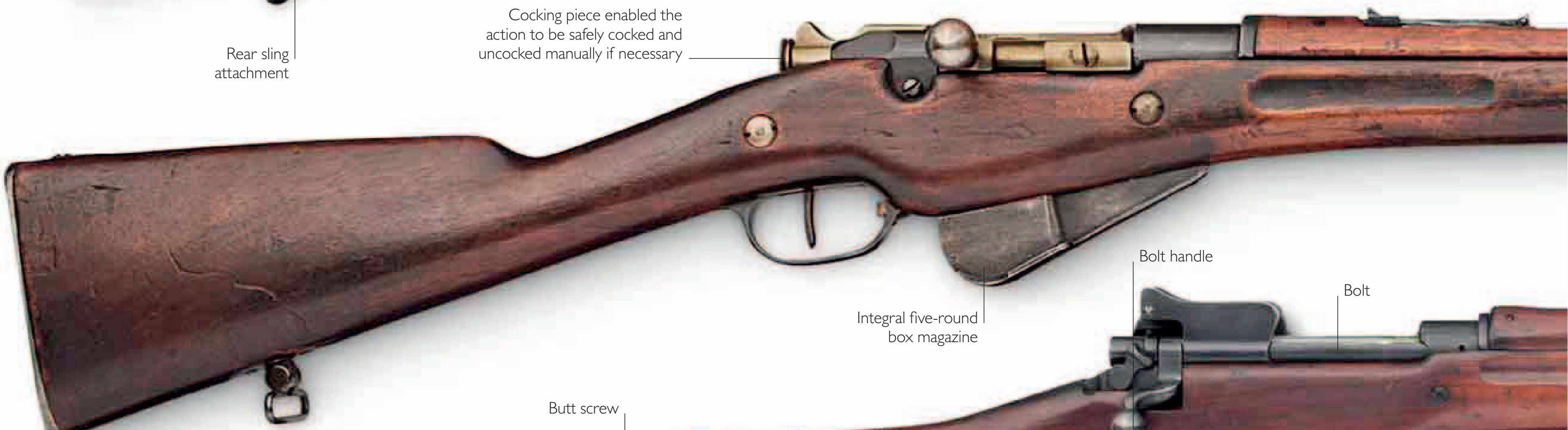




▲ SMLE MARK III

Date	1907
Origin	UK
Barrel	25¼in (64cm)
Caliber	.303in

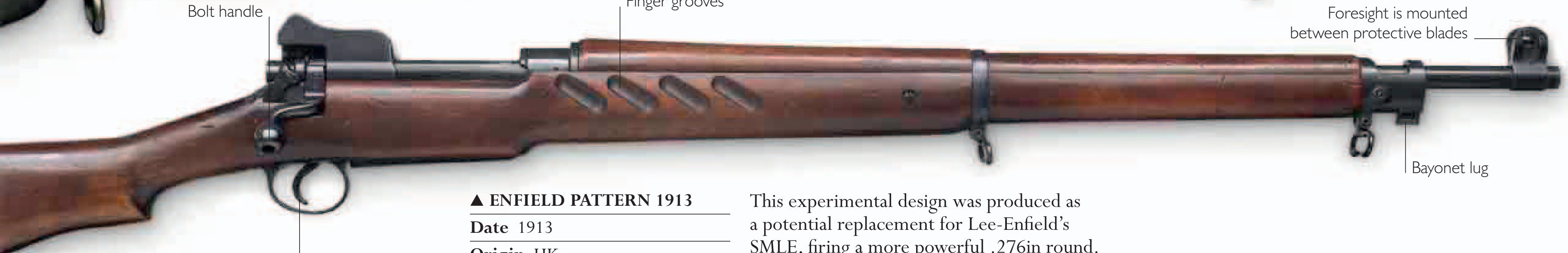
A shorter version of the Lee-Enfield Mark I (see p.148) had been introduced in 1904 as the Short Magazine Lee-Enfield (SMLE, often nicknamed "Smellie"). The SMLE Mark III introduced improvements to the rear sight, magazine, and chamber.



▲ BERTHIER CARBINE

Date 1907
Origin France
Barrel 15in (38cm)
Caliber 8mm

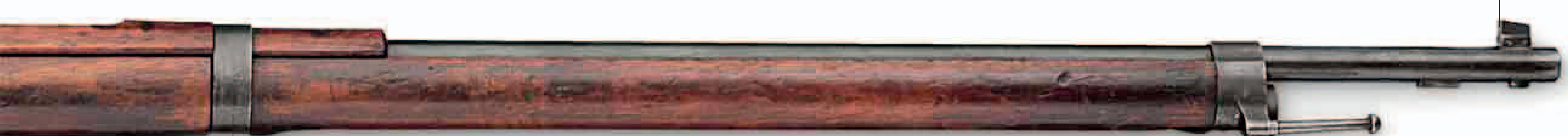
The French military authorities replaced the tubular-magazine Lebel rifle (see p.147) with the Berthier carbine, which used the same bolt mechanism but had a box magazine. Its capacity of only three rounds, however, was a major flaw. The carbine was first introduced into service in 1902. This example was built in 1907.



▲ ENFIELD PATTERN 1913

Date 1913
Origin UK
Barrel 26in (66cm)
Caliber .276in

This experimental design was produced as a potential replacement for Lee-Enfield's SMLE, firing a more powerful .276in round. At the start of World War I, manufacturing problems with this new Pattern 1913 rifle resulted in a further change in caliber.



▲ BERTHIER MLE 1916

Date 1916
Origin France
Barrel 31½in (79.8cm)
Caliber 8 × 50mm

Although the Berthier carbine (top) continued to use the bolt action of the Lebel, it was outmoded in appearance, due to the length of its barrel. However, its only serious defect lay in its limited magazine capacity. Seen here is a modified version issued in 1916, with an enlarged five-round magazine.

▲ ENFIELD PATTERN 1914

Date 1914
Origin UK
Barrel 26in (66cm)
Caliber .303in Mauser

Around the onset of World War I, the Pattern 1913 rifle was modified to use the .303in chambering, and the weapon was redesignated as the Pattern 1914. The Model 1917, a .30in-caliber version of the Pattern 1914, was later adopted by the US Army.

MANUALLY OPERATED REPEATING RIFLES (1917–45)

The experience of World War I had severely tested military rifles in service throughout the world. Most had stood up to combat conditions well, and when World War II loomed, most rifles still had the bolt-action mechanism recognizable from 50 years before. While the barrels of many had been reduced in length to make rifles lighter and handier, this had little adverse effect on their accuracy over fighting distances.

▲ ARISAKA YEAR 38/44 CARBINE

Date	1944
Origin	Japan
Barrel	18in (45.72cm)
Caliber	6.5mm

Introduced to Japanese service in 1907, the Arisaka Year 38 rifle was upgraded during World War II. This model is called the Year 38/44 Carbine because it was made in the 38th year of the reign of the Emperor Meji and was updated in 1944. This short carbine has a folding bayonet hinged beneath the muzzle.

▲ MAUSER KAR 98K

Date	1935
Origin	Germany
Barrel	23½in (60cm)
Caliber	7.92 × 57mm

The "Karabiner" 98K embodied improvements to the Mauser Gewehr 98 rifle (see p.153) and became the standard German service rifle of World War II. More than 14 million guns were manufactured between 1935 and 1945. A number of variations were produced, including those for mountain troops, paratroops, and snipers. During the war, the original design was simplified to speed up production.

▲ LEE-ENFIELD NO. 4, MK.1

Date	1939
Origin	UK
Barrel	25¼in (64cm)
Caliber	.303in

The new Lee-Enfield, which appeared late in 1939, differed very little from the model it replaced – the SMLE Mark III (see p.154). The bolt and receiver (the central body of the firearm containing the operating parts) were modified; the rear sight was a new design and was placed on the receiver and the forestock was shortened, exposing the muzzle. The Number 4 remained in service until 1954.

▼ ARISAKA TYPE 99

Date	1939
Origin	Japan
Barrel	25¾in (65.5cm)
Caliber	7.7mm

Japan's war experience showed that the 6.5mm round used in the Year 38 rifle was inadequate. The Type 99 used the more potent 7.7mm round. It was available in two versions, a short carbine (shown here) and a standard version, 6in (15.2cm) longer. An oddity of the Type 99 was a folding metal monopod support beneath the forestock (detached from this gun), although this was not rigid enough for its purpose.

▲ MOSIN-NAGANT CARBINE M1944

Date	1944
Origin	USSR
Barrel	20¼in (51.7cm)
Caliber	7.62 × 54mm

In 1910, the 3-line Mosin-Nagant rifle (see p.147) was modified to produce a carbine by shortening its barrel. In 1938, it was revamped, largely to make it cheaper to manufacture, and in 1944, it attained its final form with the addition of a folding cruciform bayonet. Though it was obsolete by that time, the People's Republic of China began manufacturing copies in 1953.

LARGE-SCALE PRODUCTION
By the 1860s, the Colt factory in Hartford, Connecticut, was the largest of its kind in the world. Employees carried out specific tasks in order, producing firearms on a large scale. Here, revolvers are being assembled in around 1917.

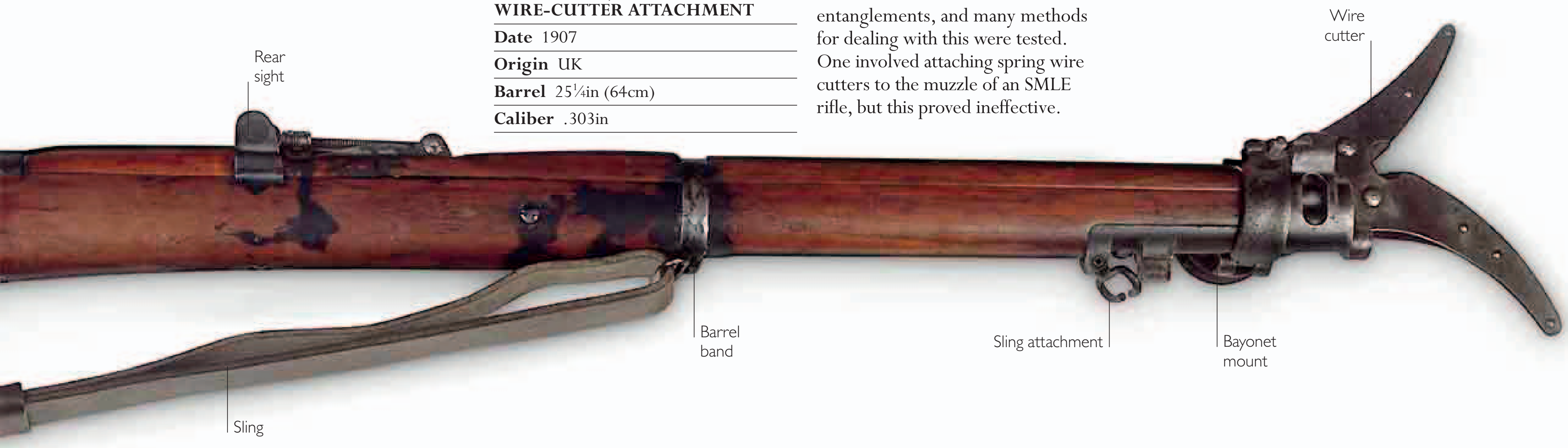
RIFLES FOR SPECIAL PURPOSES

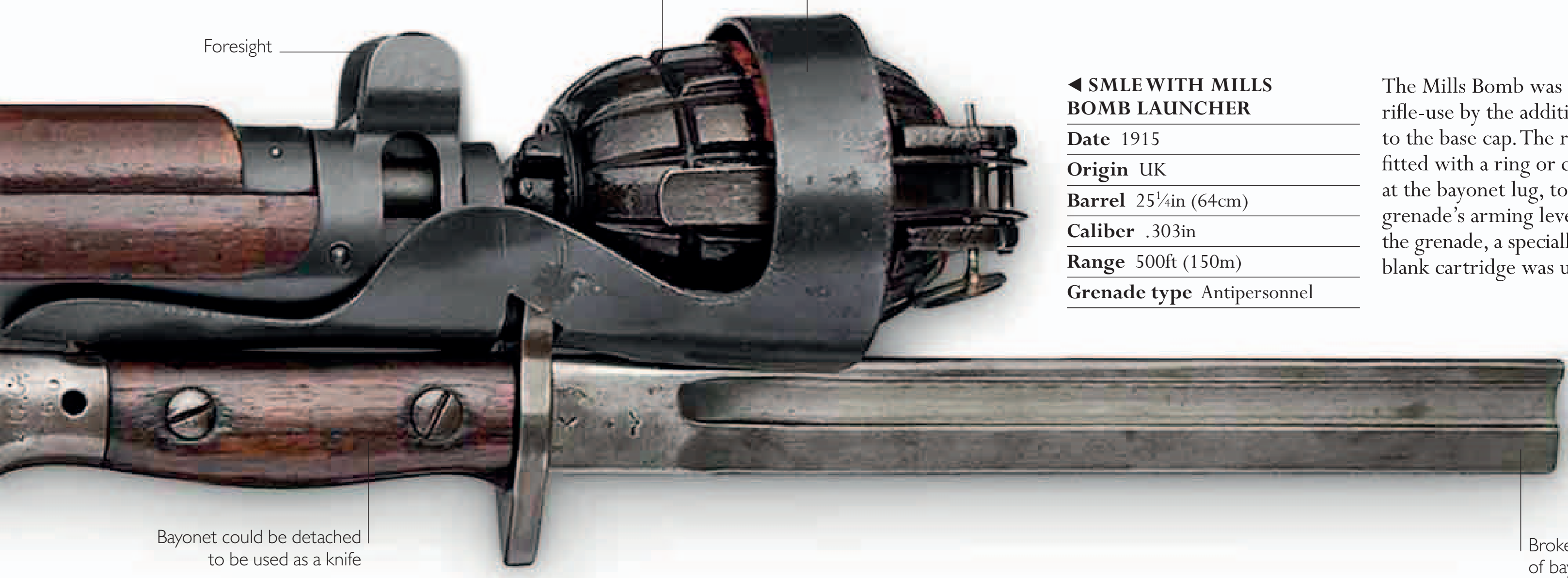
Difficulties encountered during World War I included barbed wire entanglements and the need to project grenades over longer distances than a man could throw. This spurred the combatant forces to develop new devices to deal with these challenges. Britain's Lee-Enfield rifle, for example, could be given special adaptations including cutters to enable infantrymen to penetrate barbed wire defenses, and a special cup to help fire a Mills Bomb (TNT-filled grenade) into enemy trenches.

▼ SMLE (SHORT MAGAZINE LEE-ENFIELD) MKIII RIFLE WITH WIRE-CUTTER ATTACHMENT

Date	1907
Origin	UK
Barrel	25¼in (64cm)
Caliber	.303in

The battlefields of World War I were festooned with barbed wire entanglements, and many methods for dealing with this were tested. One involved attaching spring wire cutters to the muzzle of an SMLE rifle, but this proved ineffective.

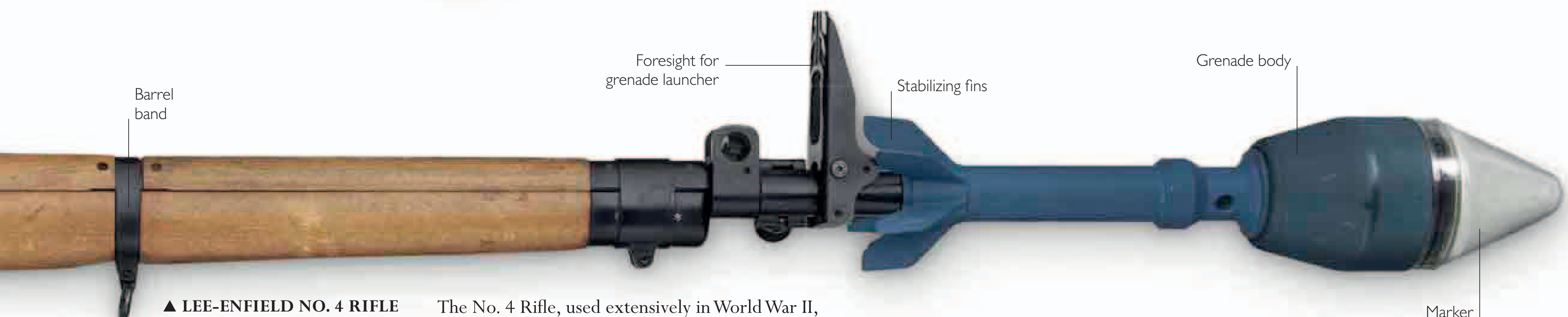




◀ SMLE WITH MILLS BOMB LAUNCHER

Date	1915
Origin	UK
Barrel	25¼in (64cm)
Caliber	.303in
Range	500ft (150m)
Grenade type	Antipersonnel

The Mills Bomb was adapted for rifle-use by the addition of a rod to the base cap. The rifle itself was fitted with a ring or cup, mounted at the bayonet lug, to retain the grenade's arming lever. To fire the grenade, a specially formulated blank cartridge was used.



▲ LEE-ENFIELD NO. 4 RIFLE WITH GRENADE LAUNCHER

Date	1940s
Origin	UK
Barrel	30in (76.2cm)
Caliber	.303in
Range	330ft (100m)
Grenade type	Antitank

The No. 4 Rifle, used extensively in World War II, had an exposed muzzle, which enabled the British Army to develop a new style of tubular launcher. The rifle could launch a fin-stabilized antitank grenade, which was mounted over its muzzle on the bayonet lugs. Using a powerful blank cartridge, it was fired with the butt of the rifle grounded. This example is equipped with a later model L1A1 practice grenade.

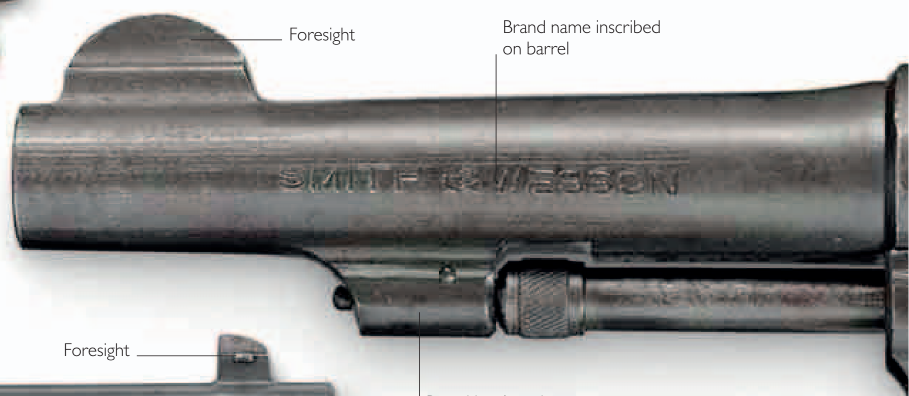
CENTER-FIRE REVOLVERS

Once revolvers adopted center-fire metallic cartridges (see pp.112–13), invented in the 1860s–70s, several basic designs of frame became established, and these were to remain almost consistent for a very long period. Solid frames with cylinders that hinged out sideways for reloading were most common. The user pushed the extractor rod to eject the cartridges. Alternatives included the Webley and Scott system, which extracted all the cartridges at once as the frame swung open. The strength, simplicity, and durability of a revolver meant that it could be deployed reliably in military, sporting, and self-defense roles. Earlier self-cocking and single-action designs gave way to a more universal use of the double-action mechanism, which provided the option for rapid fire or for cocking the revolver manually to aim with more precision.

▲ LEBEL MODÈLE 1892

Date	1892
Origin	France
Barrel	11¼in (28.6cm)
Caliber	8 × 27mm rim-fire

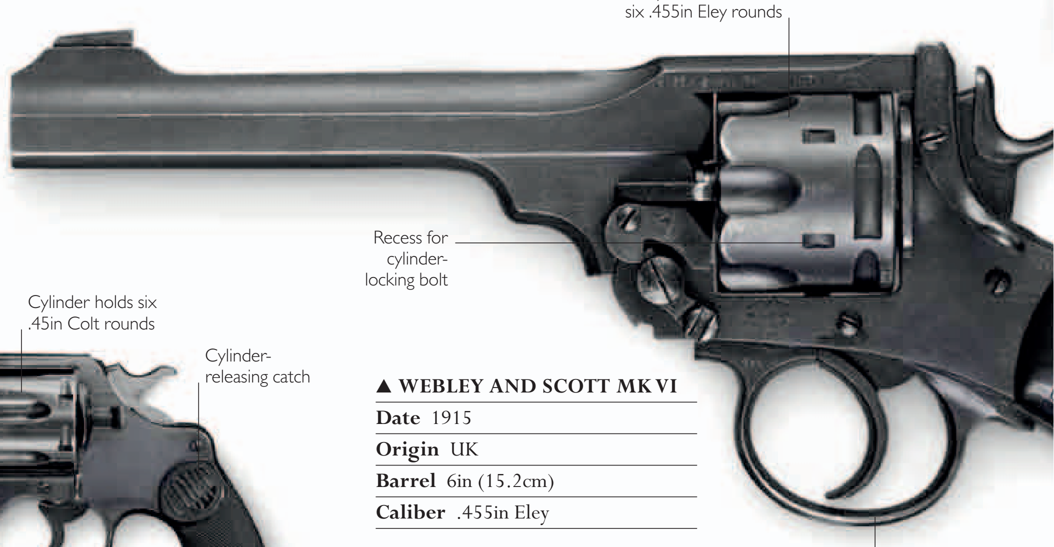
The double-action, solid-frame Lebel Modèle 1892 was loaded by means of a gate. It was used by the French Army in World War I.



▼ RAST AND GASSER M1898

Date	1898
Origin	Austria
Barrel	8¾in (22.3cm)
Caliber	.32in

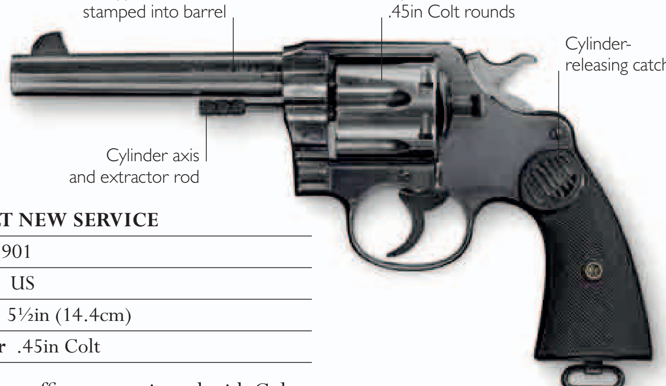
This solid-frame, double-action pistol was issued to soldiers in the Austro-Hungarian Army in World War I. Around 200,000 of them were produced from 1898 to 1912. In this design, the cylinder revolved around a fixed axle and cartridges were loaded and extracted one at a time through a rearward-hinging gate.



▲ WEBLEY AND SCOTT MK VI

Date	1915
Origin	UK
Barrel	6in (15.2cm)
Caliber	.455in Eley

The last in a long line of service revolvers produced by the famous Birmingham, England, partnership, the Mark VI was introduced early in World War I. This revolver, which took Eley cartridges, was renowned for its sturdy reliability. Its frame could hinge open to expose the rear face of the cylinder for rapid reloading.



▶ COLT NEW SERVICE

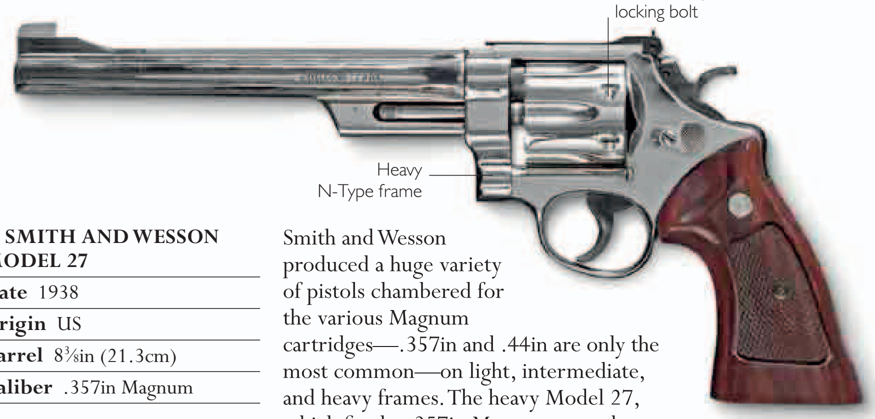
Date	1901
Origin	US
Barrel	5½in (14.4cm)
Caliber	.45in Colt

American officers were issued with Colt "automatics" beginning in 1902, but some felt that they were likely to jam. They preferred the last revolver produced for the US Army—the .45in-caliber double-action Colt New Service, which remained in service until 1941.

▲ SMITH AND WESSON M1917

Date	1917
Origin	US
Barrel	5½in (14.4cm)
Caliber	.45in ACP

During World War I, Smith and Wesson was commissioned to produce a revolver that chambered the .45in ACP round. This was the M1917. Although it was a success, it faced extraction problems unless the ammunition was loaded in flat half-moon clips, each carrying three rounds.



▶ SMITH AND WESSON MODEL 27

Date	1938
Origin	US
Barrel	8⅜in (21.3cm)
Caliber	.357in Magnum

Smith and Wesson produced a huge variety of pistols chambered for the various Magnum cartridges—.357in and .44in are only the most common—on light, intermediate, and heavy frames. The heavy Model 27, which fired a .357in Magnum, was the most popular model, and was produced with 4in (10.2cm), 6in (15.2cm), and 8⅜in (21.3cm) barrels.

▲ ENFIELD NO. 2 MARK 1

Date	1938
Origin	UK
Barrel	5in (12.7cm)
Caliber	.38in

After World War I, the British Army decided to adopt a lighter caliber for its service side-arm. The revolver it chose was almost a copy of the Webley and Scott MK VI (left). The version shown was issued to tank crews, and lacks a hammer spur to prevent it catching from on clothing in the confined spaces of a tank.

▲ SMITH AND WESSON MILITARY AND POLICE

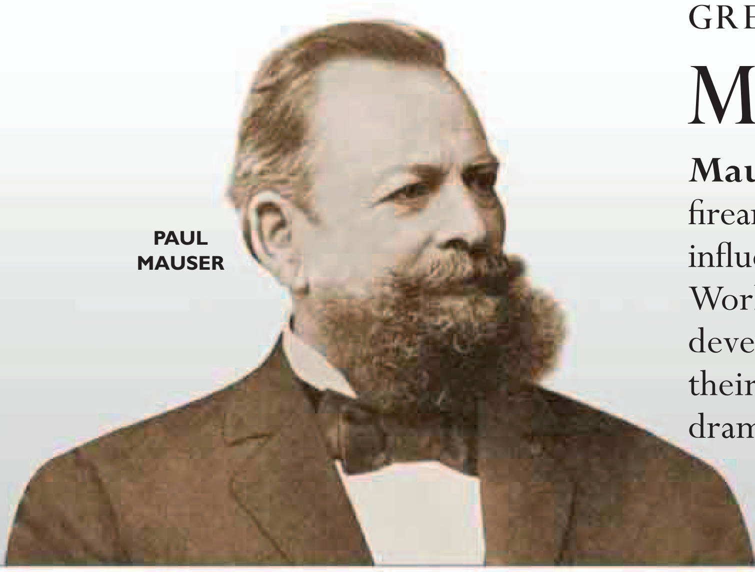
Date	1900
Origin	US
Barrel	5in (12.7cm)
Caliber	.38in Special

Having championed the hinged-frame revolver, Smith and Wesson, with the advent of more powerful ammunition, was obliged to switch to a solid frame with a swing-out cylinder for its Military and Police pistol. This was chambered for the long .38in Special round.

GREAT GUNSMITHS

MAUSER

Mauser is one of the most celebrated names in the history of firearms design. Although Paul Mauser, its creator, died in 1914, Mauser's influence was still clear in the design of many of the rifles in use during World War II. It was in the late 1800s and early 1900s that Paul Mauser developed a series of bolt-action rifles, weapons that became known for their ease of use and reliability. This helped them sell in large numbers, dramatically changing the way battles were fought.



PAUL MAUSER

Paul Mauser was born into a family of German gunsmiths and his father, Franz Andreas Mauser, worked at the Württemberg Royal Armory. Paul Mauser was drafted as an artilleryman in 1859 and did his military service at the arsenal at Ludwigsburg. Here, he was able to continue his trade as a gunsmith. At both the Royal Armory and at Ludwigsburg, the young Mauser found that the prevailing rifle was the Dreyse needle-fire rifle (see pp.108–09), a bolt-action weapon. Although the Dreyse rifle was widely used, Mauser wanted to improve it, in particular to eliminate problems such as gas blowback (caused by expanding gases created by the ignition of the propellant) and the gun's tendency to discharge accidentally. So from the 1860s onward, Mauser began to develop new bolt-action weapons to address these issues.

▲ **MODEL 1898**
German troops used this rifle very effectively in World War I. It replaced the Model 1888 rifle as the main rifle in service in Germany.

> "The **pistol** was the best thing in the world."
>
> *WINSTON CHURCHILL, FORMER PRIME MINISTER OF UK,* **ON THE MAUSER C.96**

TRANSFORMING WARFARE

Bolt-action rifles began to become popular in the 1860s and Mauser patented his first one in 1868. The advantages of the bolt action for loading a gun at the breech were immediately clear—it was reliable and easy to use, and because it did not have a downward-moving lever it could be fired and loaded more easily in a prone position than a lever-action rifle. Also, unlike muzzle-loading guns, it did not have to be loaded while standing up, making it safer to use in battle. Bolt-action weapons would gradually become more widespread. Mauser's weapons also used metallic cartridges. This overcame a major problem with the Dreyse needle-fire rifle, with its long, needlelike firing pin, which sometimes caused the weapon's paper cartridges to discharge accidentally when the bolt was being closed. However, all early Mausers were single-shot weapons and were at a marked disadvantage compared to the repeating rifles introduced by Winchester in 1866. Mauser began to design bolt-action rifles with a repeating action in which a cycle of the bolt loads the chamber for the next shot. The most successful of these was the Model 1898 (see p.153), which took five smokeless cartridges in a disposable charger (or stripper clip). Light and easy to use, the Model 1898 was one of the most successful rifles of its time, a reliable repeater that could be loaded and fired from a prone position and could stop an enemy advance in its tracks. Adopted by the German Army (where it was given the designation Gewehr 98), the rifle played a major part in World War I and set a high standard for other manufacturers to emulate.

◄ **GERMAN TROOPS WITH MAUSER RIFLES**
Seen here is a group of German troops in battle, in about 1916, aiming their Mauser Gewehr 98 rifles from a ruined building.

MAUSER MODEL 1871

MAUSER C.96

1871 The Model 1871 is the first rifle manufactured by Paul and his brother, Wilhelm Mauser.
1874 The Mausers purchase the Württemberg Royal Armory and begin to make 100,000 Model 1871 rifles for Württemberg's army.
1878 Mauser develops the Zig-Zag, the first German military revolver to employ modern brass cartridges.
1896 The distinctive grip of the C.96 semiautomatic pistol leads to its nickname, "Broom handle."
1898 The Model 1898, purchased by the German Army, becomes the most successful Mauser rifle.
1914 Paul Mauser dies, but the company continues to prosper, supplying weapons in large numbers during World War I.
1918 The Mauser 1918 T-Gewehr is the world's first antitank rifle.
1935 The K98k is adopted by German armed forces.
1948 The Mauser factory is dismantled after World War II, and engineers salvage some of the equipment for the company that will become known as Heckler and Koch.

▶ **YOUNG WINSTON**
The actor Simon Ward, playing Winston Churchill in the 1972 film *Young Winston*, carries a Mauser C.96 pistol. Winston Churchill used this gun in the Sudan and during the Boer War, and it became his favorite weapon.

THE PISTOLS OF MAUSER

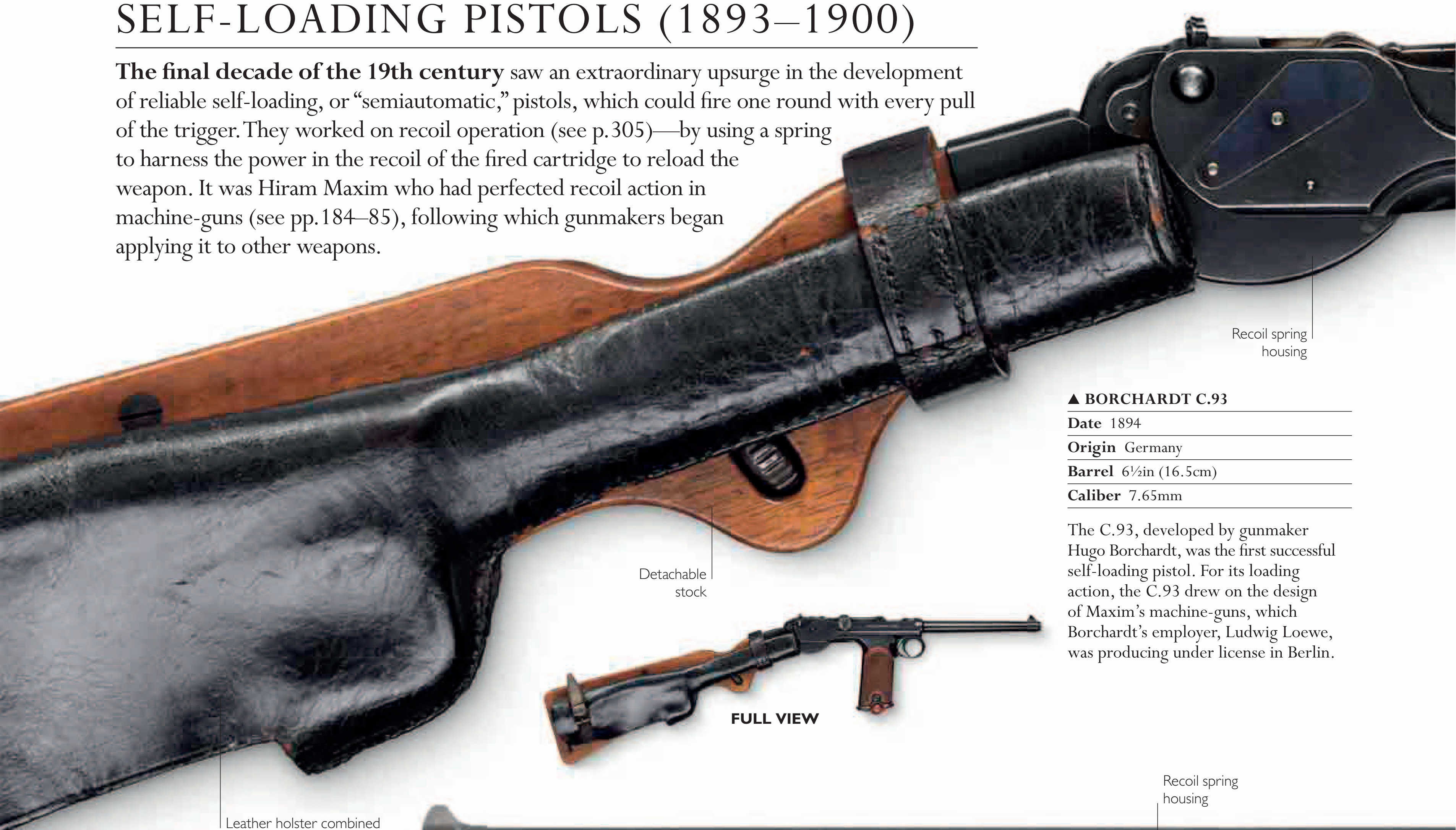
When the first semiautomatic pistols (see p.166) were developed by German gunsmiths such as Hugo Borchardt in the 1880s and 1890s, Mauser also moved into this market. Mauser's first, the highly successful C.96 (see p.166), was a highly distinctive firearm with a box magazine in front of the trigger and a grip that looked like the handle of a broom. The gun also had a removable wooden shoulder stock that doubled as a carrying case or holster. Carried by Winston Churchill and Lawrence of Arabia, the C.96 became well-known, and Mauser manufactured more than a million of them. The C.96 also took the Mauser name to China, where large numbers of the weapon were manufactured. The name Mauser is almost synonymous with "pistol" in many countries in Asia.

WAR AND PEACE

After World War I, the Mauser company used its engineering and manufacturing skills to branch out into peacetime products, such as tools, sewing machines, and even cars. But when Germany began to rearm in the mid-1930s, the Mauser line of firearms continued with the KAR 98k (see p.157), a bolt-action rifle first produced in 1935 but descended from the Model 1898 (left). Like the older rifle, the KAR 98k took ammunition loaded in a stripper clip, but it had a down-turned bolt handle (in contrast to the straight bolt handle of the Model 1898), which made for faster operation. The KAR 98k was used widely by the German army in World War II, especially for providing covering fire for machine-gunners.

SELF-LOADING PISTOLS (1893–1900)

The final decade of the 19th century saw an extraordinary upsurge in the development of reliable self-loading, or "semiautomatic," pistols, which could fire one round with every pull of the trigger. They worked on recoil operation (see p. 305)—by using a spring to harness the power in the recoil of the fired cartridge to reload the weapon. It was Hiram Maxim who had perfected recoil action in machine-guns (see pp. 184–85), following which gunmakers began applying it to other weapons.



FULL VIEW

▲ BORCHARDT C.93

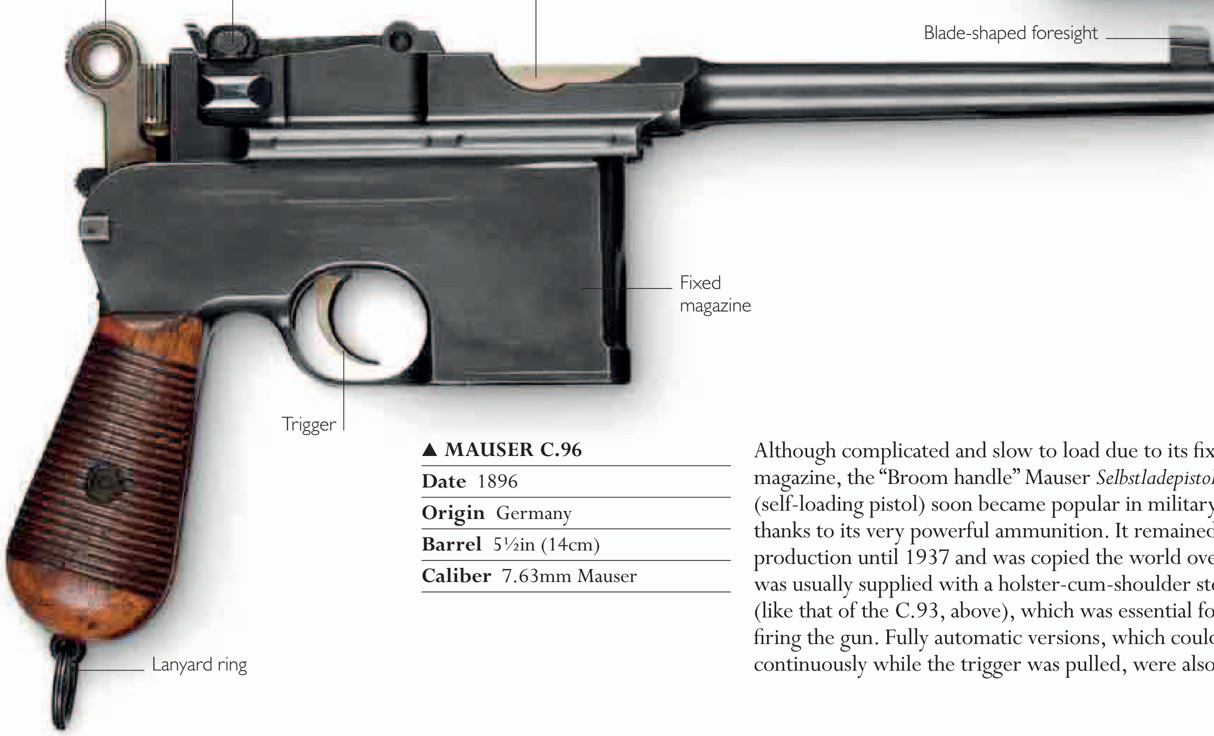
Date	1894
Origin	Germany
Barrel	6½in (16.5cm)
Caliber	7.65mm

The C.93, developed by gunmaker Hugo Borchardt, was the first successful self-loading pistol. For its loading action, the C.93 drew on the design of Maxim's machine-guns, which Borchardt's employer, Ludwig Loewe, was producing under license in Berlin.

▲ "MARS," BY GABBETT-FAIRFAX

Date	1899–1902
Origin	UK
Barrel	10½in (26.5cm)
Caliber	8.5mm Mars/.45in Webley

The "Mars" pistol was too big, expensive, complex—and too unforgiving—to succeed in the already congested and competitive weapons market of 1900.



▲ MAUSER C.96

Date	1896
Origin	Germany
Barrel	5½in (14cm)
Caliber	7.63mm Mauser

Although complicated and slow to load due to its fixed magazine, the "Broom handle" Mauser *Selbstladepistole* (self-loading pistol) soon became popular in military circles thanks to its very powerful ammunition. It remained in production until 1937 and was copied the world over. It was usually supplied with a holster-cum-shoulder stock (like that of the C.93, above), which was essential for safely firing the gun. Fully automatic versions, which could fire continuously while the trigger was pulled, were also produced.

▲ **BERGMANN NO. 3**	
Date	1896
Origin	Germany
Barrel	4½in (11.2cm)
Caliber	6.5mm Bergmann

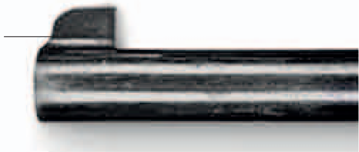
The Louis Schmeisser-designed "No. 3" was among the simplest of pistols, with a small-capacity fixed magazine and a "blowback" breech. The blowback system used the combined weight of the breechblock and the resistance of the pistol's mainspring to counter the recoil force generated on firing a cartridge. This enabled the breechblock to move fully rearward, where it was held back by the sear. Pulling the trigger again made the breechblock fly forward under spring pressure, collecting a cartridge, chambering it, and firing it. The cycle would then repeat.

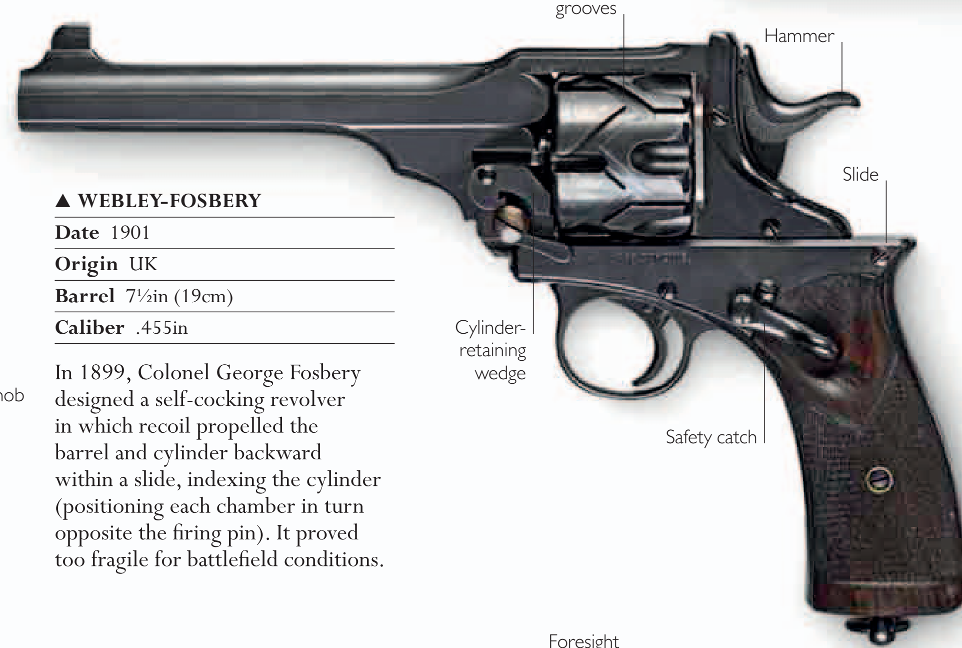
▲ **BROWNING MODEL 1900**	
Date	1900
Origin	Belgium
Barrel	4in (10.2cm)
Caliber	7.65mm

John Browning (see pp.180–81), probably the most prolific gun designer ever, moved to Belgium from his native US in 1895. There he produced an improved version of his first semiautomatic pistol, which became known as the Model 1900. It used a breech of the blowback type. Small and light, the Model 1900 was hugely popular, and over 700,000 units were sold before production ceased in 1911.

SELF-LOADING PISTOLS (1901–24)

This period saw the appearance of several designs of self-loading pistol that are still familiar today. John Browning created a series of slide-action pistols produced by Colt, culminating in the Model 1911A1, which was carried by American forces through both world wars. Georg Luger perfected the toggle-bolt breech mechanism of Hugo Borchardt to produce the pistol which became the ubiquitous German military sidearm. Other pistols, while technically interesting, proved less successful.

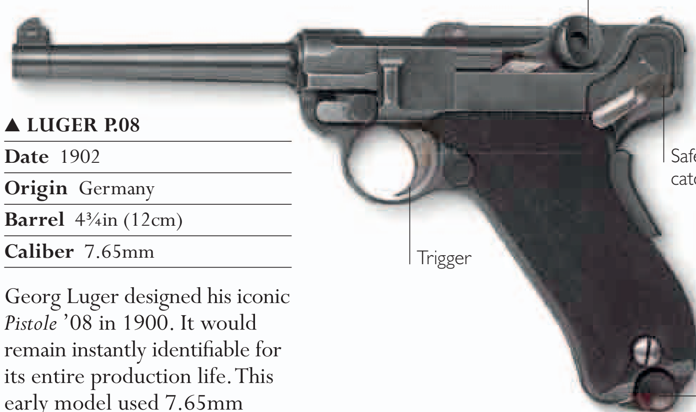




▲ WEBLEY-FOSBERY

Date 1901
Origin UK
Barrel 7½in (19cm)
Caliber .455in

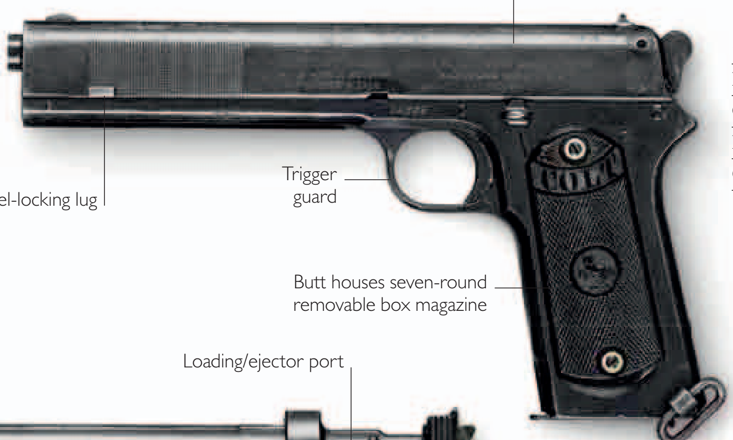
In 1899, Colonel George Fosbery designed a self-cocking revolver in which recoil propelled the barrel and cylinder backward within a slide, indexing the cylinder (positioning each chamber in turn opposite the firing pin). It proved too fragile for battlefield conditions.



▲ LUGER P.08

Date 1902
Origin Germany
Barrel 4¾in (12cm)
Caliber 7.65mm

Georg Luger designed his iconic *Pistole* ’08 in 1900. It would remain instantly identifiable for its entire production life. This early model used 7.65mm ammunition, which lacked stopping power.



◀ COLT MODEL 1902

Date 1902
Origin US
Barrel 6in (15.2cm)
Caliber .38in ACP

Browning produced a series of successful locked-breech pistols for the military market. However, the Model 1902 was not as popular. This gun featured a double-link mechanism. Its barrel was connected to the pistol frame at each end via pivoting links, which locked the barrel and slide together until the bullet left the muzzle.

▲ STEYR M1905

Date 1905
Origin Austria-Hungary
Barrel 6½in (16cm)
Caliber 7.63mm Mannlicher

The M1905, designed by Austrian manufacturer Steyr-Mannlicher (see pp.290–91), was chambered for a round generally thought too powerful for a recoil action, but succeeded due to the high standard to which it was manufactured. This pistol was never especially popular though.

▲ LUGER P.08 AMERICAN EAGLE

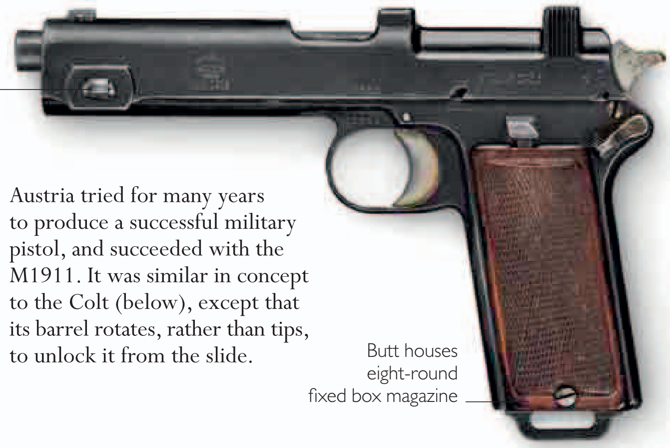
Date 1906
Origin Germany
Barrel 6in (15.2cm)
Caliber 9mm

International sales of Luger pistols grew enormously and in 1906, new models, in 9mm caliber, included one for commercial sale in the US. This finely finished version had the manufacturer’s mark (DWM) and also an American eagle on the top of the receiver.

▲ WEBLEY MODEL 1910

Date	1910
Origin	UK
Barrel	5in (12.7cm)
Caliber	.38in

Webley of Birmingham, England, produced a range of locked-breech, self-loading pistols from about 1904. They were all designed by J. H. Whiting, who collaborated with Hugh Gabbett-Fairfax on the "Mars" (see p.166), and were adopted by some police forces.



▶ STEYR-HAHN MODEL 1911

Date	1911
Origin	Austria
Barrel	5in (12.7cm)
Caliber	7.63mm Mannlicher

Austria tried for many years to produce a successful military pistol, and succeeded with the M1911. It was similar in concept to the Colt (below), except that its barrel rotates, rather than tips, to unlock it from the slide.

▲ COLT M1911A1

Date	1924
Origin	US
Barrel	5in (12.7cm)
Caliber	.45in ACP

Browning designed the Colt M1911 in 1911, following which it was accepted as the US Army's official sidearm. He designed it in response to a demand by US soldiers fighting Moro rebels in the Philippines for a pistol firing a heavy .45in round in place of the less-effective .38in caliber revolvers with which they had been issued. The example shown here is a later M1911A1.

▲ LUGER P.08 9MM PARABELLUM

Date	1908
Origin	Germany
Barrel	4in (10cm)
Caliber	9mm Parabellum

The Luger P.08 is one of the best-known pistols in the world. Luger copied many features of Borchardt's C.93 pistol of 1893 (see p.166), but adopted a leaf recoil spring and moved it into the butt, improving the overall balance considerably. Luger also produced improved ammunition for his pistol, the Parabellum round, which was to become the world standard.

SHOWCASE

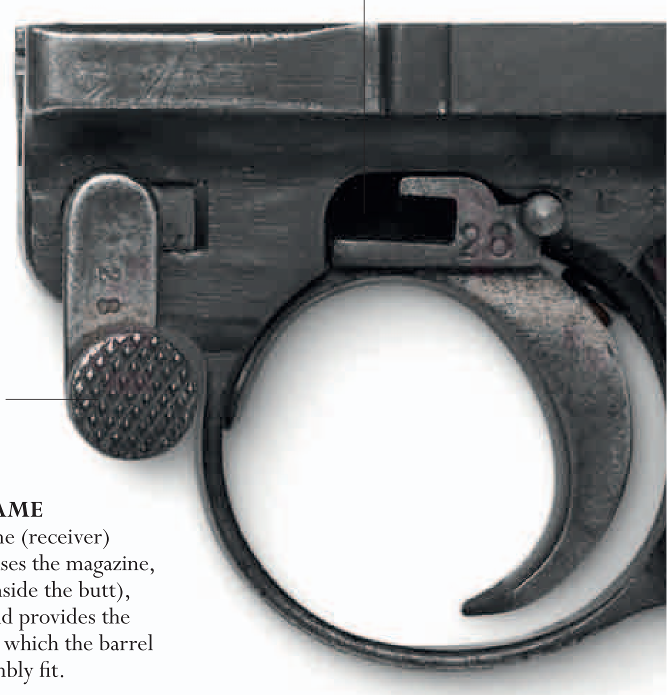
LUGER LANGE P.08 PISTOL

Recognized worldwide, this distinctive gun was used heavily by German forces in both world wars because of its reliability, accuracy, and light weight. It is one of the earliest self-loading pistols (see p.166), but unlike others, it is equipped with a recoil-operated toggle-lock instead of the slide action that later became standard. Firing the gun pushes the breechblock backward, folding the toggle and ejecting the spent cartridge.

▶ LOADING INDICATOR WITH CARTRIDGE
The extractor, or loading indicator, is attached to the breechblock. When a cartridge is in place, the extractor lifts upward at the front, exposing the word "*geladen*" (loaded) stamped on its side. It is easy to see, and feel, if a Luger pistol is loaded. Most Luger pistols used the Parabellum cartridge, which became the standard pistol round of armies across the world.

▲ BARREL AND LOCK ASSEMBLY
The barrel fits into a block that has two plates projecting rearward. The toggle assembly is fitted between these plates. The barrel and the toggle assemblies are attached to the main frame (receiver) of the pistol. To field-strip the gun for cleaning, the barrel assembly is pushed backward. This allows the user to turn the release lever clockwise and lift off the sideplate. The user can then pull out the release lever, allowing the barrel assembly to slide forward out of the receiver.

▲ SIDEPLATE
Unique to the Luger is an L-shaped lever located on the inner side of the sideplate. This lever connects the trigger with the sear. The sear in this gun holds back a striker until the trigger is pulled. Without the sideplate in place, the gun is inoperable.



▶ MAIN FRAME
The main frame (receiver) of the gun houses the magazine, mainspring (inside the butt), and trigger, and provides the platform onto which the barrel and lock assembly fit.

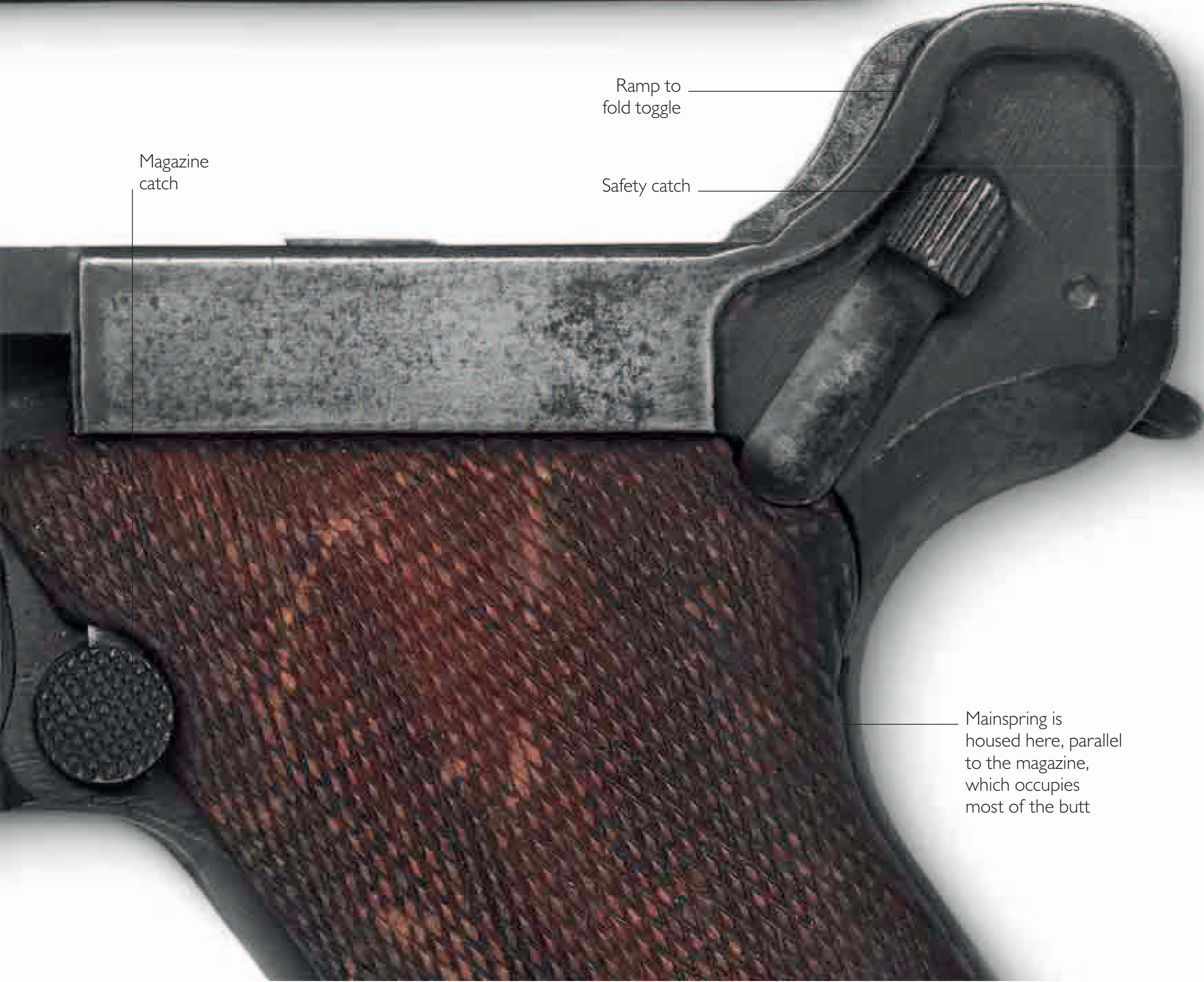
▼ TOGGLE ASSEMBLY
The toggle assembly consists of the sliding breechblock and the hinged toggle. The toggle is a mechanical linkage between the breechblock and the mainspring, which runs down the back of the gun's butt. The mainspring is attached to the toggle by the coupling link.

▼ REAR TOGGLE PIN
The toggle pin fixes the toggle assembly to the barrel frame.

LUGER LANGE P.08 PISTOL
Date 1917
Origin Germany
Barrel 7in (17.8cm)
Barrel 2in (5cm)
Caliber 9mm Parabellum

Georg Luger's P.08 was available in calibers of 7.65 or 9mm and various barrel lengths. This "Lange," or long-barreled version, was issued to artillerymen as a personal weapon, and is also known as the "artillery" model. It was equipped with either a standard 8-round magazine or a 32-round drum magazine, both detachable and using 9mm Parabellum cartridges. The gun has a rifle-type adjustable rear sight graduated to 875 yards (800m) and was supplied with a simple detachable shoulder stock to enable a more steady aim at longer ranges.

FULL VIEW



▲ TOGGLE (FOLDED)
The user loads the gun by pulling the toggle, which folds upward, drawing the breechblock backward and compressing the mainspring (left, in the butt). As the toggle folds upward, the spring inside the magazine pushes a cartridge up. Then, as the mainspring extends, it straightens the toggle and pushes the breechblock and cartridge forward, sealing the breech and chambering the cartridge. On firing, the recoil sends the breechblock and toggle backwards, and the toggle folds as it runs up a ramp on the rear of the frame, triggering a cycle of automatic loading.

UGO GUSSALLI BERETTA

GREAT GUNSMITHS

BERETTA

The world's oldest firearms manufacturer is the Italian company Fabbrica d'Armi Pietro Beretta SpA, which originated in the 16th century as a supplier of gun barrels to the arsenal in Venice. From these small beginnings, Beretta has expanded into a large business with a global reputation in a variety of fields—from small arms for military use to hand-made shotguns, often beautifully engraved. These guns continue to be recognized for their excellent design and high standard of quality under the able guidance of Ugo Gussalli Beretta and his sons.

In the 15th and 16th centuries, the city of Venice was a powerful and independent republic with lands in northern Italy and the Mediterranean. The Venetians grew rich through trade, and to help defend their empire, they developed the arsenal at Venice, originally a ship-building complex, as a major gun manufacturer. The arsenal called on craft workers from outside the city to supply parts for weapons. One of these craft workers was Mastro Bartolomeo Beretta, a gunsmith from Gardone Val Trompia in Lombardy, whose business began to prosper in 1526, when he supplied 185 harquebus barrels to the arsenal.

▼ **BERETTA CRAFTSMAN**
A worker assembles a hunting rifle at the Beretta factory in Italy in 1985. The stunning engraving on these premium weapons is done by hand and individually signed by the engraver.

THE CRAFT TRADITION

The Venetians valued the work of gunsmiths such as Beretta and levied low taxes on them, giving them more power to run their own affairs and a ready market for their products. Mastro Bartolomeo Beretta, exploiting local deposits of high-grade iron ore to make his guns, did well, and he and his descendants handed down the techniques of gunsmithing from father to son from the 16th century to the present. Venice provided a strong market for Beretta's firearms until the city went into decline in the 18th century. By this time, Beretta's weapons were well-known beyond the Venetian empire, so the company could still flourish as its initial market shrank. In the 19th century, Pietro Antonio Beretta and his son Giuseppe traveled up and down Italy demonstrating their company's products and collecting orders. Purchasers liked the quality, workmanship, and craft values of Beretta's products and the orders continued to flow in, especially for their finely crafted, ornately engraved rifles.

PRIZED FOR PRECISION

Throughout its history, the company has developed weapons for supply to a variety of military and civilian users. Its military weapons have moved with the times. For example, during World War I, the company developed the Model 1918, one of the first submachine-guns used by the Italian army. During the 20th century, Beretta handguns, especially its semiautomatic pistols, were widely employed by the military and police, and this has continued into the 21st century. Strength in this area is partly due to Pietro Beretta, who took over in 1903 and developed international sales, and partly to Tullio Marengoni, Beretta's chief designer from

MODEL 1934

MODEL S-686, 1982

1526 Mastro Bartolomeo Beretta supplies 185 harquebus barrels to the arsenal in Venice.

1915 Beretta begins to produce semiautomatic pistols—a type of gun that will become one of its most important products during the 20th century.

1918 Beretta's first submachine-gun, the Model 1918, is launched and taken up by the Italian Army.

1934 The Model 1934, a compact, semiautomatic pistol designed for the Italian Army, is created.

1935 The SO series of over-and-under shotguns is launched, beginning an enduring line of double-barreled shotguns, including the Model S-686, that lasts until today.

1953 In Ian Fleming's first James Bond novel, *Casino Royale*, the hero carries a Beretta 418 pistol.

1985 The semiautomatic M9 is ordered for the US Army as a replacement for the venerable M1911 pistol designed by John Browning.

“We are **Beretta**. We don't want to make a copy of other shapes.”

ATTRIBUTED TO **FRANCO BERETTA, SON OF UGO GUSSALLI BERETTA**

◀ **TARGET SHOOTING**
Beretta weapons have found particular favor with competitive skeet shooters. Here, Australian shooter George Barton fires a Beretta during an event in Melbourne in 2006.

1904 until his death in 1965. Marengoni's work in small arms bore fruit in the form of the Model 34, which sold in huge numbers over a 40-year period. This tradition has continued with the M9, issued to the US Army, and the 92 series, bought widely by armed forces around the world. These weapons are valued for their precision of manufacture and reliability, as are Beretta's competition rifles and shotguns, especially the SO (*Sovrapposto*, indicating that the barrels are arranged one above the other) shotgun series launched in 1935. The firm's position in this area was also strengthened by the fact that Pietro Beretta's nephew, Carlo, was an avid competition marksman, giving the designers informed feedback on the firearms he used.

FOR THE ATHLETES

By 1956, the excellence of the weapons was confirmed at the Melbourne Olympics, at which a shooting competitor with a Beretta won gold for the first time; medals went to Beretta shooters in nearly all the following Olympics, and there were also successes in the World Championships from 1978 onward. The success enjoyed by the SO1 has continued to today, with the SO5 and the SO6—premium firearms that combine excellent balance and precision with beautiful design. In addition to these premium weapons, Beretta also produces many competition and hunting weapons designed for users on a budget that still maintain the quality and reliability that have made the company's name.

SELF-LOADING PISTOLS (1925–45)

In the years following World War I, military forces worldwide began adopting self-loading pistols for use by their officer corps. While some were intended solely for personal defense, others, such as the Browning High Power or GP35, were dual-purpose weapons suitable for offensive operations due to their caliber and magazine capacity.

▼ NAMBU TAISHO 14	
Date	1920
Origin	Japan
Barrel	4in (12cm)
Caliber	8mm Nambu

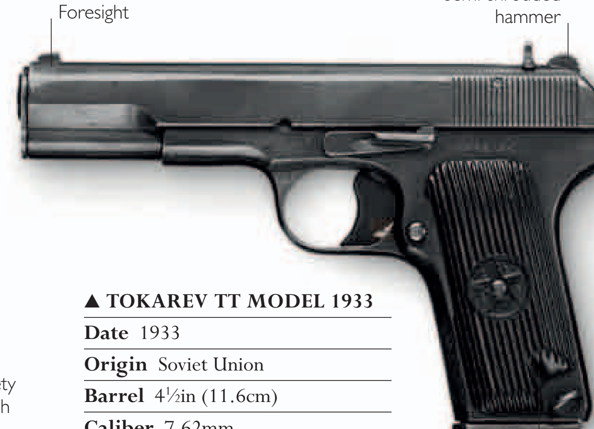
The first Nambu pistols appeared in 1909. Although they were clearly influenced by the Luger P.08 (see p.168), they have nothing in common with it internally, the unlocking of the bolt from the barrel being achieved by the rotation of a linking block.

▲ ASTRA MODEL 901	
Date	1927
Origin	Spain
Barrel	6¼in (16cm)
Caliber	7.63mm Mauser

This self-loading pistol was part of the Astra 900 series, a copy of the *Schnellfeuer* ("Rapidfire") version of the Mauser C.96 (see p.165). It could switch between semiautomatic and automatic firing modes. In fully automatic mode, the gun would keep firing as long as the trigger was kept pulled. The gun was, however, difficult to control in that mode.

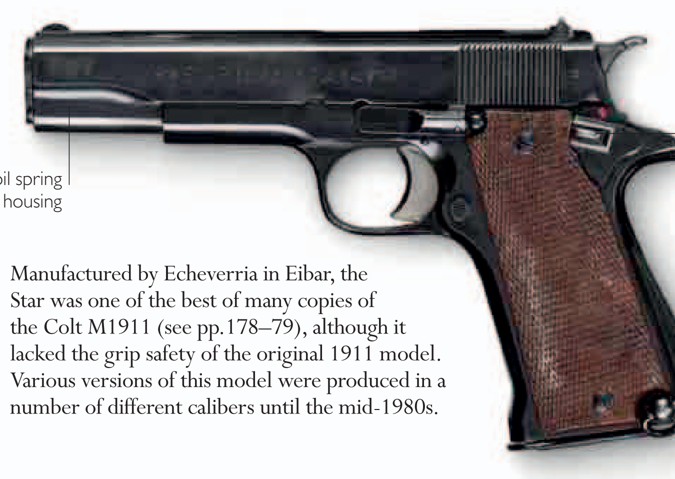
▲ WALTHER PPK	
Date	1931
Origin	Germany
Barrel	3¼in (8.3cm)
Caliber	7.65mm

The Walther PPK was popularized through its cinematic use by James Bond, and it did indeed find its way into many security service hands, mainly because of its compact dimensions. It was a simple recoil weapon most commonly produced in .32in ACP (7.65mm) caliber, and was fed from a seven-round magazine.



▲ TOKAREV TT MODEL 1933	
Date	1933
Origin	Soviet Union
Barrel	4½in (11.6cm)
Caliber	7.62mm

The Tokarev TT was the first self-loading pistol on general issue to the Red Army. In design, it was similar to the Browning GP35 (right), with a similar recoil-driven self-loading action. It was simple and could be field-stripped without tools. It lacked a safety catch.



► STAR MODEL M	
Date	1932
Origin	Spain
Barrel	5in (12.5cm)
Caliber	9mm Largo

Manufactured by Echeverria in Eibar, the Star was one of the best of many copies of the Colt M1911 (see pp.178–79), although it lacked the grip safety of the original 1911 model. Various versions of this model were produced in a number of different calibers until the mid-1980s.

▶ BERETTA MODEL 1934

Date	1934
Origin	Italy
Barrel	6in (15.2cm)
Caliber	9mm short

Pietro Beretta SpA (see pp.172–73) is the world's longest-established gunmaker. Its M1934 became the official Italian officer's side-arm during World War II. The design evolved from one executed two decades earlier. This recoil-operated weapon was restricted to firing a reduced-power round, originally in 7.65mm caliber.

▶ BERETTA 318

Date	1935
Origin	Italy
Barrel	2¼in (5.7cm)
Caliber	.25in ACP

The Beretta Modello 318 was produced in Italy from 1935 to 1943. It was one of a developing line of Beretta small-frame pistols in .25in ACP caliber introduced in 1919, and it was exported in decent numbers to the US, where it sold under the name Bantam or Panther.

▲ RADOM M1935

Date	1935
Origin	Poland
Barrel	4½in (11.5cm)
Caliber	9mm Parabellum

The Radom was similar in concept to the Browning GP35 (left), but it was more compact and had extra security features. These included a decocking device that pulled the firing pin back and allowed the hammer to fall forward safely without firing the pistol.

▲ BROWNING GP35

Date	1935
Origin	Belgium
Barrel	4¾in (11.8cm)
Caliber	9mm Parabellum

Self-loading pistols were used only occasionally by special forces before the High Power (Grand Puissance) GP35 became the first self-loading pistol to be officially adopted into British service in 1954. It replaced the revolver as the official military sidearm in Britain. This model was the last Browning design.

▶ WALTHER P38

Date	1938
Origin	Germany
Barrel	4¾in (12.4cm)
Caliber	9mm Parabellum

Developed by the Walther company just prior to World War II, the P38 has come to be recognized as one of the finest semiautomatic pistols ever designed. Simple in construction and ruggedly built, it proved to be reliable under all circumstances.

SELF-LOADING RIFLES

Self-loading, or semiautomatic, rifles existed before the end of the 19th century. The first one was developed by Manuel Mondragon of Mexico in 1891, but like other early designs it proved too complex for military use. While some early self-loading rifles were recoil-operated (see p.305), others began utilizing a system of gas-driven reloading (see p.305). In 1917, French gunmakers introduced the St. Etienne self-loading rifle, while in the US, John M. Browning perfected his "automatic" rifle, the BAR (Browning Automatic Rifle). Both were in service in World War I. A later successful design was the M1 Garand rifle, designed by John Garand, which, with its numerous variations, saw widespread service in World War II. The German Sturmgewehr 44 had fully automatic firing capability, and led the way toward today's assault rifles (see pp.250–51).

▼ M1 GARAND RIFLE

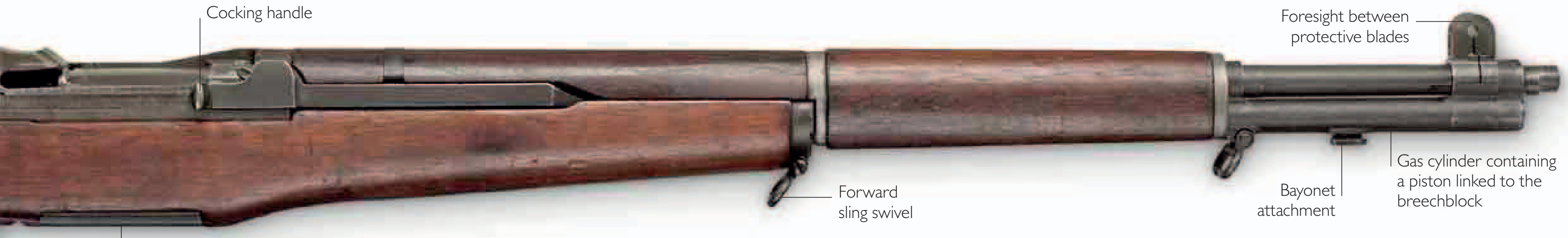
Date	1932
Origin	US
Barrel	24in (61cm)
Caliber	.30in-06

Designed by John Garand, the M1 rifle was the first general issue self-loading rifle to be accepted for US military service. By the end of World War II, more than five million of them had been manufactured.

▲ MONDRAGON RIFLE MODEL 1908

Date	1908
Origin	Mexico/Switzerland
Barrel	24in (61cm)
Caliber	7mm

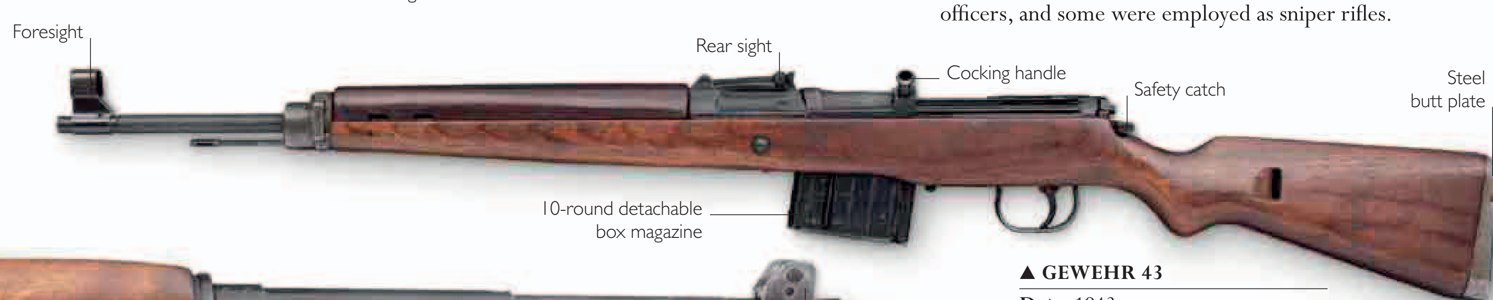
The Model 1908 Mondragon was the final version of a gas-operated, semiautomatic rifle first designed by Mexican General Manuel Mondragon in 1891. Though designed for infantry use, some rifles were issued to German air crew at the beginning of World War I.



▲ TOKAREV SVT40

Date	1940
Origin	Soviet Union
Barrel	24in (61cm)
Caliber	7.62 × 54mm

Fedor Tokarev designed a self-loading rifle with a tilting bolt locking into the floor of the receiver, and had it accepted by the Red Army in 1938. Two years later, he produced a more robust weapon that was cheaper and quicker to manufacture. The Samozaryadnaya Vintovka Tokarev 40 (SVT40) was issued to noncommissioned officers, and some were employed as sniper rifles.



▲ GEWEHR 43

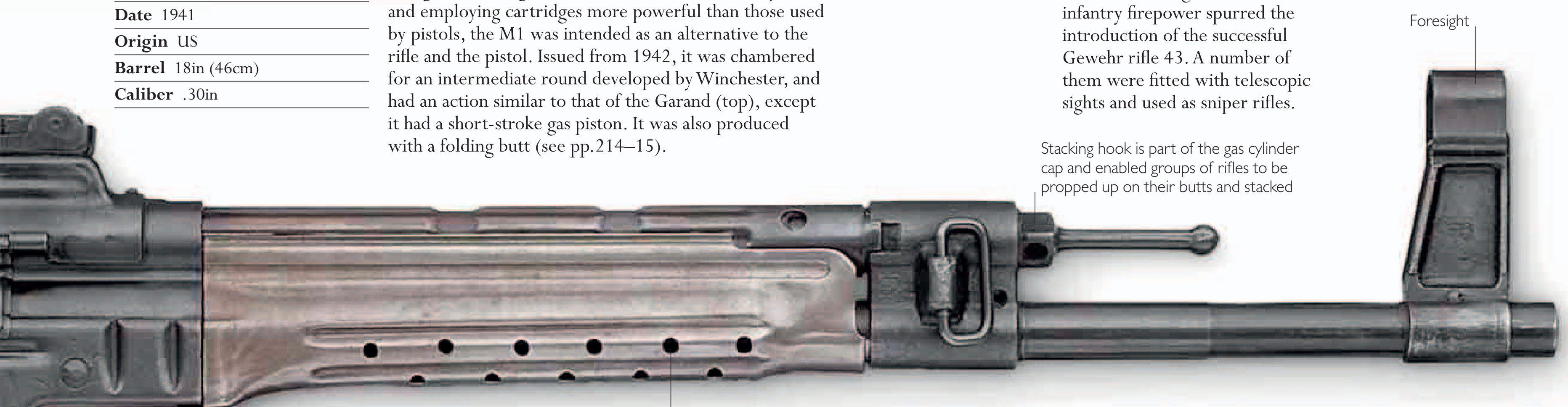
Date	1943
Origin	Germany
Barrel	22in (56cm)
Caliber	7.92 × 57mm

The German army's request for a self-loading rifle to increase infantry firepower spurred the introduction of the successful Gewehr rifle 43. A number of them were fitted with telescopic sights and used as sniper rifles.

▲ M1 CARBINE

Date	1941
Origin	US
Barrel	18in (46cm)
Caliber	.30in

Designed to be lighter and handier than an infantry rifle, and employing cartridges more powerful than those used by pistols, the M1 was intended as an alternative to the rifle and the pistol. Issued from 1942, it was chambered for an intermediate round developed by Winchester, and had an action similar to that of the Garand (top), except it had a short-stroke gas piston. It was also produced with a folding butt (see pp.214–15).



FULL VIEW

▲ STURMGEWEHR 44 (STG44)

Date	1944
Origin	Germany
Barrel	16½in (41.8cm)
Caliber	7.92 × 33mm Kurz

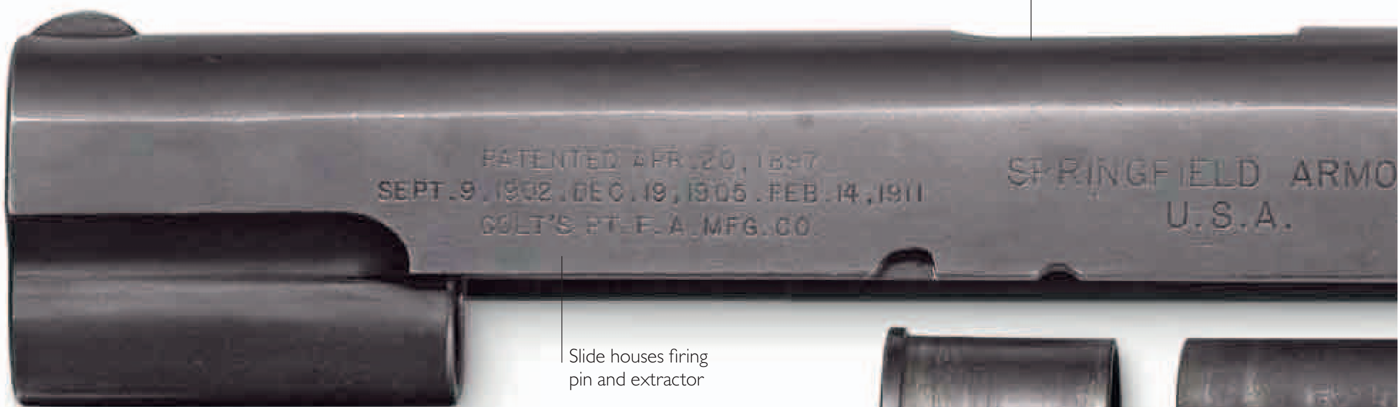
In 1940, work began on a rifle capable of selective fire—it could switch between semiautomatic and fully automatic fire. It was chambered for a new intermediate 7.92 × 33mm round. It was put into production as the *Maschinen Pistole* (machine-pistol) 43 and later renamed the Sturmgewehr (assault rifle) 44. The StG44 was an early example of a handheld machine-gun, and used gas to reload its mechanism.

SHOWCASE

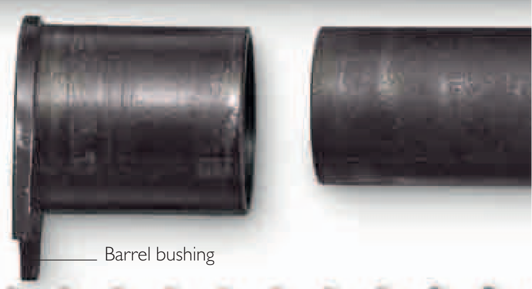
COLT MODEL 1911

This all-time classic recoil-operated pistol (see p.305) has its origins in the work of John Browning in the 1890s. It used the .45in ACP (Automatic Colt Pistol) cartridge, which delivered a bullet with twice the energy of the 9mm cartridges favored in Europe. Adopted by the US government in 1911, it is still in limited service, a record for a military handgun.

▲ .45IN ACP CARTRIDGE
Designed by Browning in 1904, this powerful center-fire cartridge is also used by the Thompson submachine-gun (see p.212–13).



▲ SLIDE AND RECOIL SPRING HOUSING
The slide houses the barrel, recoil spring, and breechblock. When the bullet is fired, the slide recoils backward, extracting the empty case and cocking the hammer. Driven forward by the recoil spring, the slide then feeds a new cartridge into the chamber. The hammer remains cocked until the trigger is pulled, at which point it strikes the firing pin.



▶ RECOIL SPRING
After the gun is fired and the slide has moved backward, the recoil spring forces it forward again, feeding a new cartridge into the chamber and sealing the breech ready for firing.

▶ REAR SIGHT
This steel block with a "V" notch is fixed into a dovetail slot on the slide. The rear sight is set in correct position at the factory and is not adjustable.

▲ EJECTION PORT
The ejection port is an aperture cut in the upper portion near the rear end of the slide to allow the ejection of empty cases when the gun is fired.

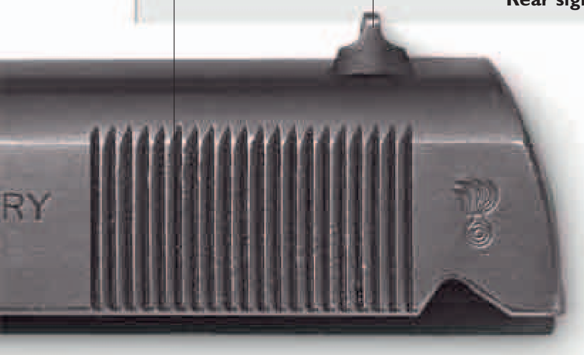
▲ RECEIVER, OR MAIN FRAME
The receiver houses the magazine and the main elements of the firing mechanism. These are the trigger, sear (not seen), hammer, mainspring (not seen, located in the butt), grip safety, safety catch, and a disconnector (not seen) to prevent full automatic fire. The receiver also houses the slide stop, which holds the barrel on the receiver independently of the slide. If removed, it allows the slide to move forward off the receiver.

COLT MODEL 1911	
Date	1914
Origin	US
Barrel	12in (30.5cm)
Caliber	.45in ACP

With seven cartridges in the magazine and one in the chamber, this rugged gun was a formidable weapon to be confronted with. The Model 1911's use of the same ammunition as the Thompson submachine-gun made these two weapons ideal and deadly partners, not only for use in the battlefield by the military but also by law enforcement agencies, and "gangs" in their battles on the streets. The model shown here was made in 1914.

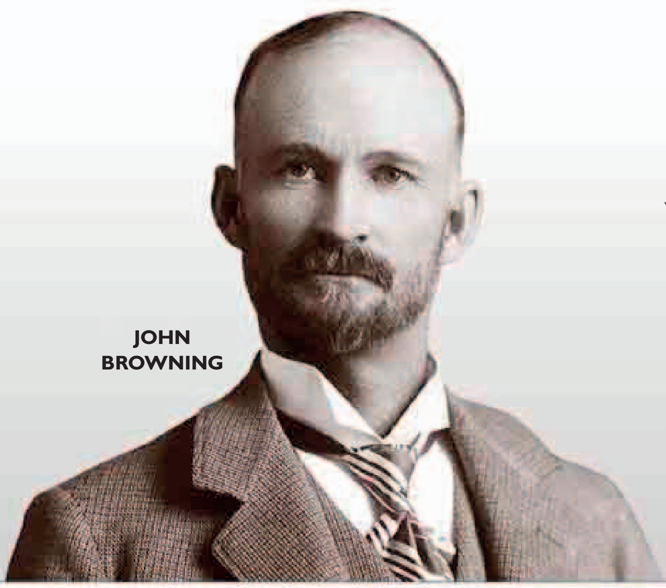
FULL VIEW

FULL VIEW (SLIDE PULLED BACK)



▼ BARREL ASSEMBLY
The barrel is fitted into the barrel bushing, and the recoil spring sits underneath the barrel. To field strip the gun, the recoil spring is pushed backward, allowing the barrel bushing to be rotated sideways. The slide stop can then be removed and slide and barrel taken apart from the main frame.

▼ MAGAZINE
A steel box magazine holds seven cartridges and is fitted inside the butt. When the last cartridge is fired, the platform inside the magazine engages with the slide stop, which holds the slide in an open position to show the magazine is empty. Inserting a full magazine and depressing the slide stop allows the slide to move forward and feed a cartridge into the chamber ready for firing.



JOHN BROWNING

GREAT GUNSMITHS

BROWNING

John Moses Browning was one of the most versatile and widely respected gunmakers in history. Although he began as a gunsmith, based in a small workshop in his native Utah, he built his reputation not as a manufacturer but as a designer of firearms. He sold his designs to gunmakers such as Winchester, Colt, and the Belgian firm Fabrique Nationale. He became famous for the build quality and practicality of his firearms, and for his innovations, especially in the field of automatic weapons.

From the age of seven, John Browning worked for his father, Jonathan, a gunsmith in Ogden, Utah. This is where he learned the basics of the gunsmith's craft and was soon experimenting and coming up with ideas of his own. Within a few years, he had built his first gun, a single-shot rifle for his brother, Matt, and by 1879, when John was 24, he and his brother set up their own workshop. The Brownings quickly established a reputation for efficient, well-made weapons. Their small workshop could not keep up with the demand, but the brothers did not have the capital to expand. So in 1883, Browning started to sell manufacturing rights to Winchester, beginning a fruitful business relationship that produced some of the best-known firearms made in the US.

◄ **TESTING A PROTOTYPE**
John Browning tests a prototype of his heavy machine-gun in around 1918. This firearm, a water-cooled .50in caliber weapon, was an enlarged version of the .30in caliber M1917 gun.

THE BROWNING APPROACH

The 1880s and 1890s were fruitful decades for John Browning. During this time he produced many weapons in partnership with the Winchester Repeating Arms Company. His approach was to design guns that were simple in layout and therefore straightforward to manufacture and repair, as well as being robust enough to be reliable under the sometimes punishing conditions of the American West.

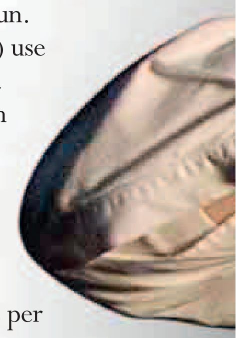
The first design Winchester bought from Browning was the single-shot rifle he was producing in his workshop in Ogden. This impressed Thomas G. Bennett, president and general manager of Winchester, when he visited Ogden in 1883. It became the Winchester Model 1885. The gun sold well, especially to users who wanted a rifle for long-range target shooting, and gained an excellent reputation. Its falling block action was so strong that Winchester used it for the punishing job of testing new cartridges. It cemented Browning's reputation as a creator of rugged, effective firearms.

Once he had sold the Model 1885 to Winchester, the young gunsmith was free to concentrate on designing new firearms for the company, and the Model 1886, a high-powered repeating rifle, soon appeared. This was followed by the Model 1892, a lighter gun popular with cowboys, the Model 1895, a bigger weapon designed for hunters, and the Model 1897 (see p.183), the first effective repeating shotgun, a weapon used by Wells Fargo bank guards and the US military. A total contrast was the Model 90, a lightweight weapon that was often given to young people who were learning to shoot. Altogether, Browning sold more than 40 designs to Winchester, 10 of which made it into production, along with designing weapons for other companies. It was an outstanding achievement that made Browning one of the most celebrated firearms designers in the world.

> "If anything can happen in a **gun**, it probably will sooner or later."
>
> *GUNMAKER* **JOHN BROWNING**

NEW BREAKTHROUGHS

Some of Browning's most notable breakthroughs came in the field of automatic weapons. In the late 1880s, he developed the first effective gas-operated automatic gun. Gas-operated firearms (see pp.194–95) use the high-pressure gas generated when a cartridge is fired to power a mechanism that extracts the spent cartridge case and delivers another one to the chamber. He offered his design to Colt and it eventually became the Colt M1895 machine-gun (see p.194), which could fire more than 400 rounds per



WINCHESTER MODEL 1887

BROWNING M1917

FN BROWNING HP 35

1883 Thomas G. Bennett of Winchester visits Browning and buys the patent of his single-shot rifle outright for $8,000.

1887 The lever-action Winchester Model 1887, designed by John Browning, is the first successful repeating shotgun.

1897 Browning signs a contract giving FN the right to manufacture and sell his .32in automatic pistol.

1900 Browning is granted a US patent for a semiautomatic rifle, which becomes the Remington Model 8 in the US and the FN Model 1900 elsewhere.

1917 The launch of the Browning M1917 heavy machine-gun is too late for widespread use in World War I, but the weapon will be used for decades afterward.

1918 The M1918 light machine-gun, also known as the Browning Automatic Rifle (BAR), begins its long service life of more than 40 years.

1935 Derived from Browning's last design, the FN Browning HP 35 also incorporates the work of FN designer Dieudonné Saive.

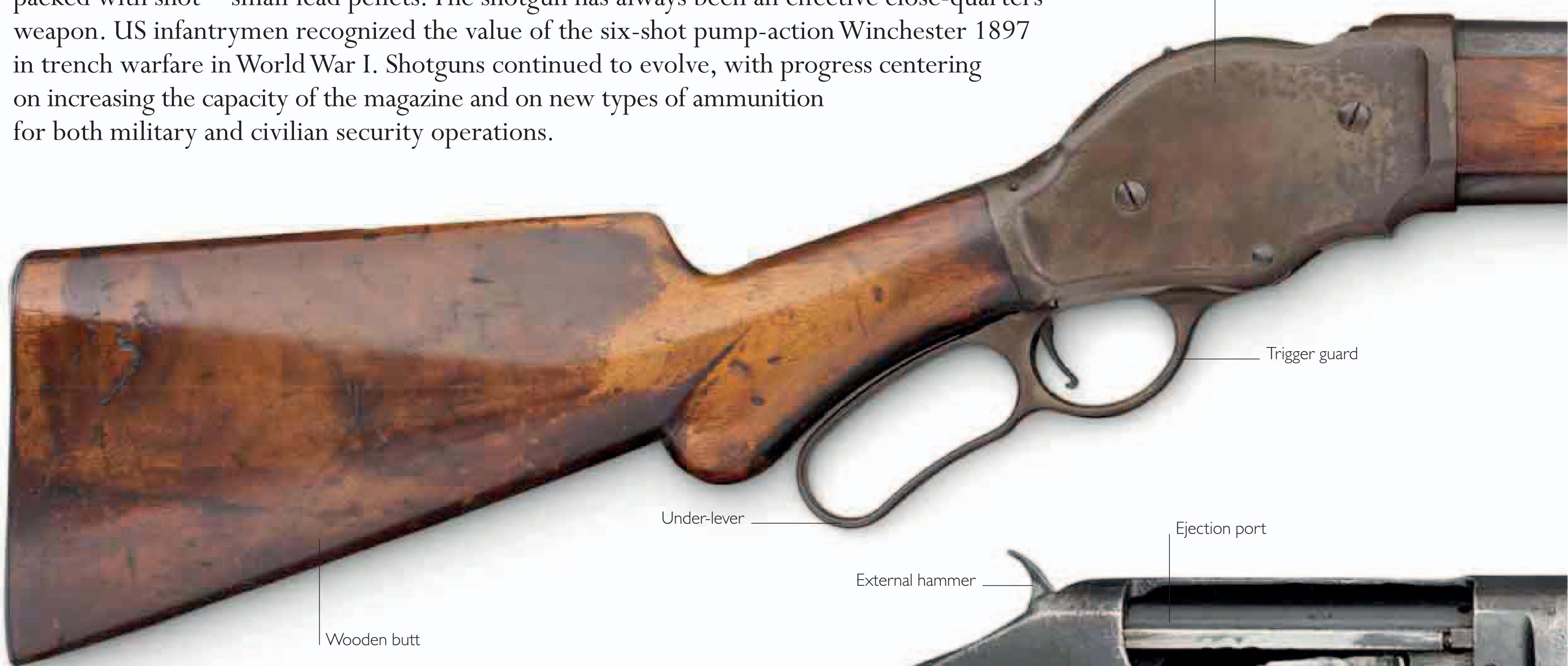
minute and used air-cooling to compensate for the heat produced by the action. The weapon sold in markets from Russia to countries in South America and saw service in the Spanish–American War (1898) and World War I. Having made a mark with this large automatic gun, Browning designed an automatic pistol. This type of weapon had been developed in Europe by manufacturers such as Mauser, but Browning was the first American to enter this market. First, he offered his design to Winchester, but he asked for a royalty on each weapon made, rather than the single-fee payment he had accepted in the past. Winchester turned down Browning's request, and the designer instead went to the Belgian company Fabrique Nationale (FN). FN accepted, and its Browning-designed M1900 semiautomatic pistol (see p.167) was produced between 1900 and 1911. This was the beginning of a partnership that lasted until Browning's death.

In the final decades of his life, Browning continued his work, concentrating especially on automatic weapons. He produced such guns as the Model 1917 (see p.190), a powerful recoil-operated machine-gun cooled with a water jacket, and the Browning Automatic Rifle (see p.194), a light machine-gun first produced in 1918. The latter remained in production, in various forms and via a number of manufacturers, into the 1950s. A tireless innovator, Browning continued working into his last years and died while working on a self-loading pistol at his bench in the FN factory in Liège, Belgium. His name lives on as the creator of some of the world's most successful firearms.

▼ PUBLIC ENEMIES
Leaning out of a car window, Stephen Dorff, playing Homer Van Meter, fires a Browning Automatic Rifle at FBI agent Purvis and his men in the 2009 film *Public Enemies.* The movie is about the notorious 1930s bank robber John Dillinger.

COMBAT AND POLICE SHOTGUNS

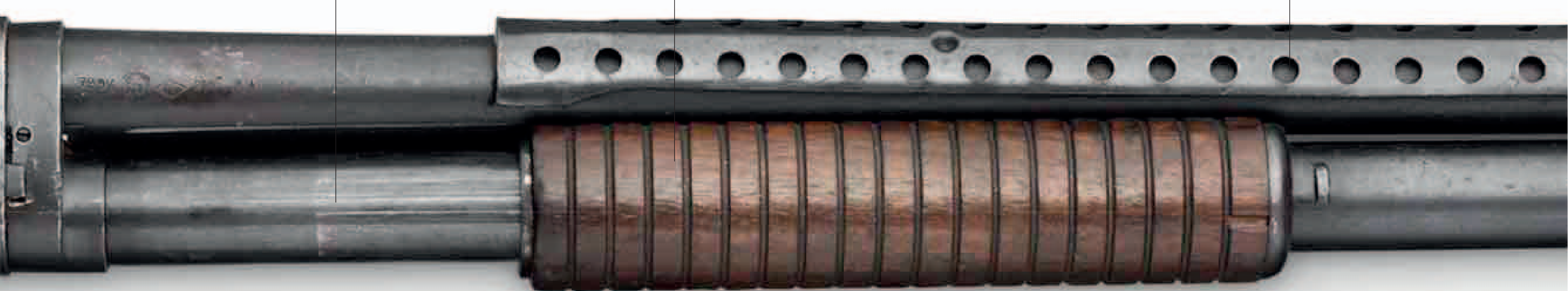
Shotguns have a long history as combat weapons, giving service in conflicts from the American Revolutionary War (1775–83) to World War I and beyond. Their cartridges are packed with shot—small lead pellets. The shotgun has always been an effective close-quarters weapon. US infantrymen recognized the value of the six-shot pump-action Winchester 1897 in trench warfare in World War I. Shotguns continued to evolve, with progress centering on increasing the capacity of the magazine and on new types of ammunition for both military and civilian security operations.

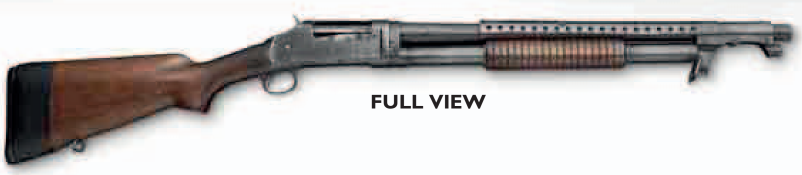


▲ WINCHESTER MODEL 1887 UNDER-LEVER SHOTGUN

Date	1887
Origin	US
Barrel	19½in (50cm)
Caliber	12-gauge (.73in/18.54mm)

An action unique to shotguns is the lever-action rolling block of the Winchester Model 1887, designed by John M Browning. Produced in .73in and .79in chamberings (and a very few to accommodate .70in bulleted cartridges), the lever action proved unsuitable for shotgun cartridges, and was discontinued in favor of pump-action guns.





FULL VIEW

▲ WINCHESTER MODEL 1897 PUMP-ACTION SHOTGUN

Date	1897
Origin	US
Barrel	20in (51cm)
Caliber	12-gauge (.73in/18.54mm)

The Winchester Repeating Arms Company commissioned John M. Browning to develop a pump-action shotgun, and he produced the M1897. This gun's magazine made it extremely useful to the combat infantryman. Pump action is a type of slide-action mechanism in which the user first pulls the cocking slide backward, ejecting an empty case and cocking the hammer. Pushing the slide forward chambers a cartridge and closes the breech. The gun is then ready to fire.

▲ GREENER-MARTINI POLICE SHOTGUN

Date	1920
Origin	UK
Barrel	28in (71.2cm)
Caliber	12-gauge (.73in/18.54mm)

Developed after World War I for use by British colonial police forces, this single-shot weapon was unconventional in that it had a Martini falling-block action. In this action, the cocking lever is pivoted forward, causing the breechblock to hinge vertically downward into the receiver. This opens the breech for loading a new cartridge manually. Furthermore, this gun accepted only cartridges of an unusual form—to prevent stolen guns from being used by civilians.

TURNING POINT

MACHINE-GUNS

In 1883, a patent filed by Hiram Maxim covered a revolutionary concept in firearms—a gun in which energy from the explosion, in addition to driving the bullet, also drove the cycle of loading and firing and would continue to do so as long as there was a supply of ammunition. All the user had to do was point the gun and pull the trigger. This true machine-gun inspired the development of new "fully automatic" and "semiautomatic" firearms, which are the weapons used today by the world's armed forces and law enforcement agencies.

▲ **MAXIM GUN**
In the Maxim gun, the energy from the recoil was used to eject each spent cartridge and insert the next one and fire it. This made it less labor-intensive and more efficient than previous rapid-firing guns that relied on manual cranking.

Mechanized guns, or what were considered to be "machine-guns," first began to appear in the middle of the 19th century. Their operation involved feeding the cartridge into the chamber of a barrel, firing it, and then extracting the empty case by a manually powered mechanical process in a continuous cycle. The first of these guns to achieve real success was the Gatling, later followed by the Nordenfelt, Hotchkiss, and Gardner guns. All performed well in their own distinctive ways and were widely used by the major military and maritime nations of the world. However, all mechanical machine-guns suffered from the same drawback—they required human energy to operate them and stamina to maintain a continuous fire.

RECYCLING WASTED ENERGY

All guns obey the same law of nature—the force that drives the ammunition forward also drives the gun backward. This was considered an unavoidable nuisance by gunmakers. Hiram Maxim, however, recognized it as a source of energy and put it to better use. He also noted other flaws associated with machine-guns, which included cartridges that often suffered from a "hang-fire"—a delayed explosion of the main charge after the primer was detonated.

THEORY BECOMES REALITY

Maxim experimentally modified rifles to use their recoil energy to load and fire them. Satisfied that the idea could work, he built an experimental gun, which operated in the same way but used a specially designed lock mechanism. This mechanism extracted cartridges from a continuous belt, fed them into the chamber, and fired them. A hang-fire was not a problem in such a gun, because it could not continue its cycle until the explosion occurred.

Conscious of the heat generated by continuous

» BEFORE

The third quarter of the 19th century saw the creation of guns capable of giving sustained fire. Often referred to at the time as "battery guns," they became thought of as "machine-guns" because the processes of loading and firing had been mechanized, turning them into "shooting machines." They were successful, but they had their drawbacks.

GATLING GUN

- **MOST GUNS WERE HEAVY** and often needed to be mounted on wheeled carriages for transport. Their use on land and at sea needed massive mountings fixed to the deck or other structures capable of supporting them.

- **A CREW OF SEVERAL MEN** was required to operate the guns, and a team of horses had to draw the gun carriage along with a limber to carry the ammunition.

- **LIGHTWEIGHT, PORTABLE MACHINE-GUNS**, such as the Nordenfelt gun, were developed. However, since they were hand-cranked, their aim was easily disturbed and not very accurate.

> **“Whatever** happens, we **have got**
> **The Maxim gun**, and they have **not.”**

HILAIRE BELLOC, IN HIS POEM, *“THE MODERN TRAVELLER”* (1898)

firing, Maxim fitted a jacket containing water around the gun’s barrel to keep it cool. His creation was aided by the invention of smokeless powder (see pp.142–43). This new propellant produced less residue to clog a barrel, and developed its explosive pressure more gradually, thereby imparting less shock to the mechanism. Maxim had observed that the guns, operated by a crank handle or a lever, were hard to train onto moving targets. With his new gun, all the user had to do was aim and shoot—the gun would continue to fire until its ammunition supply was exhausted. Maxim’s genius had conceived a new way to use explosion energy for operating a gun and created a true machine-gun.

On the battlefield, the Maxim gun brought shocking carnage and prompted a change in military tactics. It was an ideal weapon for defending a position, whether a building or a trench, and Maxim-equipped armies began to lure enemies into “charging,” at which point they could be mown down. This was seen for the first time when British colonial forces used the Maxim in the Matabele War (1893–94) in modern-day Zimbabwe. In a nation where firearms were not in common use by non-Europeans, its impact was as much psychological as physical. In one battle, it is said that 50 British soldiers with just four Maxim guns fought off 5,000 Ndebele warriors. Pitched battles and charging began to become obsolete. This weapon was again used to devastating effect in Sudan in the Battle of Omdurman (1898), fought between the British and Arab Mahdist forces. Used successfully against the charging tactics of the Arabs, the Maxim enabled the British forces to kill more than 10,000 of the enemy while losing only about 50 soldiers.

Maxim’s patent became a blueprint for many modern self-loading firearms that followed and have become icons of their type, bringing with them a new level of horror to armed conflict.

KEY **FIGURE**

HIRAM STEVENS MAXIM

(1840–1916)

American-born Hiram Maxim emigrated to Britain in 1881 and became a British subject in 1900. His childhood experience of being knocked over by a rifle’s recoil may have been instrumental in leading him to harness a gun’s recoil energy, eventually designing the Maxim machine-gun. His inventions included, among others, his “Captive Flying Machine”—a very successful fairground ride, which helped fund his experiments. He was knighted in 1901.

▼ THE MAXIM IN CHITRAL
By the 1890s, the British Army decided to issue the Maxim gun to every battalion. Captain Alan L. Peebles of the Devonshire Regiment had seen the Maxim in action in Waziristan in 1894. In 1895, he brought a pair of Maxim guns to Chitral (in modern-day Pakistan) as part of a British expeditionary force sent to recapture a fort overtaken by Afghan tribesmen. Pictured here are some soldiers from the force with a Maxim Gun.

AFTER »

Maxim’s gun turned the old, manual machine-guns into obsolete technology. Once it got into production and its capabilities became known, it provided the cutting edge every military power wanted in order to give themselves supremacy over a supposed enemy.

- **LIGHT MACHINE-GUNS** developed rapidly, leading to guns such as the Browning Automatic Rifle (see p.194). These could be carried by one man with a supply of ammunition and fired from the hip while moving.

BROWNING AUTOMATIC RIFLE

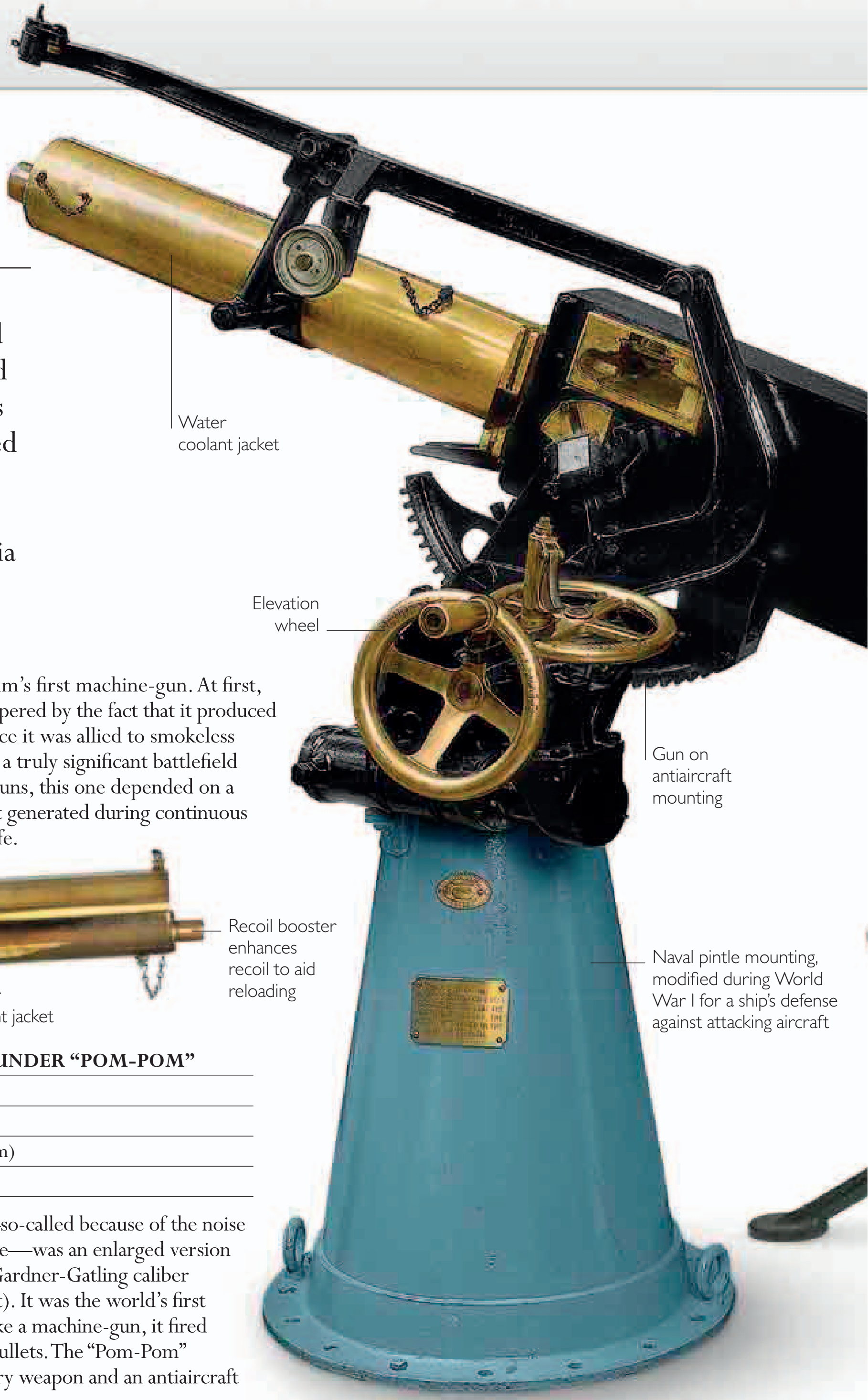
- **SUBMACHINE-GUNS** were lighter, more compact, and fired pistol ammunition. The most iconic gun of this period was the Thompson submachine-gun (see pp.212–13).

THOMPSON SUBMACHINE-GUN

- **MODERN FULLY AUTOMATIC** and semiautomatic weapons are the offspring of these early developments, relying on the same basic recoil-operation principles for their action. The technology extended beyond heavy weaponry to handguns and spurred the development of self-loading, semiautomatic pistols using recoil energy.

RECOIL-OPERATED MACHINE-GUNS (1884–95)

In 1884, Sir Hiram Maxim invented a machine-gun (see pp. 184–85) that worked by recoil-action instead of being hand-cranked like earlier machine-guns (see pp.136–39). Maxim had initially tried to harness the energy of a gun's recoil to automate its action in rifles such as the Peabody-Martini and Winchester. He ultimately perfected the process in his machine-gun. The Maxim machine-gun was fully automatic, meaning it could fire continuously while the trigger was kept pulled. Within 10 years, armies in the UK, Germany, and Russia had adopted this weapon.



▼ MAXIM EARLY PATTERN MACHINE-GUN

Date	1885
Origin	Germany/UK
Barrel	28in (72cm)
Caliber	.45in

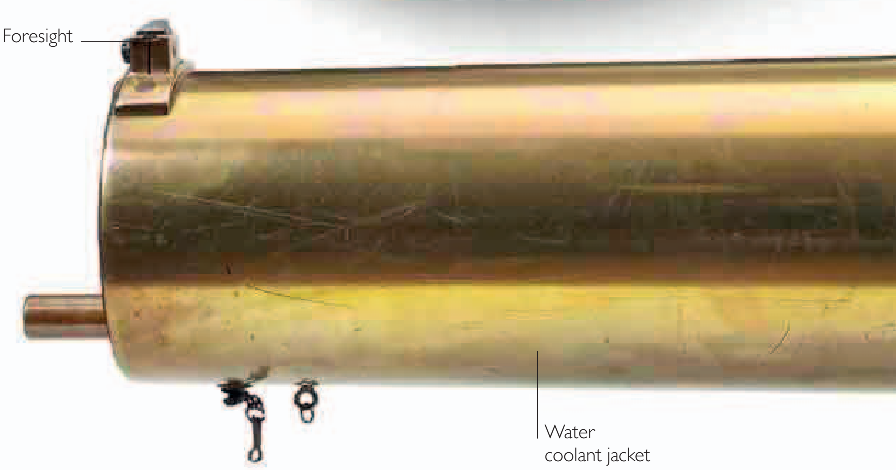
Seen here is an 1885 model of Maxim's first machine-gun. At first, orders for the Maxim gun were hampered by the fact that it produced clouds of gunpowder smoke, but once it was allied to smokeless powder (see pp.142–43), it became a truly significant battlefield weapon. Like many early machine-guns, this one depended on a water-cooling system to temper heat generated during continuous firing in order to extend its barrel life.

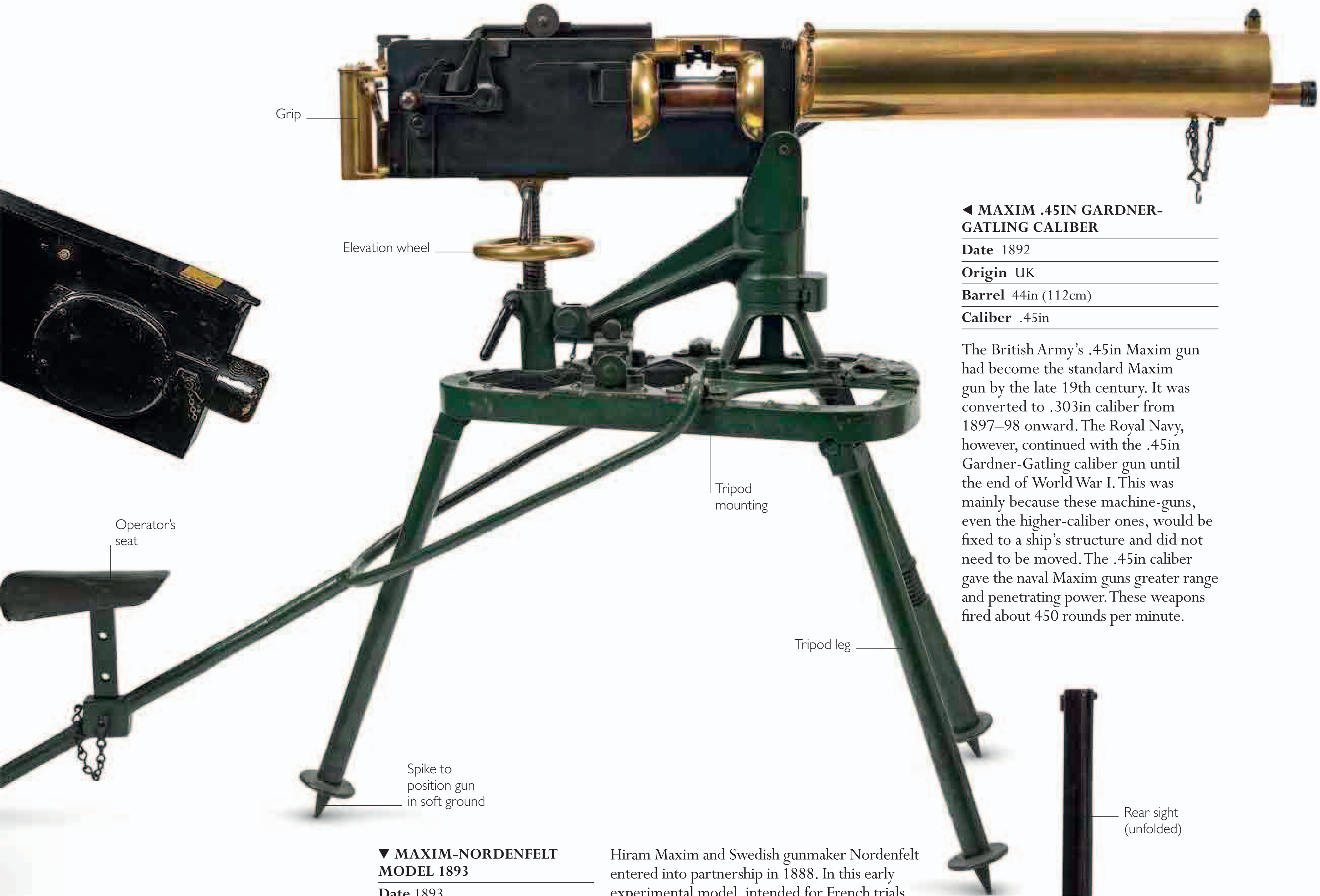

FULL VIEW

► MAXIM 1-POUNDER "POM-POM"

Date	1890
Origin	UK
Barrel	43in (109cm)
Caliber	37mm

The "Pom-Pom"—so-called because of the noise it made when in use—was an enlarged version of Maxim's .45in Gardner-Gatling caliber machine-gun (right). It was the world's first autocannon—unlike a machine-gun, it fired shells rather than bullets. The "Pom-Pom" served as an artillery weapon and an antiaircraft gun in World War I.





◀ MAXIM .45IN GARDNER-GATLING CALIBER

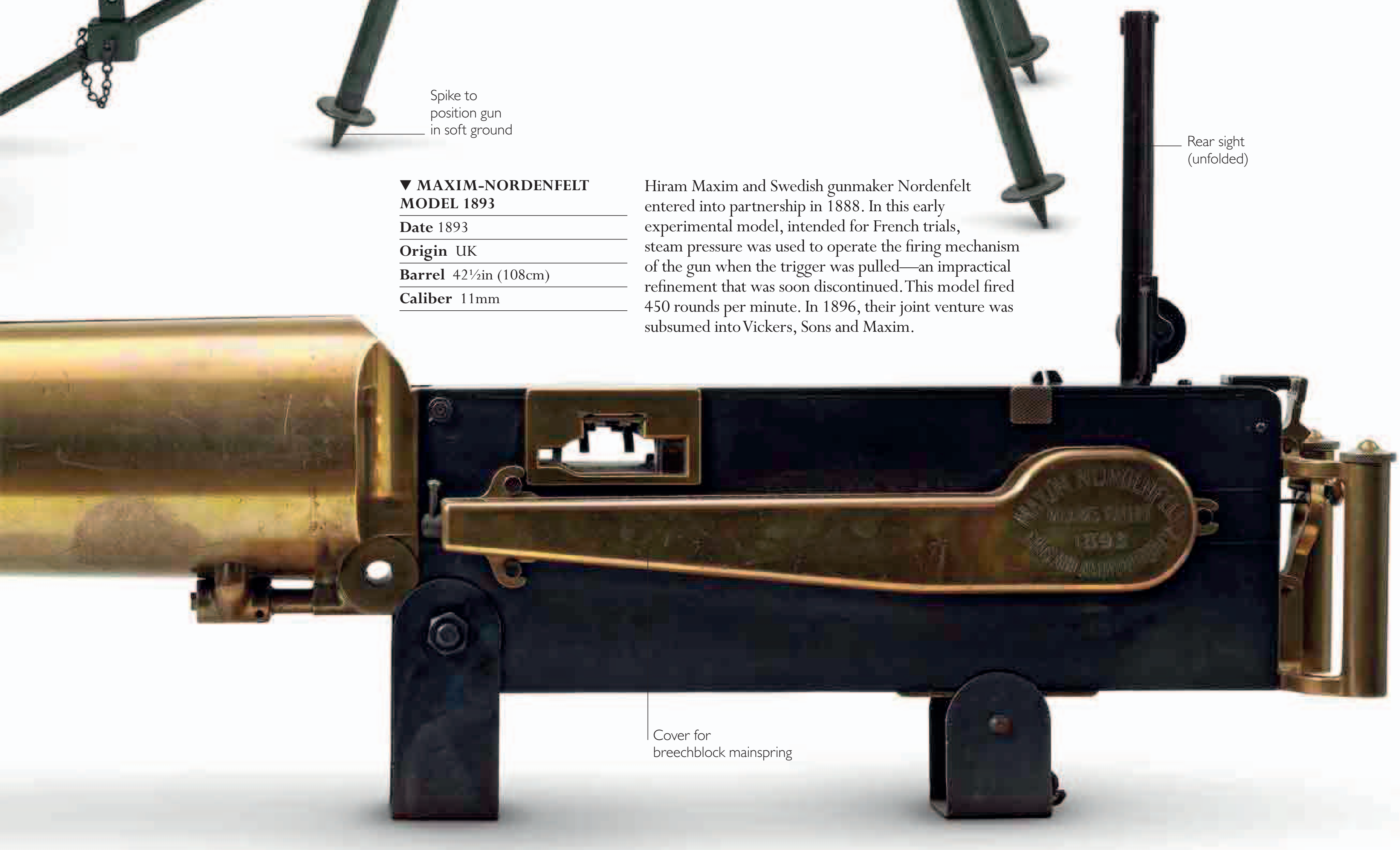
Date	1892
Origin	UK
Barrel	44in (112cm)
Caliber	.45in

The British Army's .45in Maxim gun had become the standard Maxim gun by the late 19th century. It was converted to .303in caliber from 1897–98 onward. The Royal Navy, however, continued with the .45in Gardner-Gatling caliber gun until the end of World War I. This was mainly because these machine-guns, even the higher-caliber ones, would be fixed to a ship's structure and did not need to be moved. The .45in caliber gave the naval Maxim guns greater range and penetrating power. These weapons fired about 450 rounds per minute.

▼ MAXIM-NORDENFELT MODEL 1893

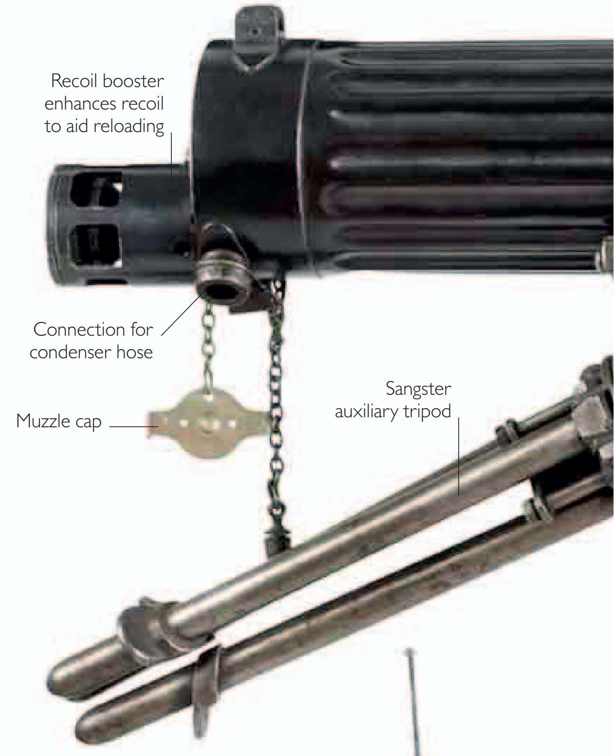
Date	1893
Origin	UK
Barrel	42½in (108cm)
Caliber	11mm

Hiram Maxim and Swedish gunmaker Nordenfelt entered into partnership in 1888. In this early experimental model, intended for French trials, steam pressure was used to operate the firing mechanism of the gun when the trigger was pulled—an impractical refinement that was soon discontinued. This model fired 450 rounds per minute. In 1896, their joint venture was subsumed into Vickers, Sons and Maxim.



RECOIL-OPERATED MACHINE-GUNS (1896–1917)

Machine-guns built at the turn of the 20th century were either recoil-operated or gas-driven (see pp.192–93). They were produced in Europe when the continent was devoid of conflict. Materials such as brass were plentiful and were used to make gun parts such as water jackets and spring housings. As Europe entered World War I, brass became scarcer, and steel—which was less expensive and also more durable—began to be employed for making gun parts. Gas-operated machine-guns could withstand greater pressure than recoil-operated ones and fire more powerful ammunition. However, recoil-operated machine-guns were more common, because their simple, reliable design found greater favor with troops.



▲ **MAXIM MACHINE-GUN MODEL 1904**

Date	1904
Origin	UK
Barrel	28½in (72.3cm)
Caliber	.30in-03

The Maxim gun was robust in construction and almost foolproof in design, taking on many forms after its introduction, including this upgraded model. This Maxim gun was the first rifle-caliber machine-gun formally adopted into US service. It was manufactured in .30in-03 caliber in the US by British gun manufacturer Vickers, Sons and Maxim. Later, some units were manufactured under licence in the US by Colt. Eventually, most Maxim models began to accept the newly introduced US .30in-06 cartridge. This gun fired 400–600 rounds per minute.

▶ **BROWNING MODEL 1917**

Date	1917
Origin	US
Barrel	24in (61cm)
Caliber	.30in

John Browning produced a poorly designed machine-gun for Colt, the gas-operated M1895 "Potato Digger" (see p.194), but later reverted to recoil operation when creating the M1917. It fired 400–520 rounds per minute. This gun sported a water jacket to cool its barrel during operation. Water-cooled machine-guns usually required a two-man crew—one to fire the gun and the other to monitor the jacket and the fabric belt which loaded ammunition into the gun. Ammunition belts could carry a higher number of cartridges than standard magazines and they could be loaded easily via the feedways on these guns.

▶ **VICKERS "LIGHT PATTERN" MODEL 1908**

Date	1908
Origin	UK
Barrel	28½in (72.3cm)
Caliber	.303in

The Model 1908 was designed to resolve shortcomings in the Vickers-Maxim "New Light" model (see p.196). It had a less bulky receiver. It could also be used in trenches with a traversing tripod base that allowed the gun to be swung upward for use. The gun could be used with a Youlton Hyperscope—a form of periscope sight commonly used in trenches in World War I. This model had a rate of fire of 450–550 rounds per minute.

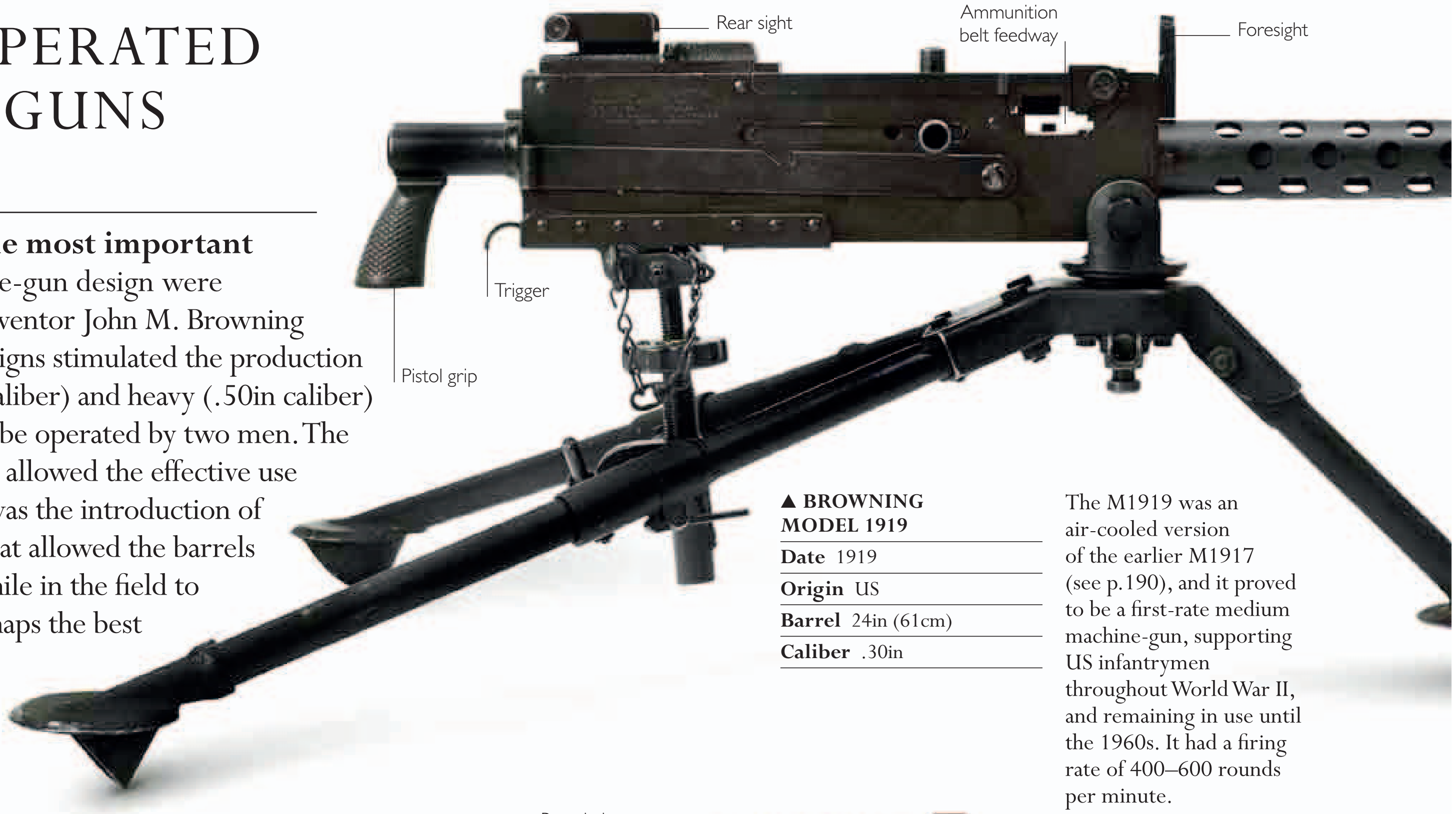
FULL VIEW

TRENCH WARFARE

Machine-guns such as those made by Hotchkiss and Maxim caused great destruction in the trench warfare of World War I. This two-man French Hotchkiss crew is flanked by two infantrymen.

RECOIL-OPERATED MACHINE-GUNS (1918–45)

Without question, the most important advancements in machine-gun design were made by the American inventor John M. Browning (see pp.180–81). His designs stimulated the production of both medium (.30in caliber) and heavy (.50in caliber) machine-guns that could be operated by two men. The second advancement that allowed the effective use of recoil-operated guns was the introduction of barrel-locking systems that allowed the barrels to be changed quickly while in the field to prevent overheating. Perhaps the best of these systems was that developed for use on the German MG42, a design that remains in use to this day.



▲ BROWNING MODEL 1919

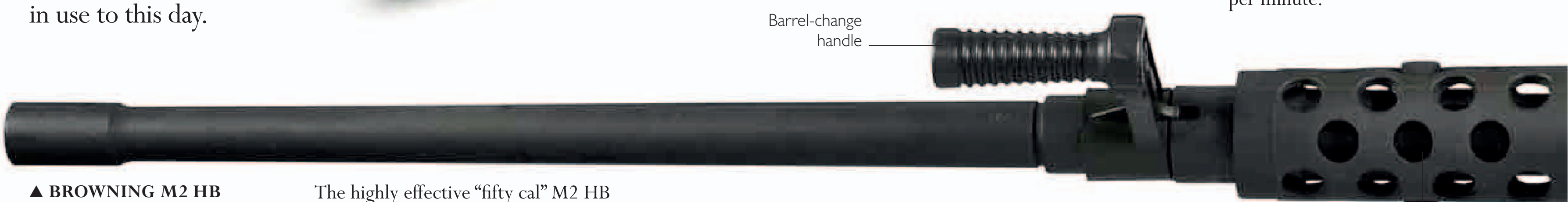
Date 1919

Origin US

Barrel 24in (61cm)

Caliber .30in

The M1919 was an air-cooled version of the earlier M1917 (see p.190), and it proved to be a first-rate medium machine-gun, supporting US infantrymen throughout World War II, and remaining in use until the 1960s. It had a firing rate of 400–600 rounds per minute.



▲ BROWNING M2 HB

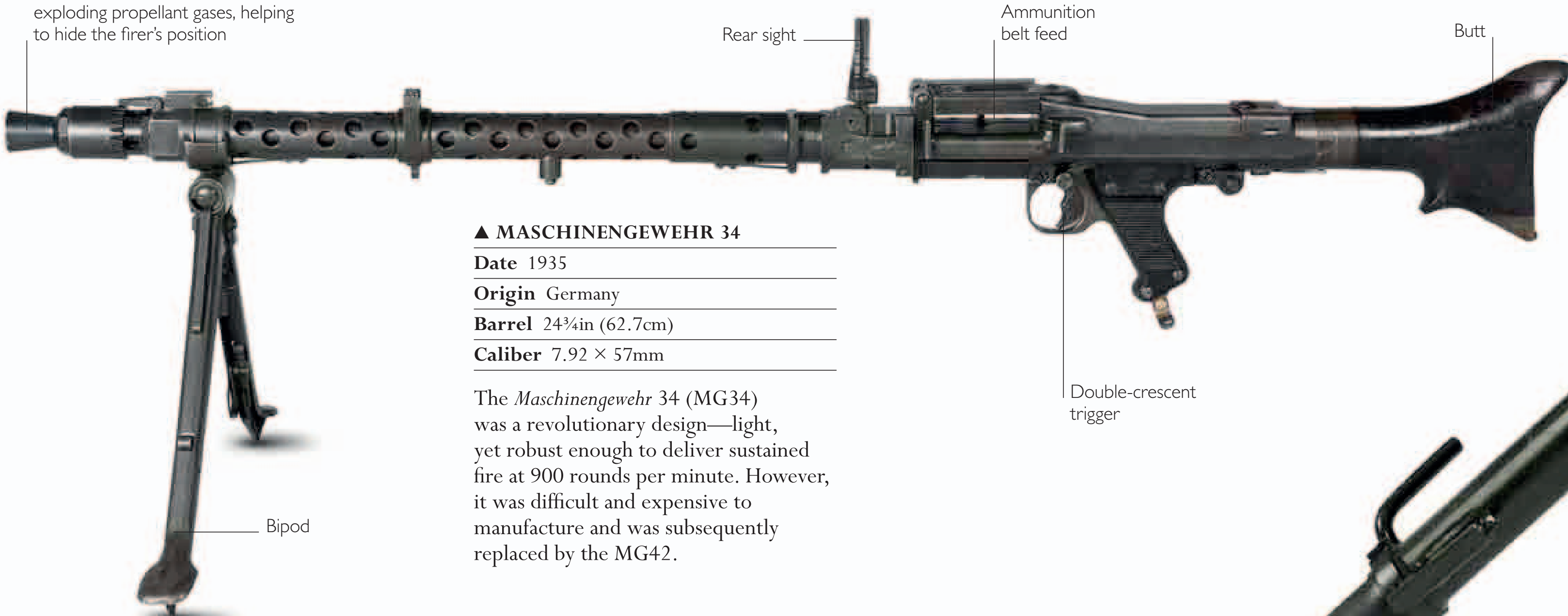
Date 1933

Origin US

Barrel 3¾ft (1.14m)

Caliber .50in

The highly effective "fifty cal" M2 HB (heavy barrel) has been used as a key armament in aircraft, on armored vehicles, and as shown here, by ground troops. This gun can fire 485–635 rounds per minute, and remains in service today.



▲ MASCHINENGEWEHR 34

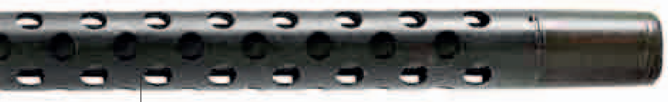
Date 1935

Origin Germany

Barrel 24¾in (62.7cm)

Caliber 7.92 × 57mm

The *Maschinengewehr* 34 (MG34) was a revolutionary design—light, yet robust enough to deliver sustained fire at 900 rounds per minute. However, it was difficult and expensive to manufacture and was subsequently replaced by the MG42.



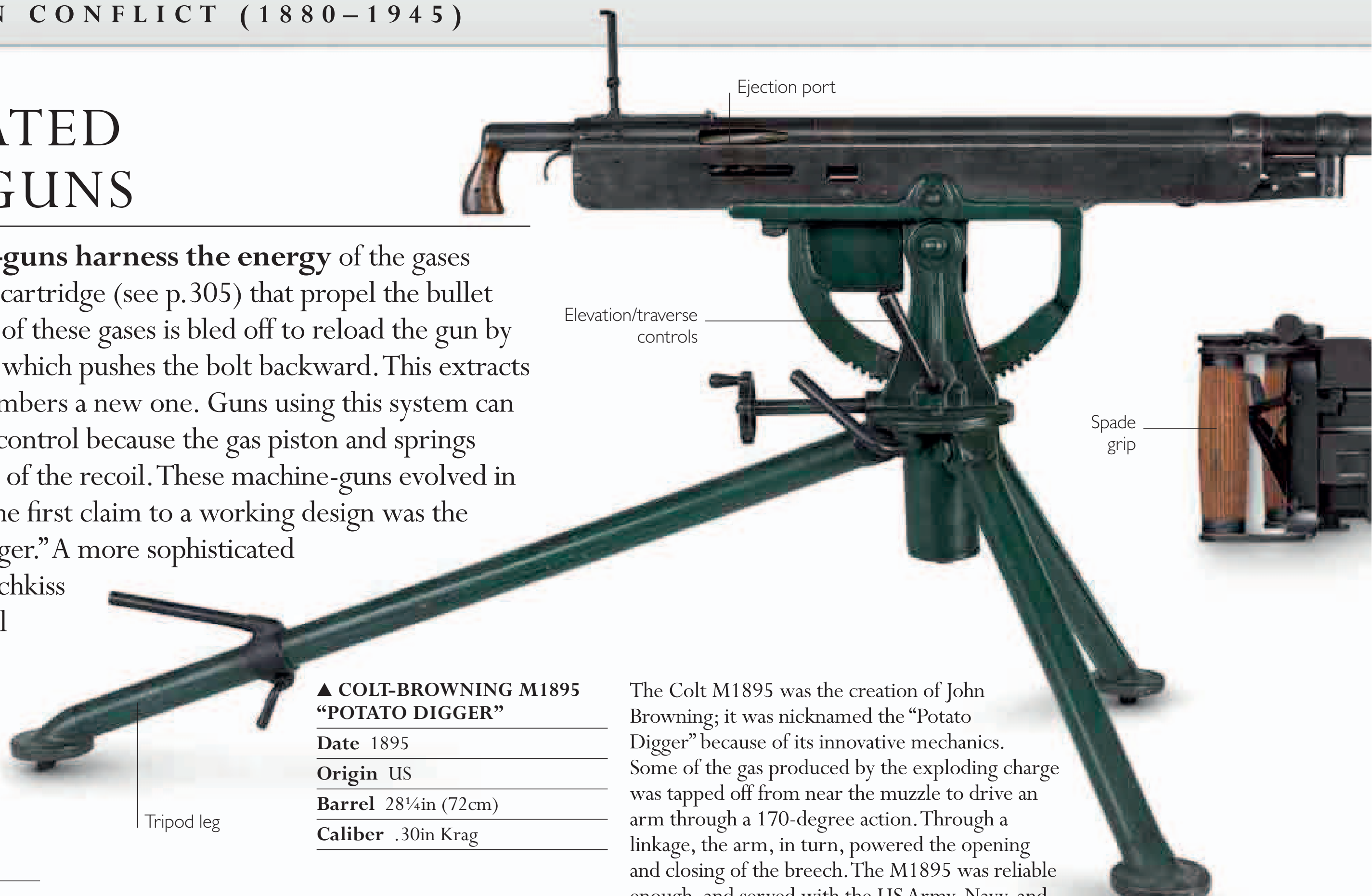
▶ MASCHINENGEWEHR 42

Date	1942
Origin	Germany
Barrel	21in (53.3cm)
Caliber	7.92 × 57mm

A successor to the MG34 (below), the MG42 had an extraordinarily high rate of fire—over 1,200 rounds per minute—and was capable of sustained long-range fire when used with a tripod. It featured a recoil-actuated automatic traverse mechanism, which moved the gun's butt slightly to the left and right when firing, allowing the weapon to spray bullets over a small arc and a large target area.

GAS-OPERATED MACHINE-GUNS

Gas-operated machine-guns harness the energy of the gases produced by the exploding cartridge (see p.305) that propel the bullet down the barrel. A portion of these gases is bled off to reload the gun by driving a piston to the rear, which pushes the bolt backward. This extracts the spent cartridge and chambers a new one. Guns using this system can be made light and easily to control because the gas piston and springs inside the gun absorb much of the recoil. These machine-guns evolved in the 1880s and 1890s, and the first claim to a working design was the Colt-Browning "Potato Digger." A more sophisticated design belonged to the Hotchkiss company's hugely successful Hotchkiss machine-gun. Gas-operated systems have continued to proliferate.



▲ COLT-BROWNING M1895 "POTATO DIGGER"

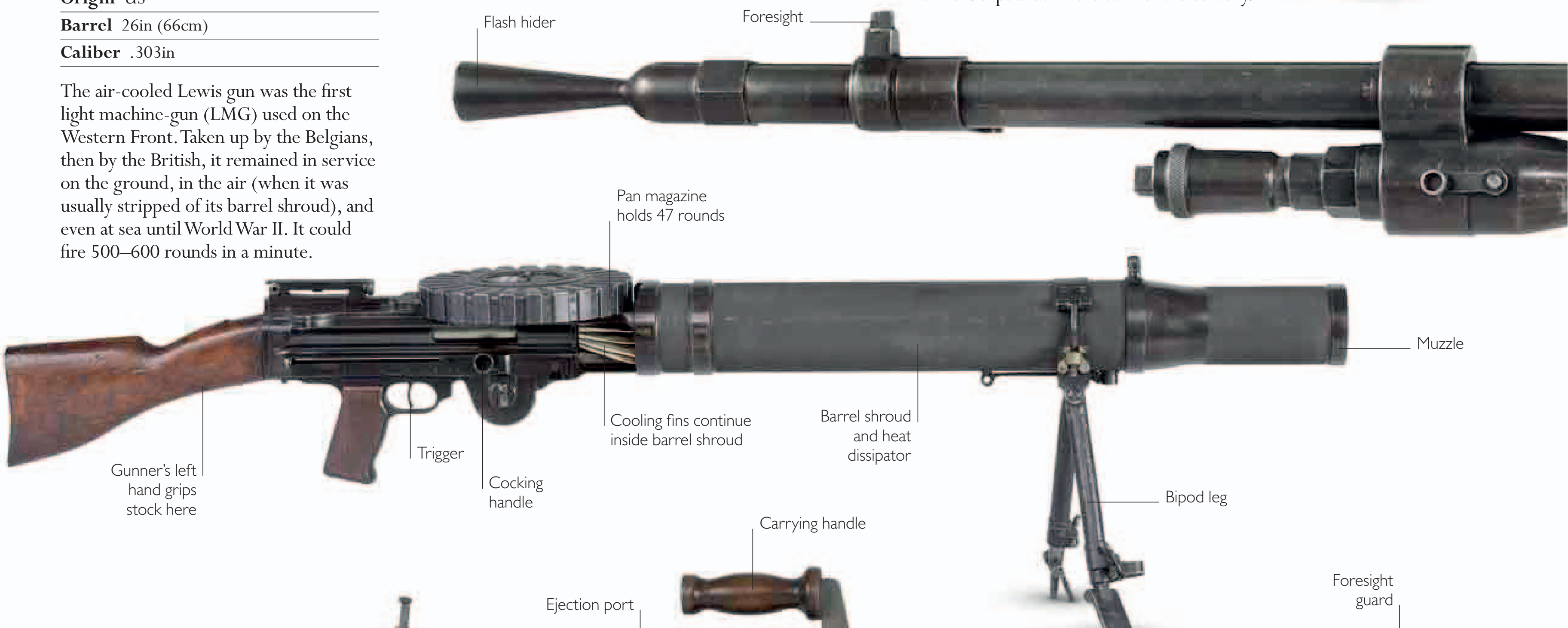
Date	1895
Origin	US
Barrel	28¼in (72cm)
Caliber	.30in Krag

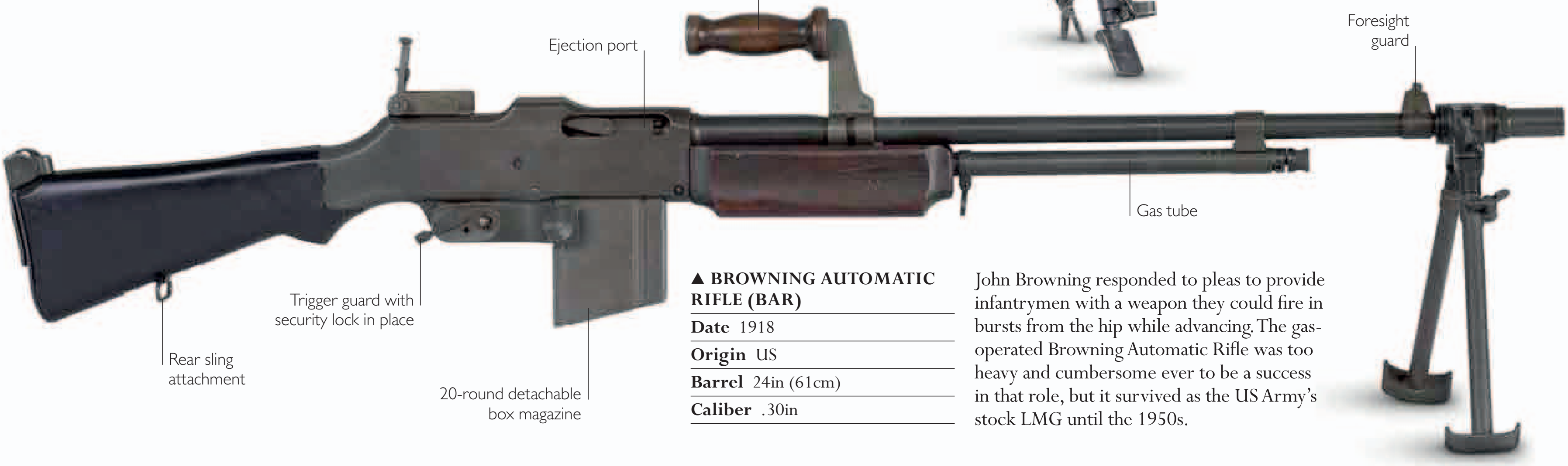
The Colt M1895 was the creation of John Browning; it was nicknamed the "Potato Digger" because of its innovative mechanics. Some of the gas produced by the exploding charge was tapped off from near the muzzle to drive an arm through a 170-degree action. Through a linkage, the arm, in turn, powered the opening and closing of the breech. The M1895 was reliable enough, and served with the US Army, Navy, and Marine Corps around the turn of the century.

▼ LEWIS GUN M1914

Date	1914
Origin	US
Barrel	26in (66cm)
Caliber	.303in

The air-cooled Lewis gun was the first light machine-gun (LMG) used on the Western Front. Taken up by the Belgians, then by the British, it remained in service on the ground, in the air (when it was usually stripped of its barrel shroud), and even at sea until World War II. It could fire 500–600 rounds in a minute.





▲ BROWNING AUTOMATIC RIFLE (BAR)

Date	1918
Origin	US
Barrel	24in (61cm)
Caliber	.30in

John Browning responded to pleas to provide infantrymen with a weapon they could fire in bursts from the hip while advancing. The gas-operated Browning Automatic Rifle was too heavy and cumbersome ever to be a success in that role, but it survived as the US Army's stock LMG until the 1950s.

▼ GORYUNOV SGM

Date	1946
Origin	Soviet Union
Length	44in (112cm)
Caliber	7.62 × 54mm

First developed during World War II, this Soviet machine-gun was modernized shortly after the conflict ended. Dust covers were added to both the feeding aperture and the ejection port for fired cartridge casings, and a finned barrel was added to dissipate heat during use. The gun was then given the name Goryunov SGM. Its rate of fire was 500–700 rounds per minute.

▼ HOTCHKISS MLE 1914

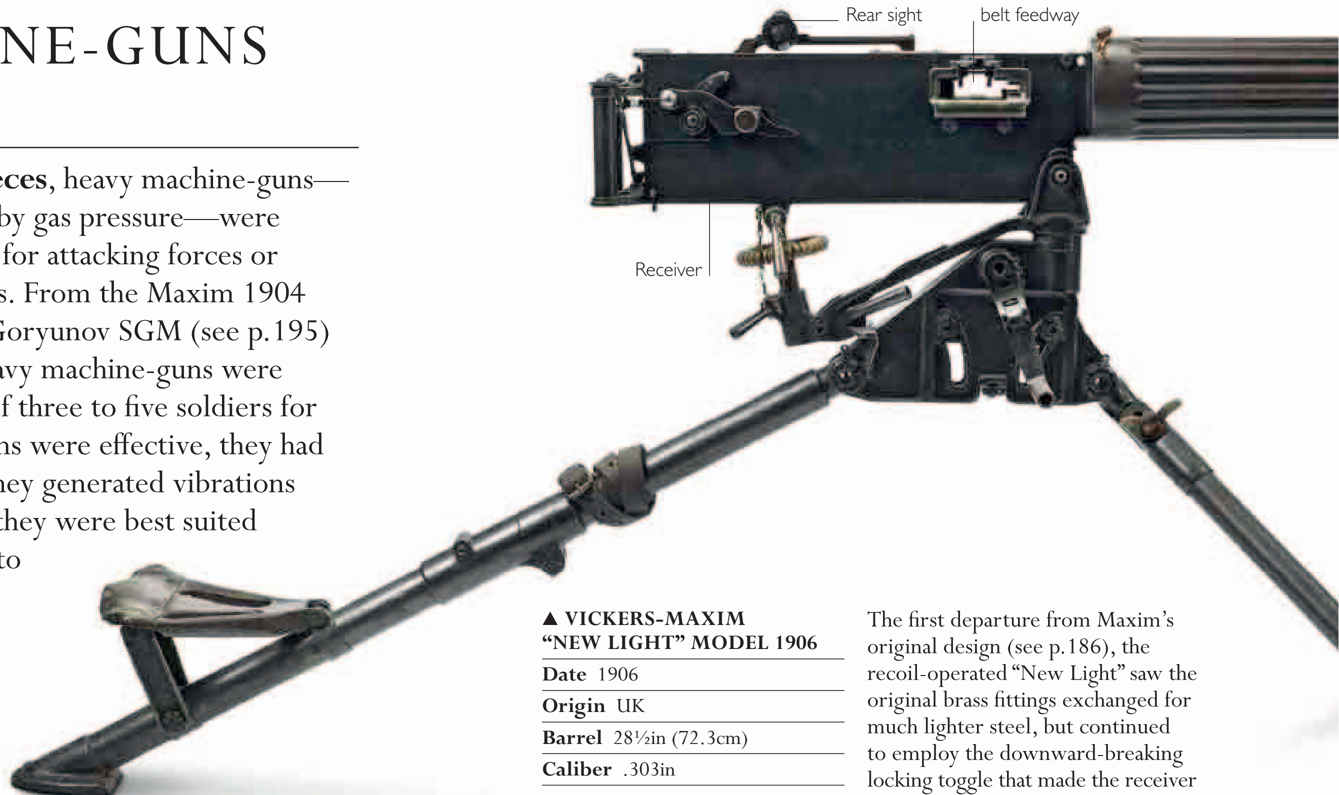
Date	1914
Origin	France
Barrel	50in (127cm)
Caliber	8mm Lebel

The Hotchkiss MLE 1914 was based upon a design originally conceived by Baron A. Odkolek von Augeza of Austria. It was improved by Lawrence V. Benet in association with Henri Mercie. The primary changes in the arm's construction involved the incorporation of fins to cool the barrel during firing—a design improvement that would be seen in many machine-guns—and a gas regulator to control the rate of fire, which was about 550 rounds per minute. Simple in construction, with only 32 parts, the MLE 1914 was fed with metallic ammunition strips that held 24 rounds.

FULL VIEW

HEAVY MACHINE-GUNS (1900–10)

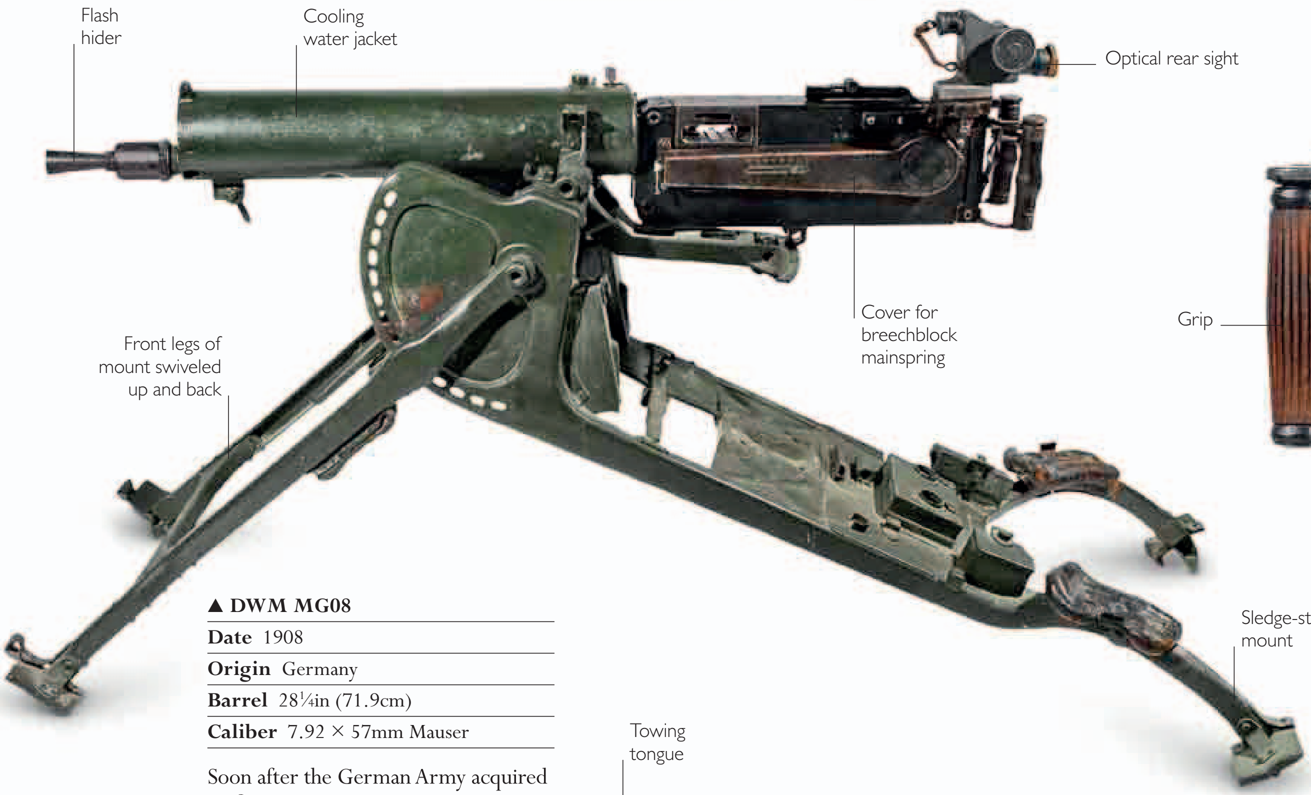
Viewed almost as artillery pieces, heavy machine-guns—some operating by recoil, others by gas pressure—were designed to provide covering fire for attacking forces or defensive fire from fixed positions. From the Maxim 1904 machine-gun (see p.188) to the Goryunov SGM (see p.195) and the Russian Maxim 1910, heavy machine-guns were cumbersome and needed crews of three to five soldiers for operation. Although these weapons were effective, they had limited mobility. During firing, they generated vibrations that made them unstable, and so they were best suited for use from static mounts fitted to vehicles or, later, aircraft.



▲ VICKERS-MAXIM "NEW LIGHT" MODEL 1906

Date	1906
Origin	UK
Barrel	28½in (72.3cm)
Caliber	.303in

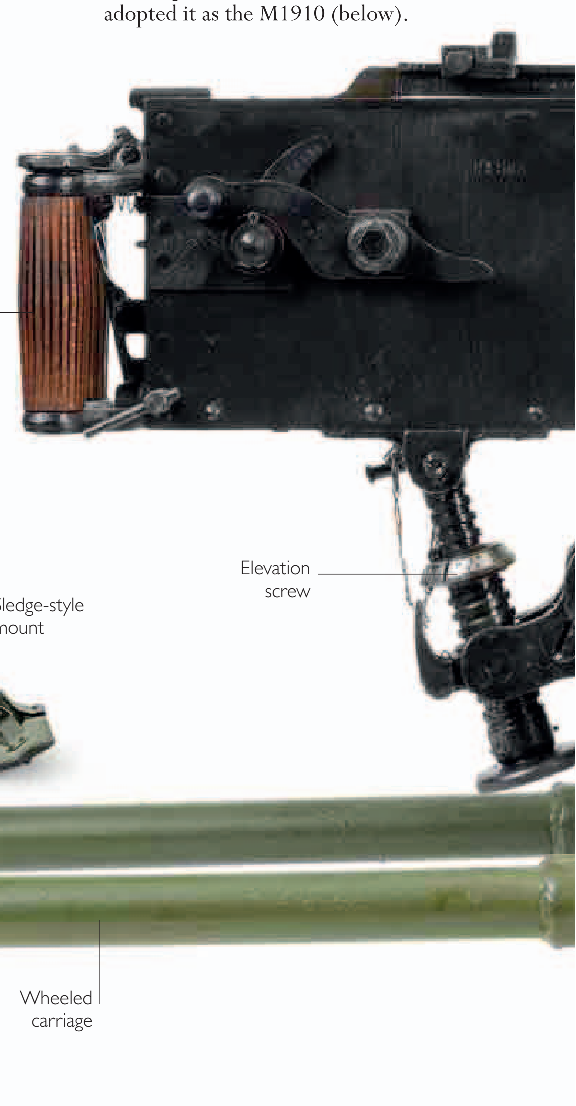
The first departure from Maxim's original design (see p.186), the recoil-operated "New Light" saw the original brass fittings exchanged for much lighter steel, but continued to employ the downward-breaking locking toggle that made the receiver large. Its rate of fire was 450–500 rounds per minute. The Russians adopted it as the M1910 (below).



▲ DWM MG08

Date	1908
Origin	Germany
Barrel	28¼in (71.9cm)
Caliber	7.92 × 57mm Mauser

Soon after the German Army acquired its first Maxims in 1895, *Deutsche Waffen und Munitionsfabriken* (DWM) began modifying the design, and the final version was adopted as the *schweres Maschinengewehr* 08 (heavy machine-rifle), or MG08. It had a heavy sledge-style mount, known as the *schlitten*. This gun fired 500 rounds per minute.



▲ SCHWARZLOSE MODEL 07/12

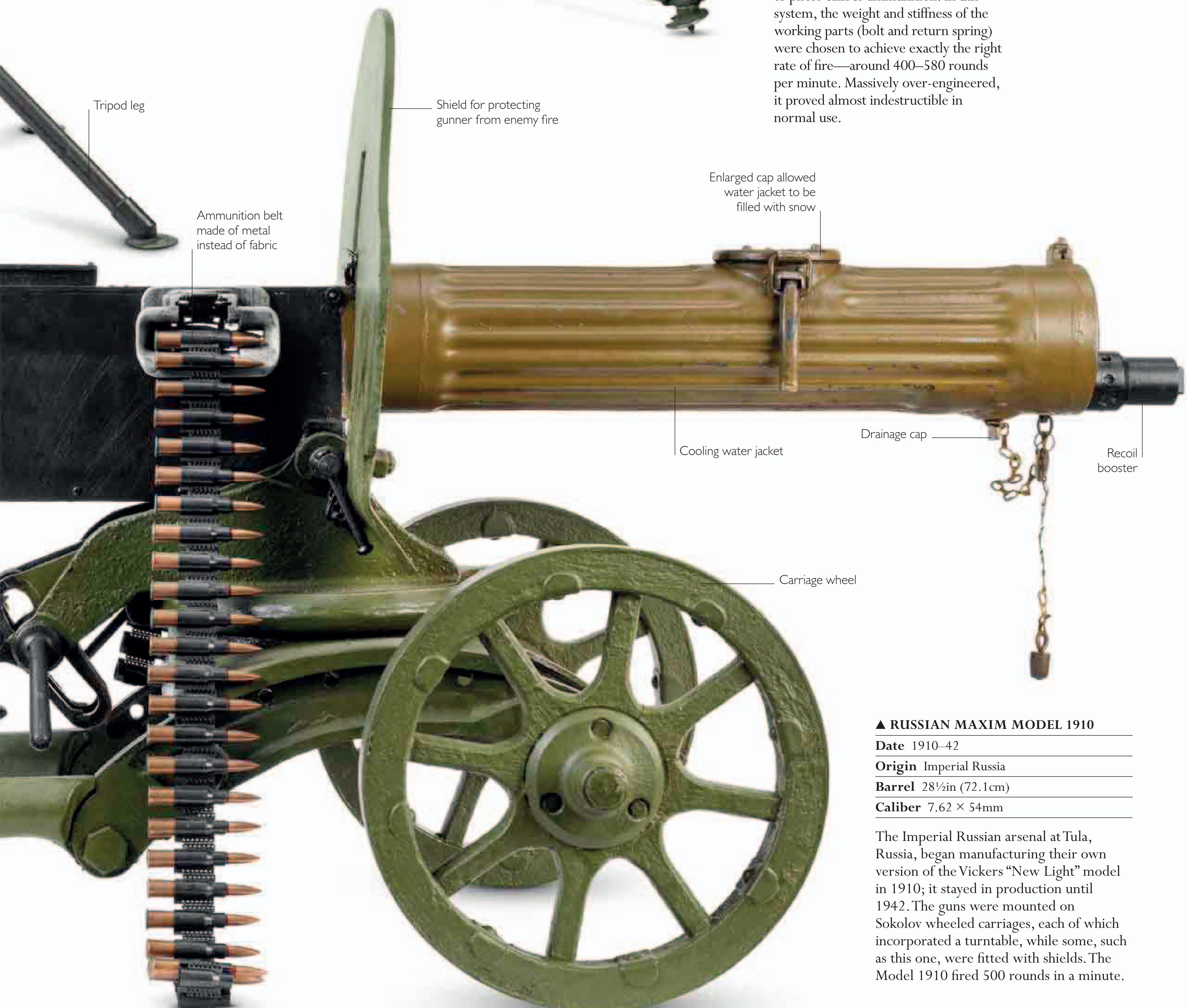
Date 1912

Origin Austria-Hungary

Barrel 20¾in (52.6cm)

Caliber 8mm Mannlicher

The Schwarzlose was the only heavy machine-gun to use an unlocked recoil-operated system, better suited to pistol-caliber ammunition. In this system, the weight and stiffness of the working parts (bolt and return spring) were chosen to achieve exactly the right rate of fire—around 400–580 rounds per minute. Massively over-engineered, it proved almost indestructible in normal use.



▲ RUSSIAN MAXIM MODEL 1910

Date 1910–42

Origin Imperial Russia

Barrel 28½in (72.1cm)

Caliber 7.62 × 54mm

The Imperial Russian arsenal at Tula, Russia, began manufacturing their own version of the Vickers "New Light" model in 1910; it stayed in production until 1942. The guns were mounted on Sokolov wheeled carriages, each of which incorporated a turntable, while some, such as this one, were fitted with shields. The Model 1910 fired 500 rounds in a minute.

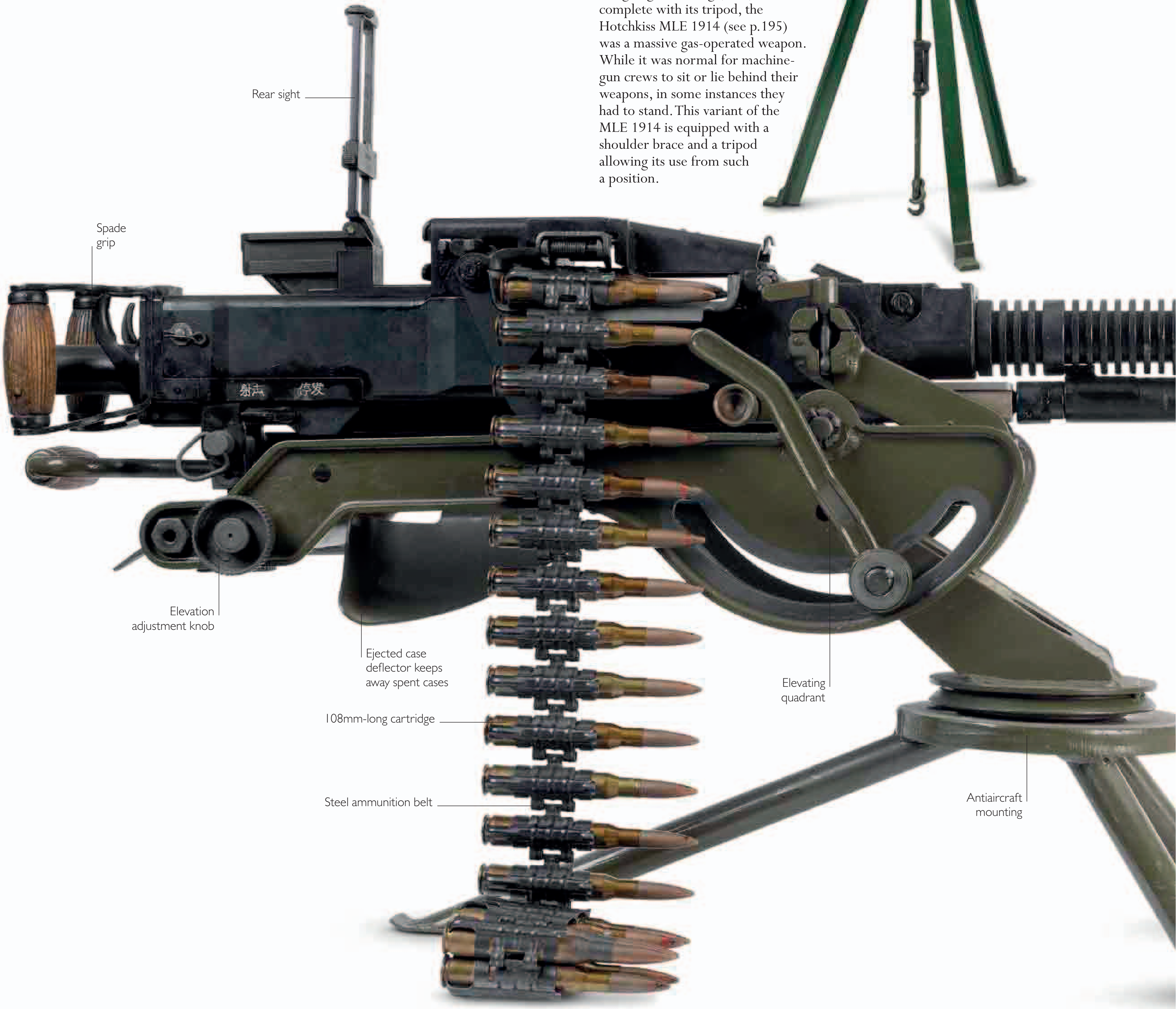
HEAVY MACHINE-GUNS (1911–45)

The heavy machine-guns of the two world wars proved their effectiveness when used against vehicles. Many were made in calibers of a sufficient size to penetrate light armor. These weapons, such as the gas-operated ones seen here, could also be used at long ranges—the Degtyarev DSHK1938 had a range of about 1¼ miles (2km), for instance. This helped to compromise the massing of enemy troops prior to attacks.

▶ HOTCHKISS M1914

Date	1914
Origin	France
Barrel	31in (78.7cm)
Caliber	8 × 50mm

Weighing over 36kg (80lb), complete with its tripod, the Hotchkiss MLE 1914 (see p.195) was a massive gas-operated weapon. While it was normal for machine-gun crews to sit or lie behind their weapons, in some instances they had to stand. This variant of the MLE 1914 is equipped with a shoulder brace and a tripod allowing its use from such a position.



▲ **FIAT-REVELLI MODEL 1914**

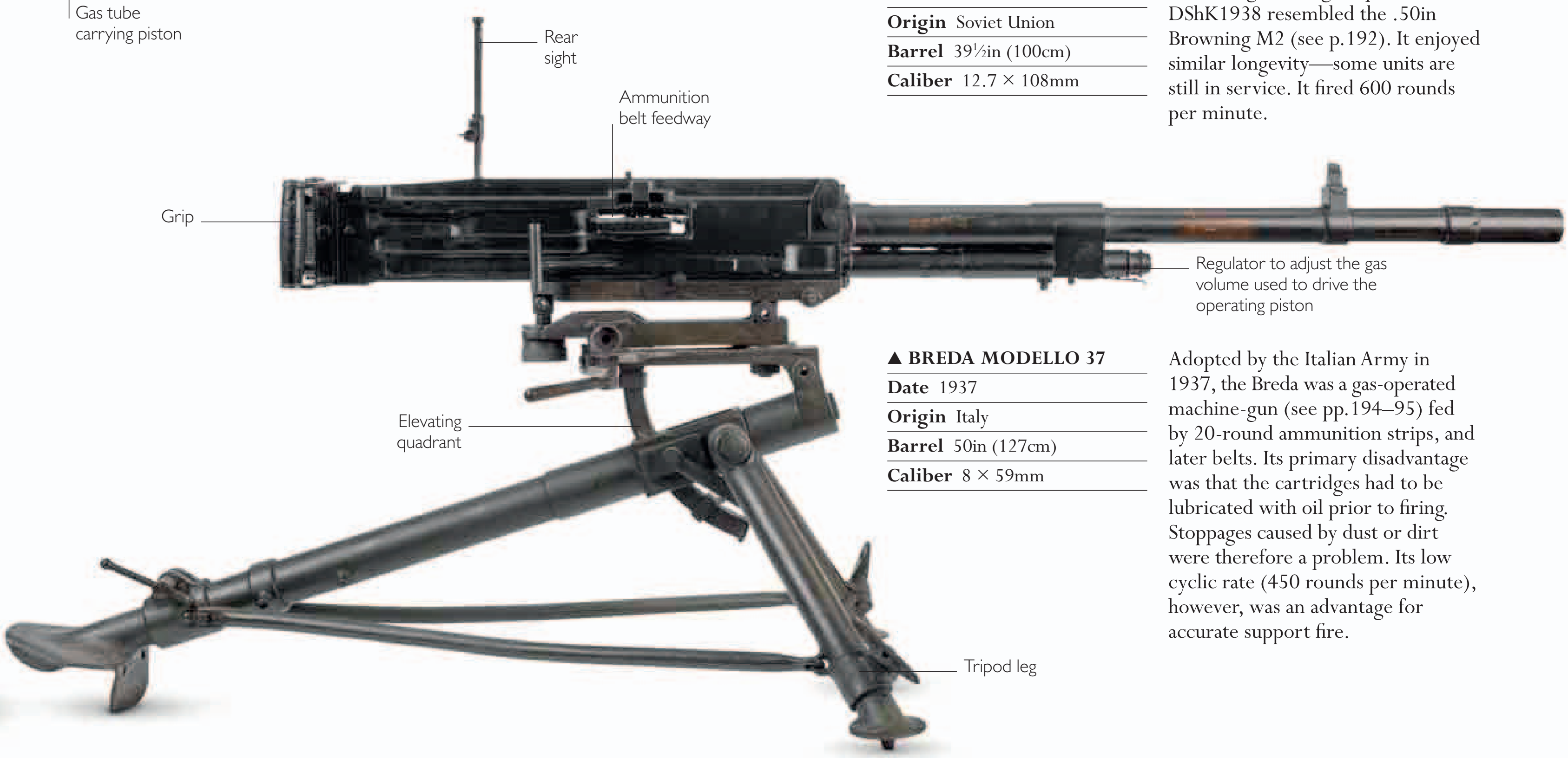
Date	1914
Origin	Italy
Barrel	25¾in (65.4cm)
Caliber	6.5mm Mannlicher-Carcano

This model employed a delayed recoil-operated system. The delay in breech unlocking allowed a better tolerance for higher breech pressures and more powerful shots than normal recoil-operated systems. Rounds were fed from a 50-round stack magazine and oiled on their way to the chamber. The oiled rounds picked up dust and dirt, causing the gun to jam frequently. This weapon's rate of fire was 500 rounds per minute.

▲ **DEGTYAREV DSHK1938**

Date	1938
Origin	Soviet Union
Barrel	39½in (100cm)
Caliber	12.7 × 108mm

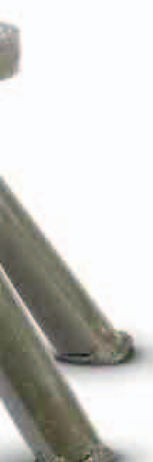
Employed as the Red Army's heavy machine-gun, the gas-operated DShK1938 resembled the .50in Browning M2 (see p.192). It enjoyed similar longevity—some units are still in service. It fired 600 rounds per minute.



▲ **BREDA MODELLO 37**

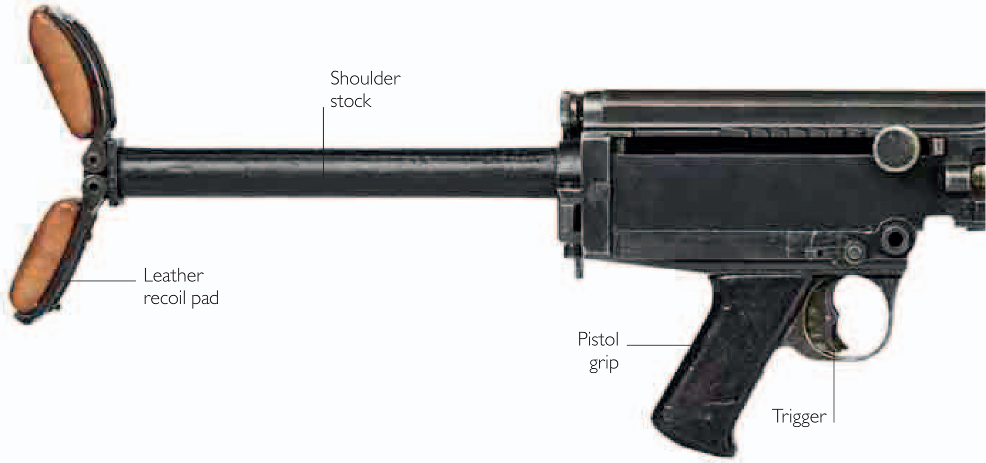
Date	1937
Origin	Italy
Barrel	50in (127cm)
Caliber	8 × 59mm

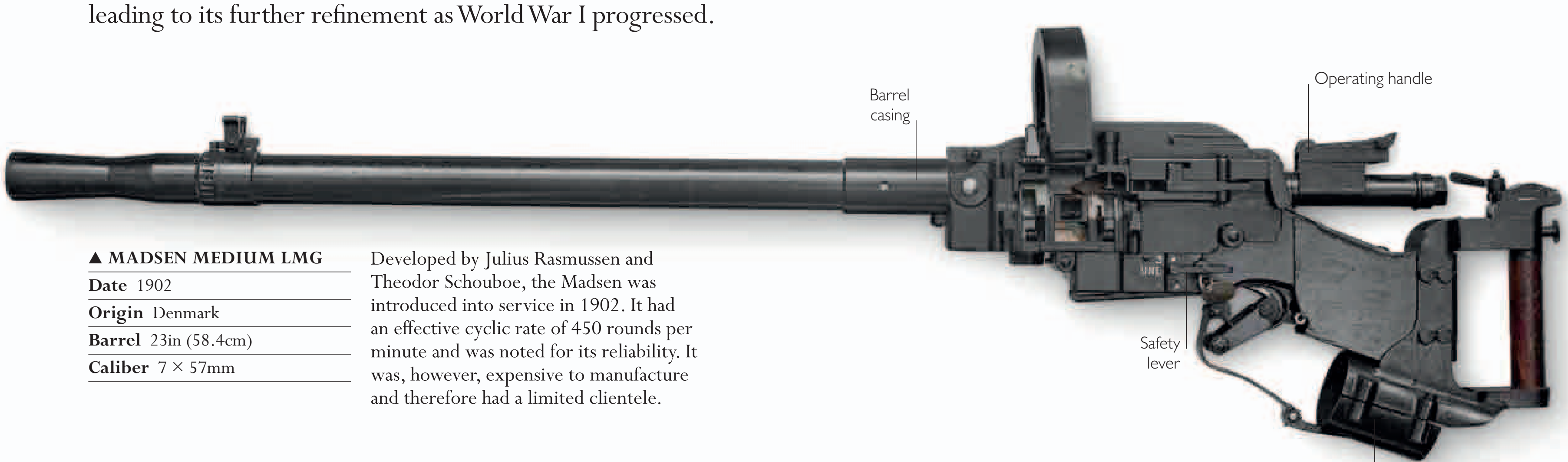
Adopted by the Italian Army in 1937, the Breda was a gas-operated machine-gun (see pp.194–95) fed by 20-round ammunition strips, and later belts. Its primary disadvantage was that the cartridges had to be lubricated with oil prior to firing. Stoppages caused by dust or dirt were therefore a problem. Its low cyclic rate (450 rounds per minute), however, was an advantage for accurate support fire.



LIGHT MACHINE-GUNS (1902–15)

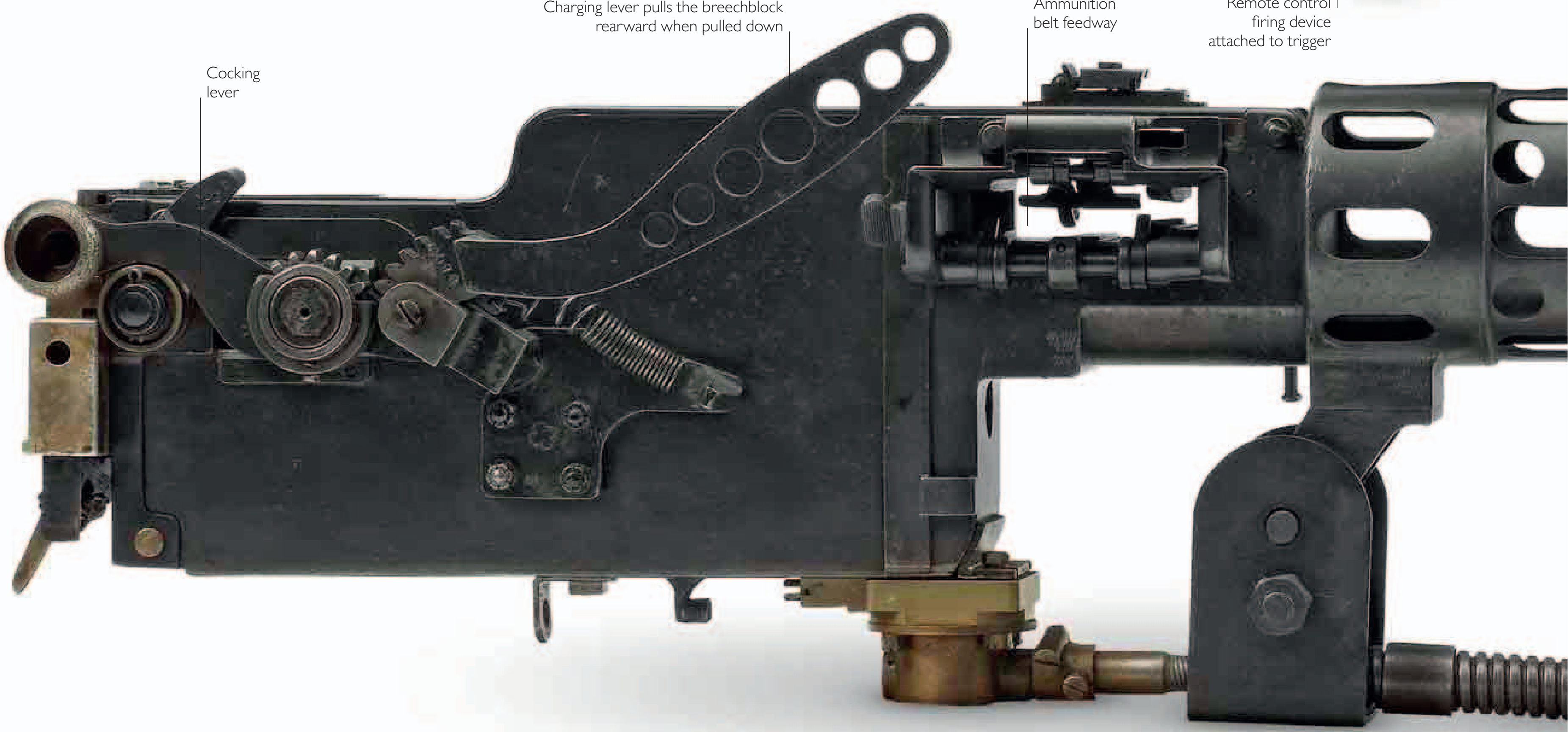
Trench warfare and stagnant lines were the norm on World War I battlefields, and the development of easily carried machine-guns became a necessity for raids and the strengthening of positions under fire. Some light machine-guns were developed strictly for use in aircraft, for which weight was a primary design consideration. During the first years of its use, the light machine-gun proved to be invaluable both as a defensive and offensive weapon, thereby leading to its further refinement as World War I progressed.

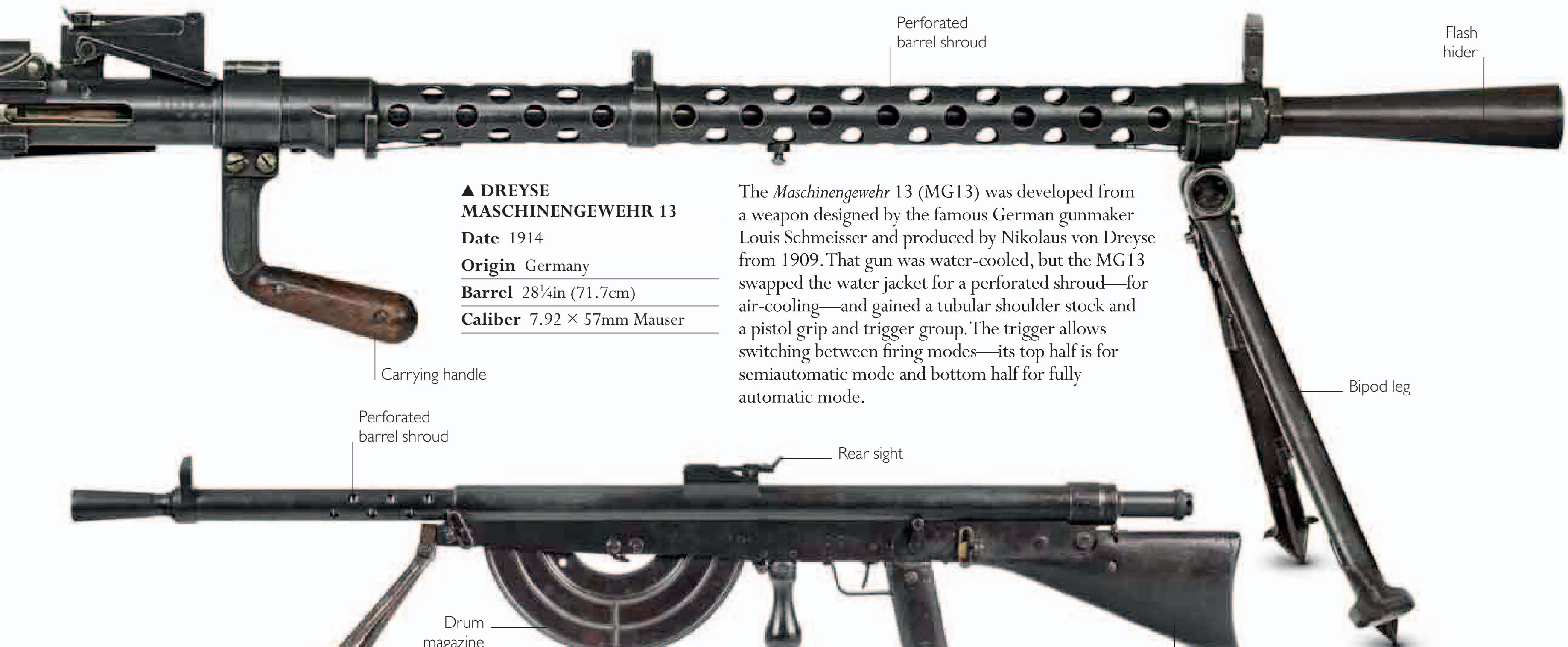




▲ MADSEN MEDIUM LMG	
Date	1902
Origin	Denmark
Barrel	23in (58.4cm)
Caliber	7 × 57mm

Developed by Julius Rasmussen and Theodor Schouboe, the Madsen was introduced into service in 1902. It had an effective cyclic rate of 450 rounds per minute and was noted for its reliability. It was, however, expensive to manufacture and therefore had a limited clientele.





▲ DREYSE MASCHINENGEWEHR 13

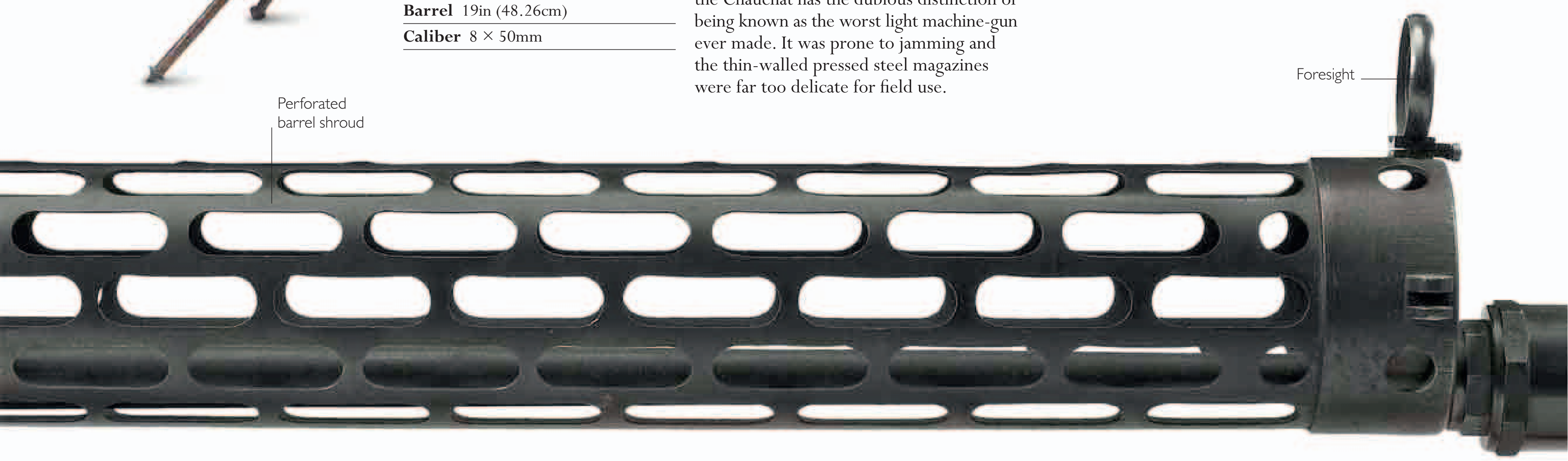
Date	1914
Origin	Germany
Barrel	28¼in (71.7cm)
Caliber	7.92 × 57mm Mauser

The *Maschinengewehr* 13 (MG13) was developed from a weapon designed by the famous German gunmaker Louis Schmeisser and produced by Nikolaus von Dreyse from 1909. That gun was water-cooled, but the MG13 swapped the water jacket for a perforated shroud—for air-cooling—and gained a tubular shoulder stock and a pistol grip and trigger group. The trigger allows switching between firing modes—its top half is for semiautomatic mode and bottom half for fully automatic mode.

▲ CHAUCHAT MLE 1915

Date	1907
Origin	France
Barrel	19in (48.26cm)
Caliber	8 × 50mm

More properly described as a machine-rifle, since it was intended for use by one person and could be fired in semiautomatic mode, the Chauchat has the dubious distinction of being known as the worst light machine-gun ever made. It was prone to jamming and the thin-walled pressed steel magazines were far too delicate for field use.



FULL VIEW

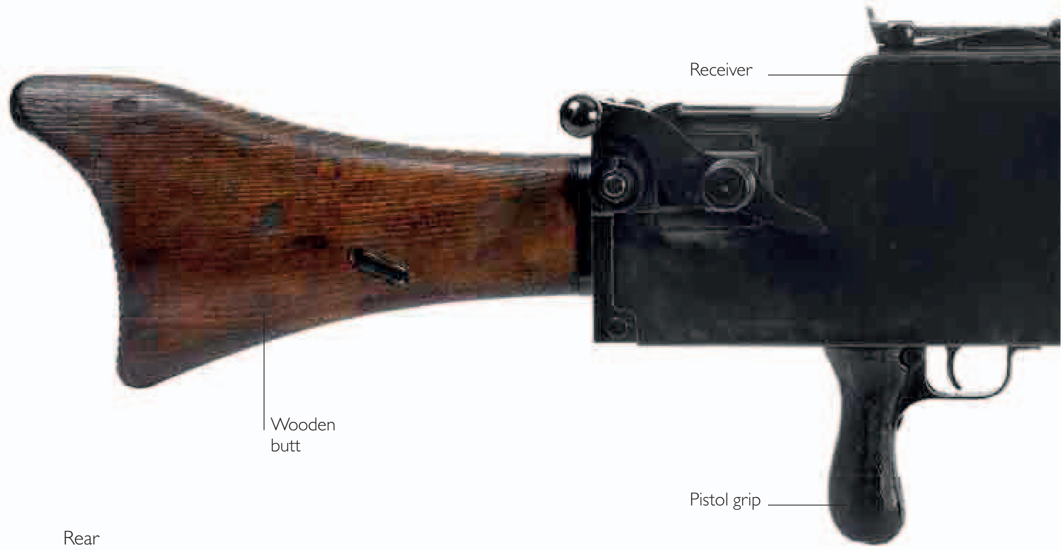
▲ SPANDAU 08/15 AIRCRAFT MACHINE-GUN

Date	1915
Origin	Germany
Barrel	28¼in (71.9cm)
Caliber	7.92 × 57mm Mauser

Though it was also used by infantrymen, fitted with a butt and pistol grip, the LMG08/15 was developed as a fixed gun for use in aircraft. In this form, it had a synchronizer cable linked to an interrupter gear, which allowed it to fire forward—right through the propeller's arc.

LIGHT MACHINE-GUNS (1916–25)

Although some light machine-guns continued to be fitted with water-cooling jackets, these models were intended for high-volume fire. When used simply to provide cover in short bursts, air-cooled weapons such as the Bergmann became the norm. These machine-guns had the benefit of easy portability because of the reduced weight, and they had less cumbersome accessories, thus requiring smaller crews.



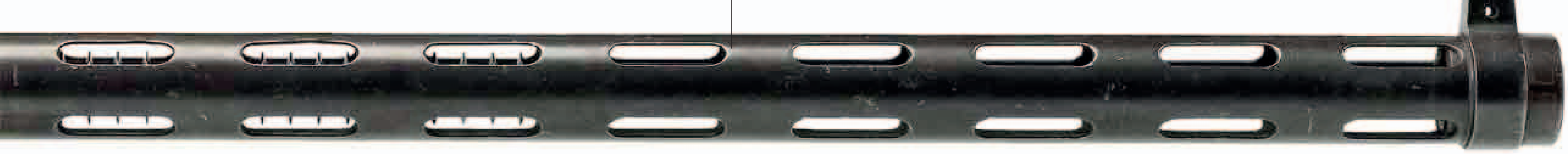
▲ BERGMANN LMG 15NA	
Date	1916
Origin	Germany
Barrel	28½in (72.6cm)
Caliber	7.92 × 57mm Mauser

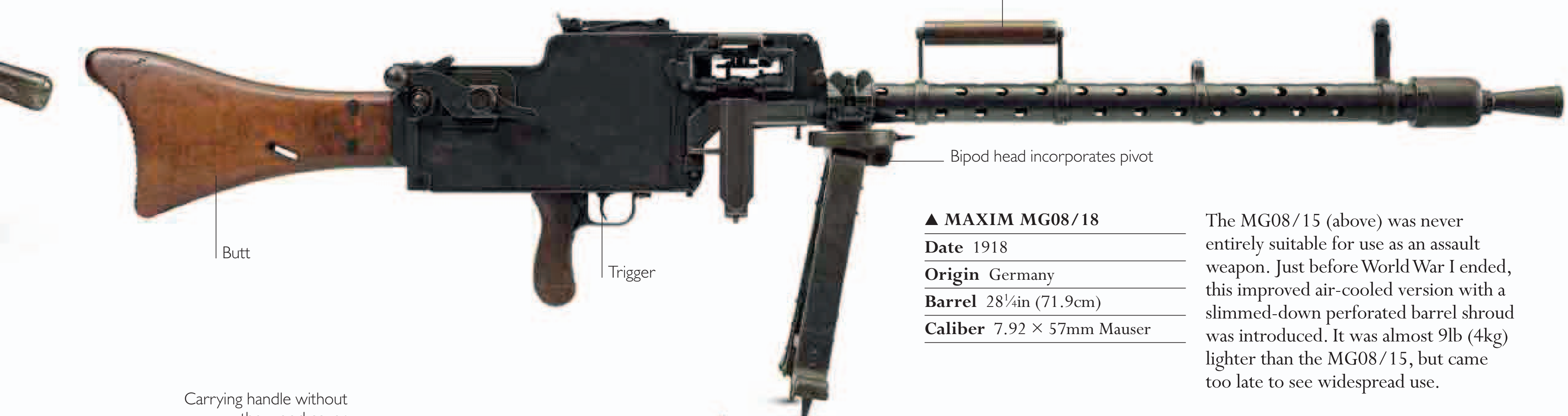
Bergmann's LMG was adopted in 1910, but it was not until the appearance of a modified version in 1916 that it found favor. Its ammunition was contained in a metal link belt, fed from a drumlike container.

▲ MAXIM MASCHINENGEWEHR 08/15

Date	1917
Origin	Germany
Barrel	28¼in (71.9cm)
Caliber	7.92 × 57mm Mauser

Germany's first, hurried attempt to produce a light machine-gun saw the DWM MG08 (see p.196) fitted with a butt, a pistol grip, and a conventional trigger, resulting in the Maxim 08/15. This improved version of the MG08 had a recontoured receiver to reduce the gun's weight and an integral bipod with a shortened ammunition belt contained in a drumlike container. Weighing 30¾lb (14kg), it was still far too heavy. Around 130,000 units were produced, and it became the principal support weapon for the stormtroopers of the *Reichswehr*—Germany's interwar armed forces.

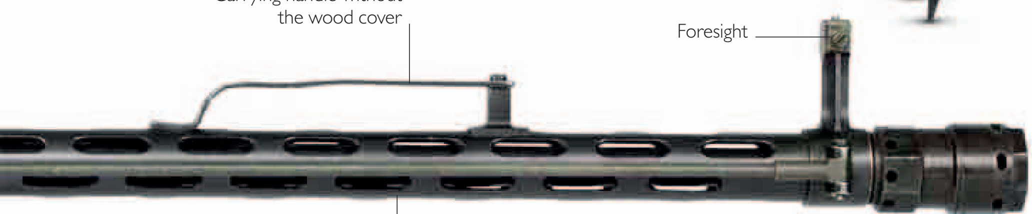




▲ MAXIM MG08/18

Date	1918
Origin	Germany
Barrel	28¼in (71.9cm)
Caliber	7.92 × 57mm Mauser

The MG08/15 (above) was never entirely suitable for use as an assault weapon. Just before World War I ended, this improved air-cooled version with a slimmed-down perforated barrel shroud was introduced. It was almost 9lb (4kg) lighter than the MG08/15, but came too late to see widespread use.



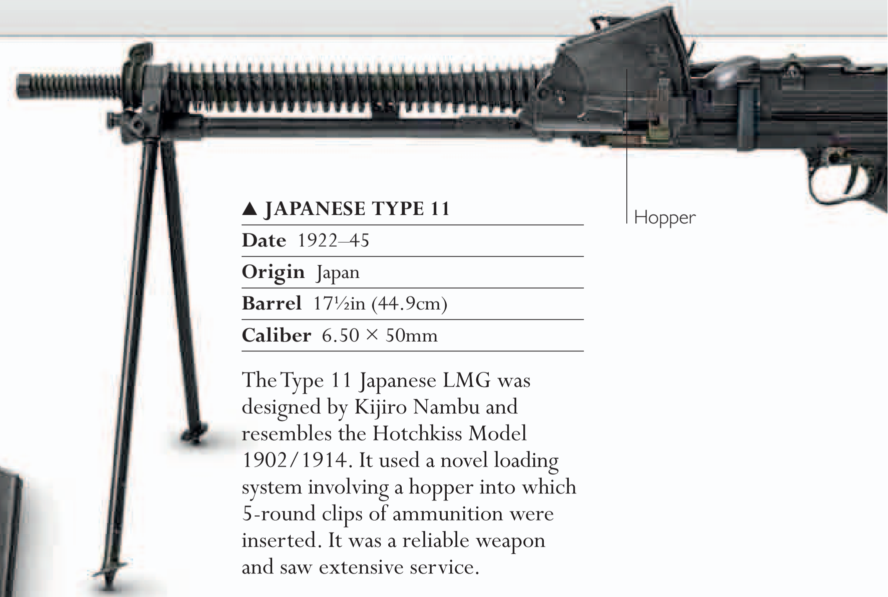
◀ MAXIM PARABELLUM LMG 14/17

Date	1917
Origin	Germany
Barrel	27¾in (70.5cm)
Caliber	7.92 × 57mm Mauser

Arguably the best of the German Maxims, the Parabellum LMG was produced in response to a specification for a weapon for flexible mounting in aircraft and airships. This later version has a slimmed-down barrel shroud. It was issued to selected infantry units in this form toward the end of the war.

LIGHT MACHINE-GUNS (1926–45)

From the 1920s onward, light machine-guns were redesigned with a view to reducing the size of their crews. While earlier LMGs, such as the Maxim 08/15 (see p.203), required a crew of four, newer LMGs such as the Bren could be operated by a one- or two-man crew. This reduction in the crew size was made possible by changing the ammunition feed system from belts, which needed an additional user for ensuring proper loading, to box magazines, which could be loaded and changed by the main user only.



▲ JAPANESE TYPE 11

Date	1922–45
Origin	Japan
Barrel	17½in (44.9cm)
Caliber	6.50 × 50mm

The Type 11 Japanese LMG was designed by Kijiro Nambu and resembles the Hotchkiss Model 1902/1914. It used a novel loading system involving a hopper into which 5-round clips of ammunition were inserted. It was a reliable weapon and saw extensive service.

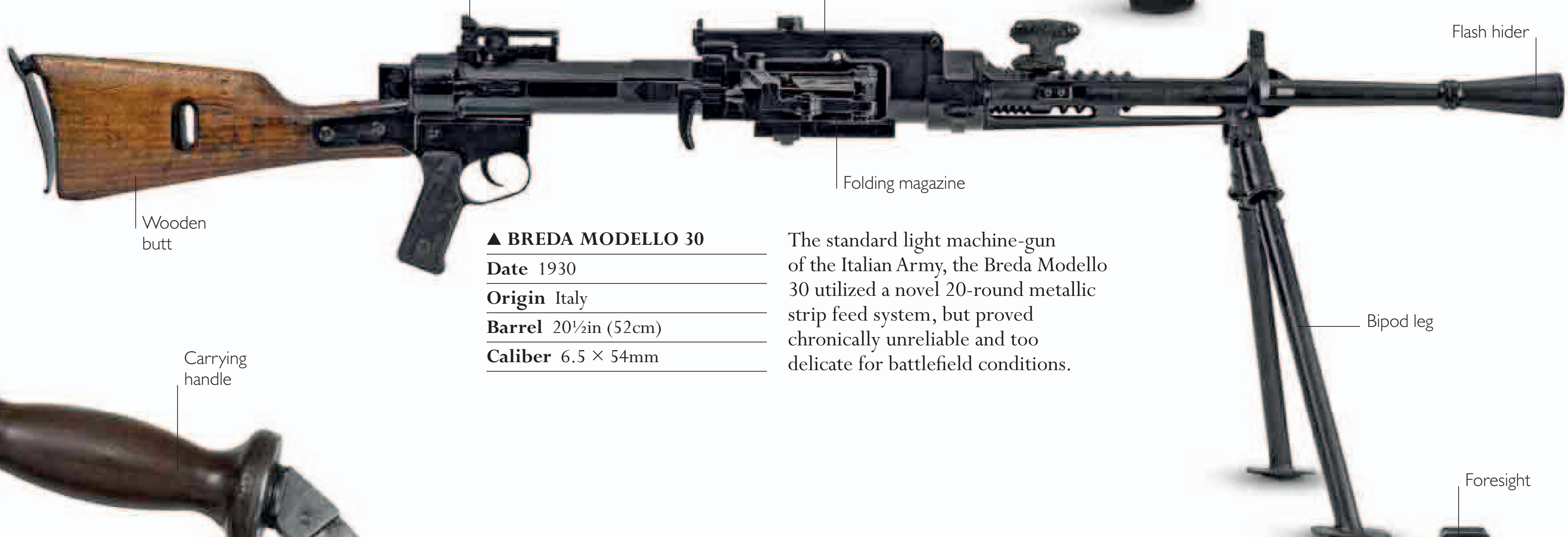
▲ CHÂTELLERAULT MODÈLE 1924/29

Date	1929
Origin	France
Barrel	19¾in (50cm)
Caliber	7.5 × 54mm

The MLE 1924 was designed as a light machine-gun replacement for the terrible Chauchat MLE 1915 (see p.201) from World War I, but was let down by poor ammunition. The cartridge was redesigned, along with parts of the gun, to produce the MLE 1924/29, which served through World War II and into the 1950s. The gun was unusual in having a dual-trigger arrangement—the forward trigger was for single-shot firing and the rear-set trigger for continuous fire.

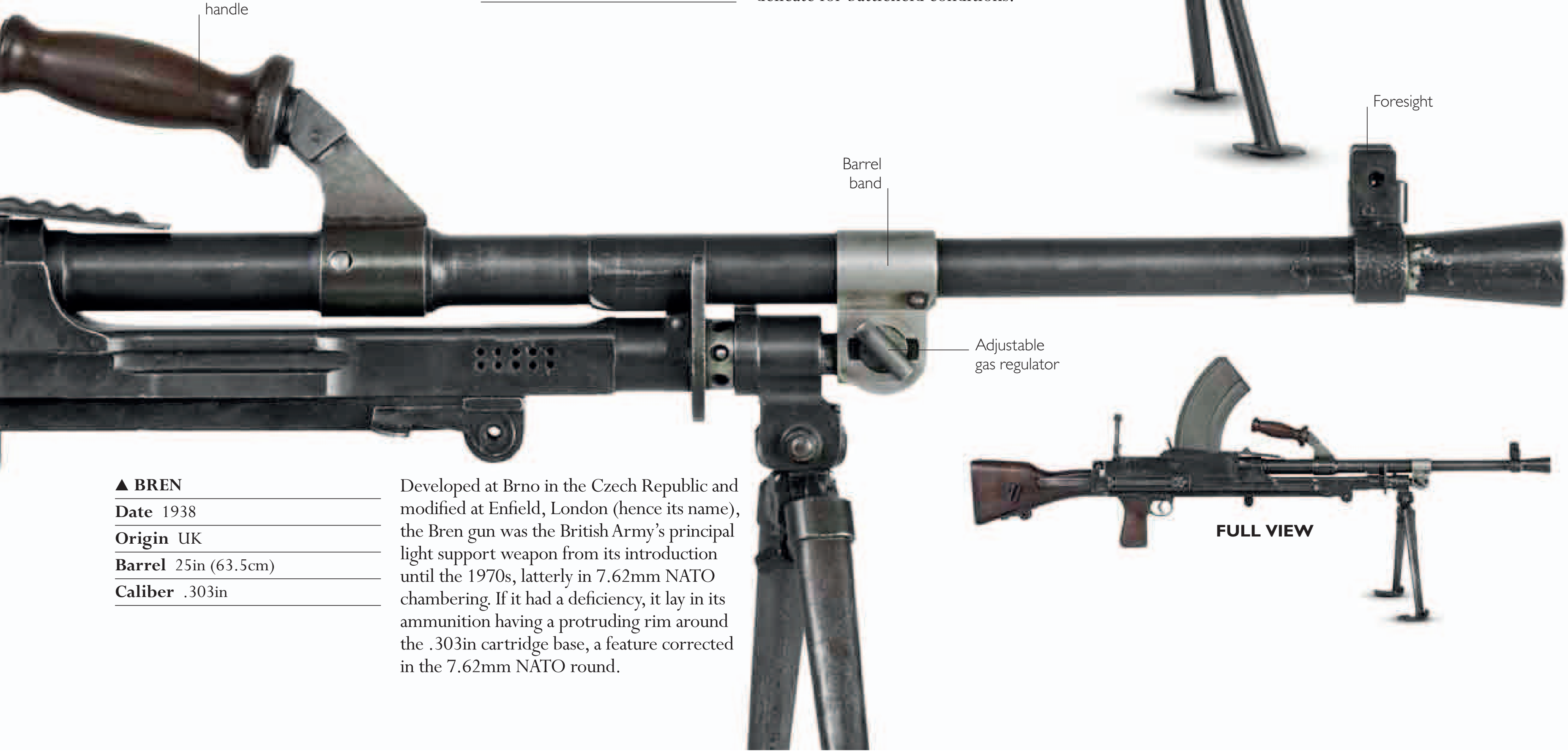
▲ VICKERS BERTHIER .303-IN LMG	
Date	1930s
Origin	UK
Barrel	24in (60.9cm)
Caliber	.303in

The British armaments firm Vickers purchased the rights to manufacture a modified version of the French Berthier (see p.155) in the early 1930s. The resulting arm, which superficially resembles the Bren gun (below), was adopted by the Indian Army in 1933 and still remains in reserve service.



▲ BREDA MODELLO 30	
Date	1930
Origin	Italy
Barrel	20½in (52cm)
Caliber	6.5 × 54mm

The standard light machine-gun of the Italian Army, the Breda Modello 30 utilized a novel 20-round metallic strip feed system, but proved chronically unreliable and too delicate for battlefield conditions.



FULL VIEW

▲ BREN	
Date	1938
Origin	UK
Barrel	25in (63.5cm)
Caliber	.303in

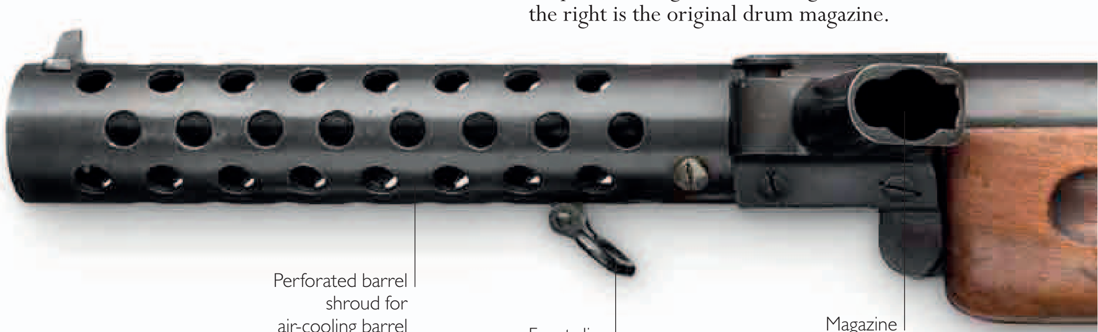
Developed at Brno in the Czech Republic and modified at Enfield, London (hence its name), the Bren gun was the British Army's principal light support weapon from its introduction until the 1970s, latterly in 7.62mm NATO chambering. If it had a deficiency, it lay in its ammunition having a protruding rim around the .303in cartridge base, a feature corrected in the 7.62mm NATO round.

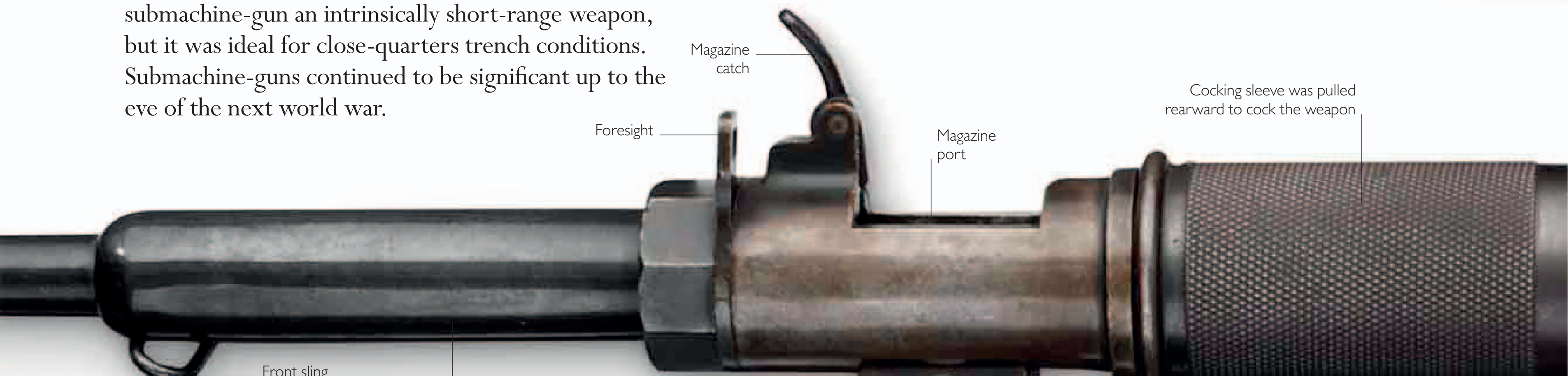
EUROPEAN SUBMACHINE-GUNS (1915–38)

Although trench warfare during World War I involved static lines facing each other, night-time raids across "No Man's Land" were frequent. Intended to probe weak points or to secure prisoners for interrogation, the taking of an enemy trench was fraught with danger. Limited manoeuvrability restricted the use of rifles and most actions were fought hand-to-hand. To counter this, arms designers developed submachine-guns—reduced-length, fully-automatic weapons using pistol cartridges. The choice of ammunition made the submachine-gun an intrinsically short-range weapon, but it was ideal for close-quarters trench conditions. Submachine-guns continued to be significant up to the eve of the next world war.

▼ **BERGMANN MP18/I**
Date 1918
Origin Germany
Barrel 7¾in (19.6cm)
Caliber 9mm Parabellum

The strong, sturdy MP18/1 was the first effective *maschinen-pistole* (machine-pistol—the German name for a submachine-gun). It was chambered for the Parabellum round Luger had developed for the P.08 pistol (pp.170–71), although that resulted in feed problems until a simpler box magazine was designed. Shown to the right is the original drum magazine.





▲ **VILLAR PEROSA M1918**
Date 1918
Origin Italy
Barrel 11in (28cm)
Caliber 9mm Glisenti

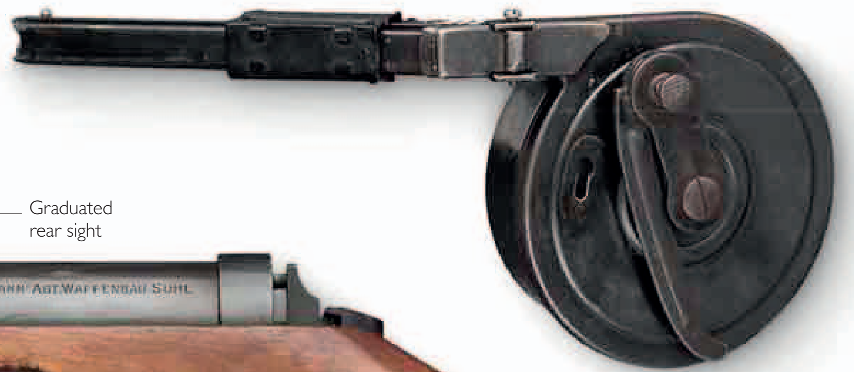
This gun had an extremely high rate of fire—900 rounds per minute—and was equipped with two triggers: a burst-fire trigger for a fully automatic mode and a single-shot trigger for a semiautomatic mode. This model is a variant of the M1915 Villar Perosa, the first ever submachine-gun (SMG), which was issued to Italian troops in 1915.


FULL VIEW


FULL VIEW

▲ **MP38**
Date 1938
Origin Germany
Barrel 10in (25.1cm)
Caliber 9mm Parabellum

Designed by Heinrich Vollmer, the MP38 submachine-gun closely resembles its famous successor, the MP40, which would use simple steel pressings, die-cast parts, and plastics. However, the MP38 can be easily distinguished by its machined steel receiver and longitudinally grooved receiver tube. Since the gun's barrel became extremely hot during firing, it was fitted with an aluminum or Bakelite resting bar beneath it, forward of the magazine.



32-ROUND "SNAIL" DRUM MAGAZINE USED BY BERGMANN MP18/1

EUROPEAN SUBMACHINE-GUNS (1939–45)

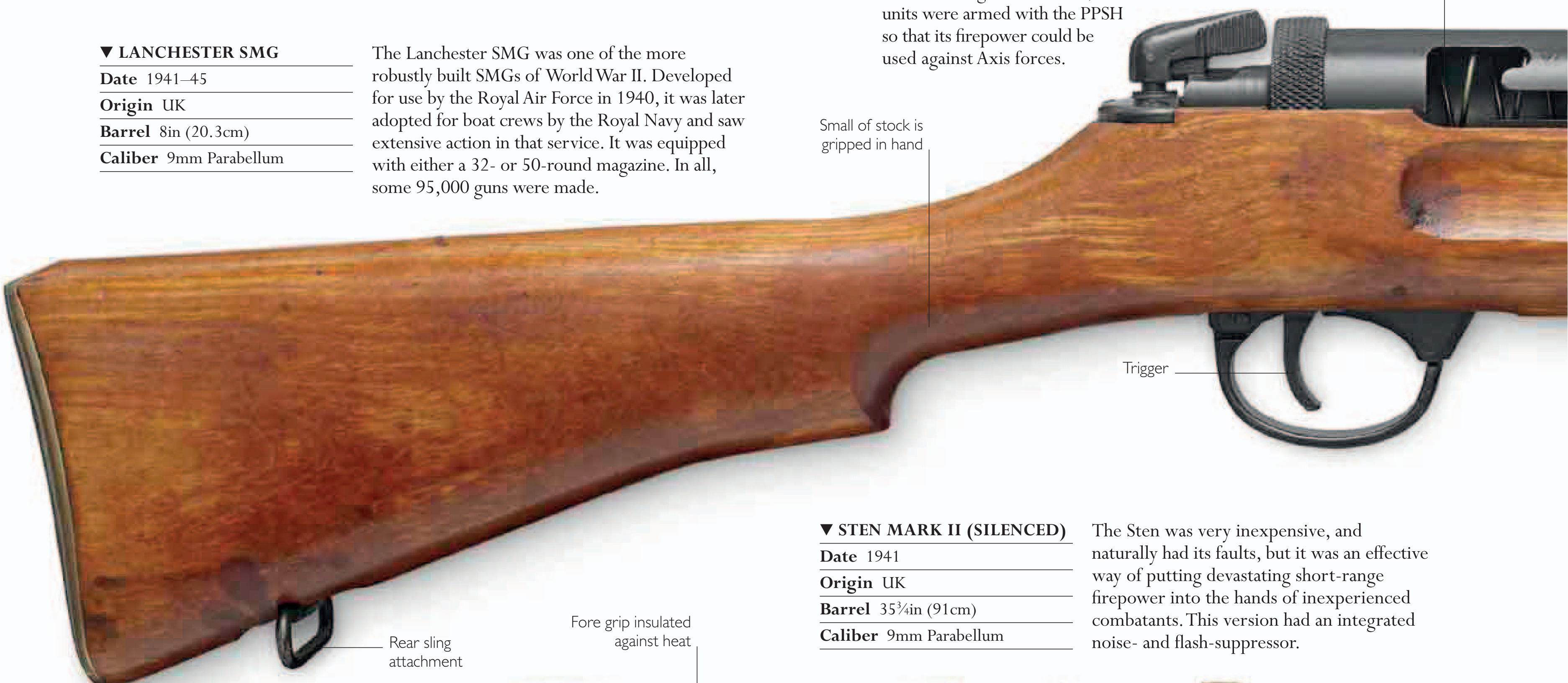
The submachine-gun (SMG) was one of World War II's primary offensive weapons. Light in weight and capable of delivering a massive amount of fire if needed, the submachine-gun was favored by shock troops and those operating in cramped quarters. Soviet forces used the PPSH-41 in extensive numbers when attacking, simply because of the volume of fire it could deliver against enemy formations.

▲ PPSH-41	
Date	1939
Origin	Soviet Union
Barrel	10½in (27cm)
Caliber	7.62mm

Georgi Shpagin's "Peh-Peh-Sheh," reliable and simple both to manufacture and to maintain, was to become the mainstay of the Red Army after it stopped the German advance into the Soviet Union. At least five million examples of this sturdy weapon had been produced by 1945. During World War II, entire units were armed with the PPSH so that its firepower could be used against Axis forces.

▼ LANCHESTER SMG	
Date	1941–45
Origin	UK
Barrel	8in (20.3cm)
Caliber	9mm Parabellum

The Lanchester SMG was one of the more robustly built SMGs of World War II. Developed for use by the Royal Air Force in 1940, it was later adopted for boat crews by the Royal Navy and saw extensive action in that service. It was equipped with either a 32- or 50-round magazine. In all, some 95,000 guns were made.



▼ STEN MARK II (SILENCED)	
Date	1941
Origin	UK
Barrel	35¾in (91cm)
Caliber	9mm Parabellum

The Sten was very inexpensive, and naturally had its faults, but it was an effective way of putting devastating short-range firepower into the hands of inexperienced combatants. This version had an integrated noise- and flash-suppressor.

▲ STEN MARK II	
Date	1941
Origin	UK
Barrel	7¾in (19.7cm)
Caliber	9mm

Cheap and easy to manufacture, the Sten Mark II was a stop-gap weapon that was to prove itself an effective submachine-gun. The gun was fitted with a 32-round magazine.

71-ROUND DRUM MAGAZINE

▲ BERETTA MODELLO 1938/42

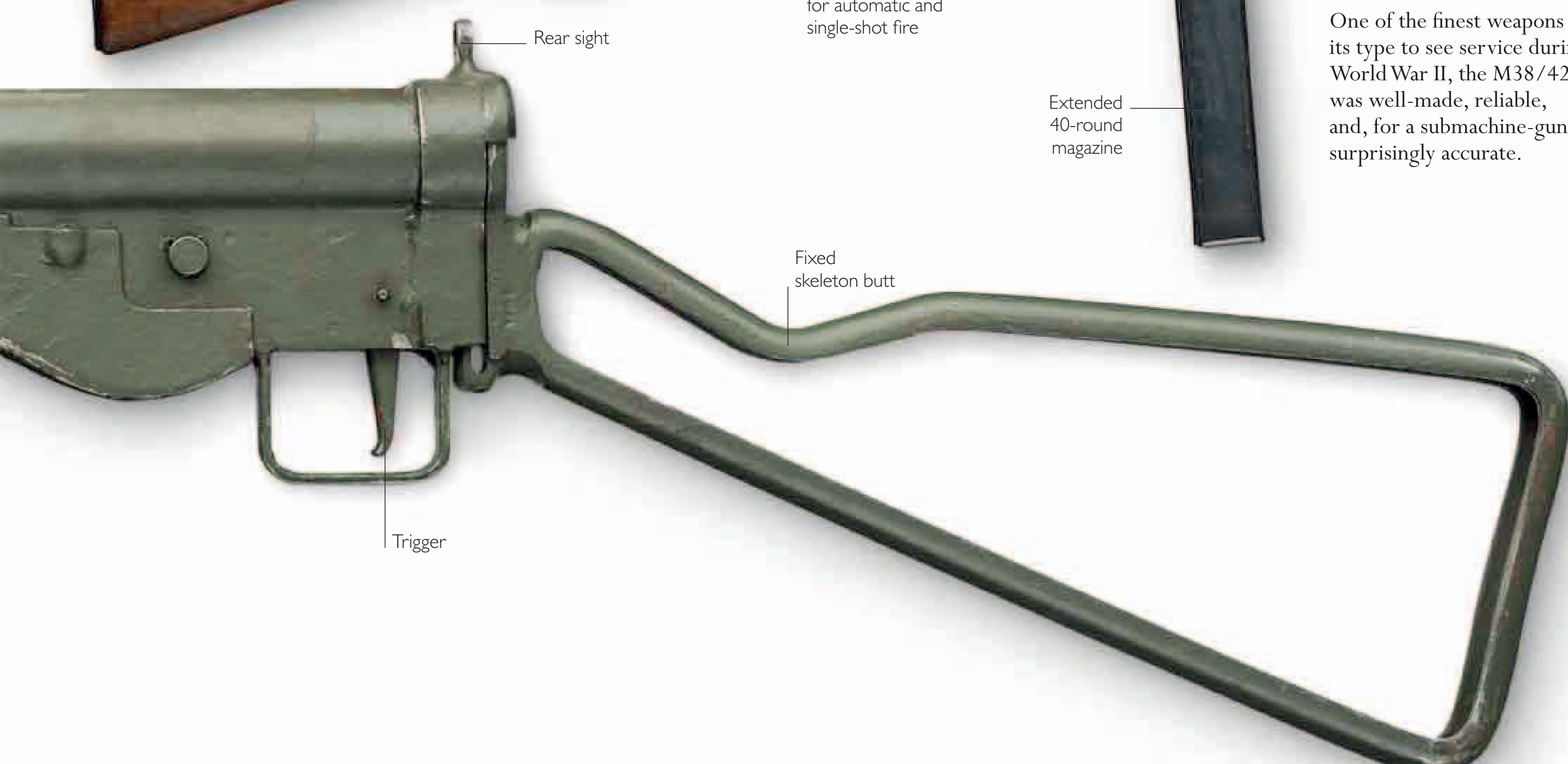
Date 1942

Origin Italy

Barrel 8½in (21.3cm)

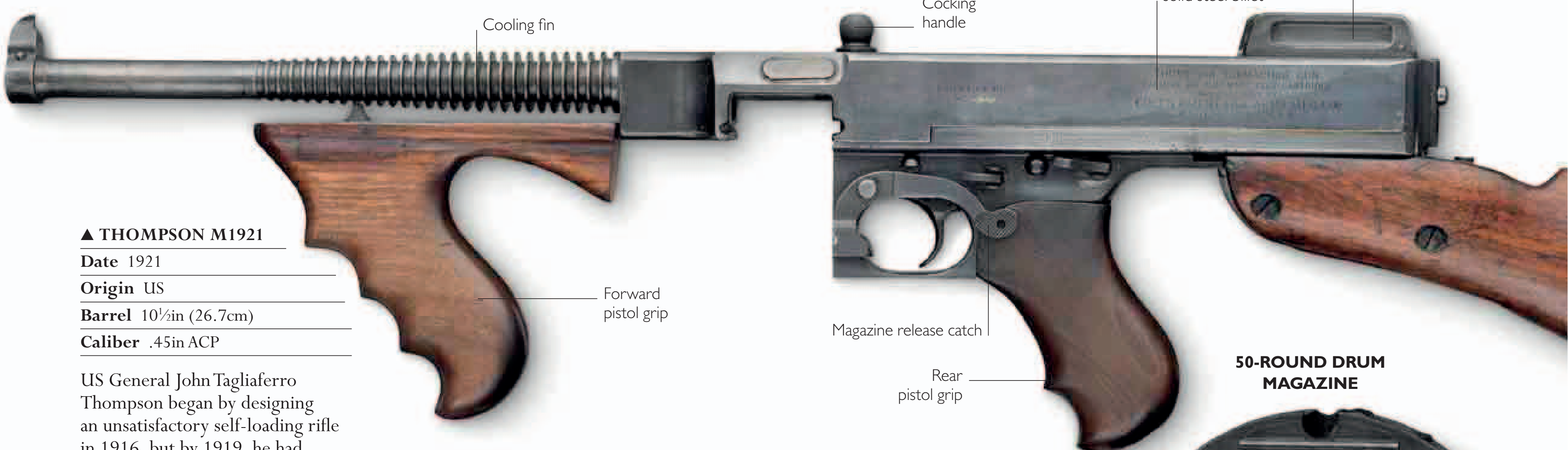
Caliber 9mm

One of the finest weapons of its type to see service during World War II, the M38/42 was well-made, reliable, and, for a submachine-gun, surprisingly accurate.



AMERICAN SUBMACHINE-GUNS (1920–45)

Originally intended for trench warfare, the submachine-gun achieved notoriety in the US during the "Roaring Twenties" as the weapon of choice for gangsters. Used by criminals such as Clyde Barrow, the Thompson submachine-gun became associated with rum running and violence. During World War II, its usefulness in the field was appreciated by commandoes and infantry facing dogged resistance in all theaters of operation.



▲ THOMPSON M1921

Date	1921
Origin	US
Barrel	10½in (26.7cm)
Caliber	.45in ACP

US General John Tagliaferro Thompson began by designing an unsatisfactory self-loading rifle in 1916, but by 1919, he had produced an early version of what would be known universally as the Tommy Gun. The M1921 was the first to come to the market, but it was not until 1928 that the US government adopted it, in small numbers, for the Marine Corps.

50-ROUND DRUM MAGAZINE

▲ M3A1

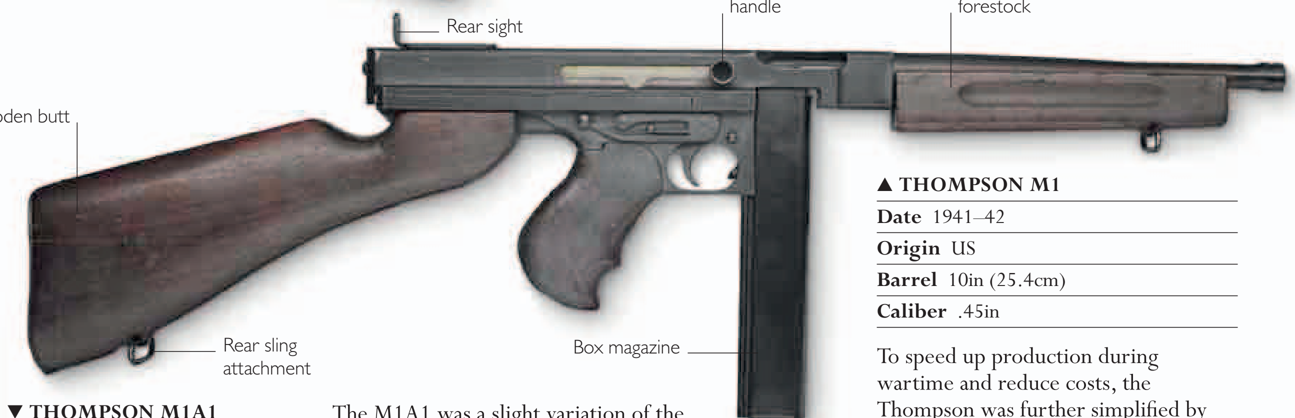
Date	1940s
Origin	US
Barrel	8in (20.3cm)
Caliber	.45in ACP

The M3 "Grease Gun," and the improved M3A1 version, were cheap to produce and simple to strip, clean, and maintain. The M3A1 fired the same heavy pistol round used in the Colt M1911A1 (see p.169).

◀ THOMPSON MODEL 1928A1

Date 1935
Origin US
Barrel 30.5cm (12in)
Caliber .45in

This model was fitted with a Cutts Compensator that allowed combustion gases generated during firing to be vented at the barrel's muzzle, thereby reducing the weapon's tendency, common in submachine-guns, to rise in fully automatic mode. This gun is a simplified version of earlier Thompson models and lacks cooling ribs and a forward pistol grip.



▲ THOMPSON M1

Date 1941–42
Origin US
Barrel 10in (25.4cm)
Caliber .45in

To speed up production during wartime and reduce costs, the Thompson was further simplified by losing the compensator, foresight, and cooling ribs to produce the M1. This gun featured a simple rear sight.

▼ THOMPSON M1A1

Date 1942–45
Origin US
Barrel 10in (25.4cm)
Caliber .45in

The M1A1 was a slight variation of the Thompson M1 (right). Additions included a foresight and a shrouded rear sight. The M1A1 saw wide service in virtually every Allied army and theater of war.

▼ UD42 SUBMACHINE-GUN

Date 1942
Origin US
Barrel 11in (28cm)
Caliber 9mm Parabellum

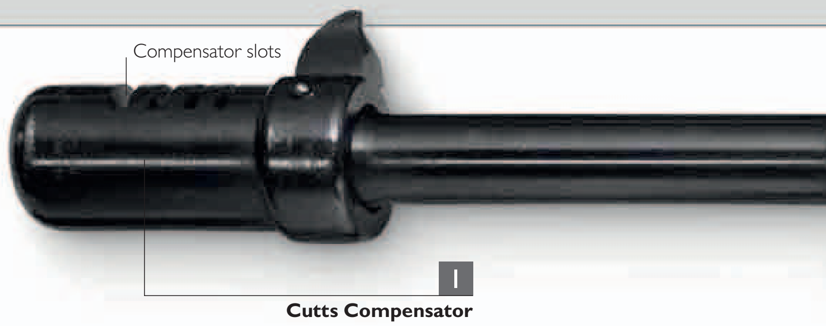
Designed by Gus Swebelius of the High Standard Arms Company, the UD42 was an extremely simple submachine-gun that could be manufactured at a relatively low cost. It was distributed primarily to resistance forces operating in Occupied Europe.

FULL VIEW

SHOWCASE

THOMPSON SUBMACHINE-GUN MODEL 1928

This iconic submachine-gun shot to fame because of its use by gangsters such as "Machine-gun Kelly" before attaining respectability in the hands of US military and federal agencies. Recoil-operated (see p.305), this weapon could fire either single shots or continuously in automatic mode, at a rate of 600–700 rounds per minute. A devastating weapon at close quarters, it employed the powerful .45in ACP cartridge.




▲ **BARREL ASSEMBLY AND RECEIVER**
The barrel fits into the receiver. It features fins that radiate heat and cool it during operation. The receiver is a hollow steel channel that holds the sliding bolt assembly.

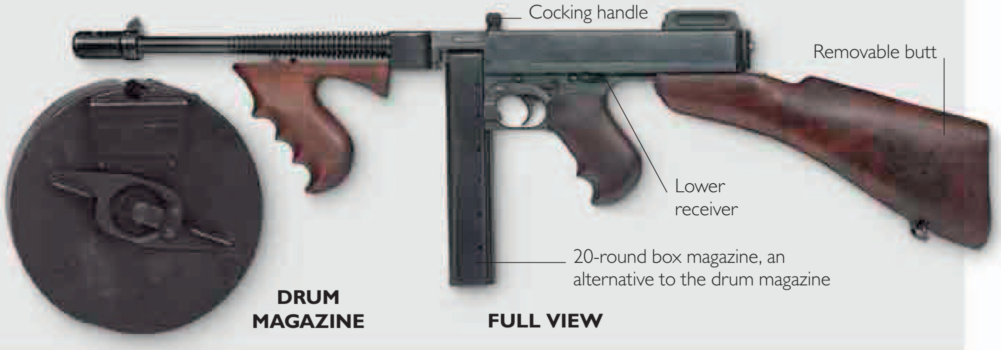
▲ **CUTTS COMPENSATOR**
The Cutts Compensator, a device designed by Richard Cutts in 1926, is screwed onto the muzzle. Unlike a regular muzzle compensator, it consists of a cylinder with slots in its upper half to divert the muzzle blast upward and force the muzzle downward. This prevents the muzzle from rising, especially when the gun is fired in automatic mode.

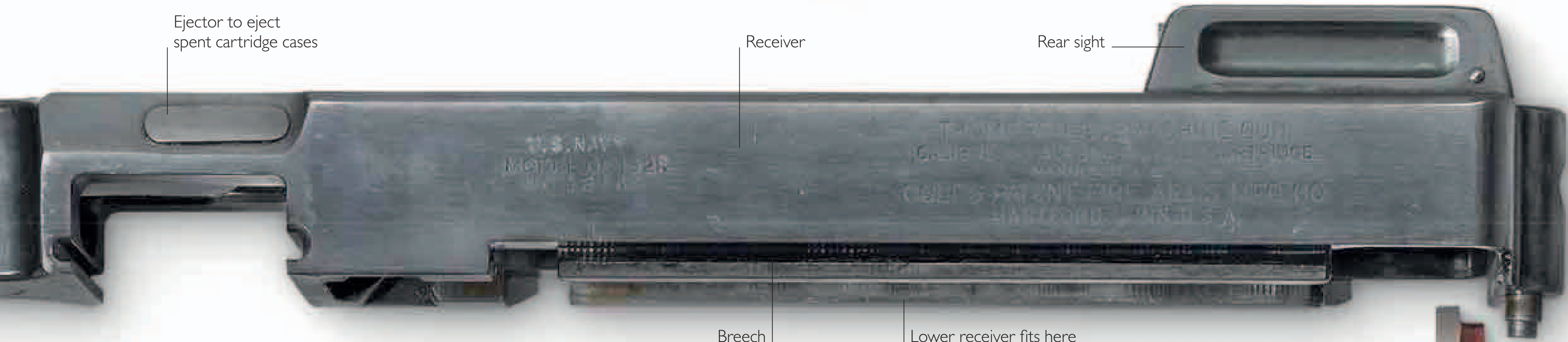
◂ **DRUM MAGAZINE**
For this gun, 50- and 100-round drum magazines were available to provide extended fire capability. To load a new cartridge into a magazine, the magazine had to be dismantled and then wound like a clock, compressing the internal spiral magazine spring.

THOMPSON SUBMACHINE-GUN MODEL 1928

Date	1928
Origin	US
Barrel	12in (30.5cm)
Caliber	.45in ACP

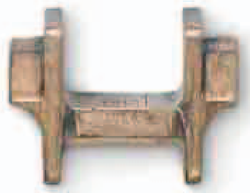
This weapon was invented by John T. Thompson. Its success is attributed to its compactness and high rate of fire. This model was adopted by the US Navy in 1928 and was a slight upgrade of the Thompson M1921 (see p.210). The Model 1928 was fitted with a Cutts Compensator and a straight forestock, which replaced the forward pistol grip for US Navy use, although some units were also produced with the grip.

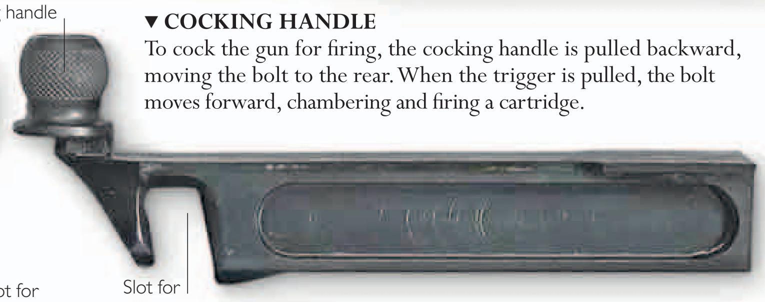




▲ MAINSPRING
The recoil force generated by firing a cartridge pushes back the bolt, compressing this spring. It then springs forward, advancing the bolt and preparing the gun to fire the next round.

▸ BLISH "H" PIECE
The Blish "H" piece connects the cocking handle with the bolt. It prevents the bolt from moving backward before the bullet has left the gun. The pressure generated on firing a cartridge pushes the "H" piece downward, locking the bolt in position and closing the breech. When the pressure drops, the "H" piece slides back upward, allowing recoil force to push the bolt backward.





▼ COCKING HANDLE
To cock the gun for firing, the cocking handle is pulled backward, moving the bolt to the rear. When the trigger is pulled, the bolt moves forward, chambering and firing a cartridge.

◂ BOLT
When firing in automatic mode, the bolt is locked and unlocked repeatedly, moving forward and backward. As a result, spent cartridge cases are continuously ejected from the ejection port and new ones are chambered from the magazine.

▸ LOWER RECEIVER
Also known as the frame, the lower receiver houses the basic firing mechanism—the trigger, the fire selector lever, the safety catch, the housing in front of the trigger guard which the magazine slides into, and the magazine-release catch. A rearward extension has the fitting onto which the removable butt is attached. It also carries the rear pistol grip.

▲ REMOVABLE BUTT
To allow the gun to be made even more compact for ease of carrying, or for concealment, the user could easily detach the butt by depressing a catch and sliding it rearward.

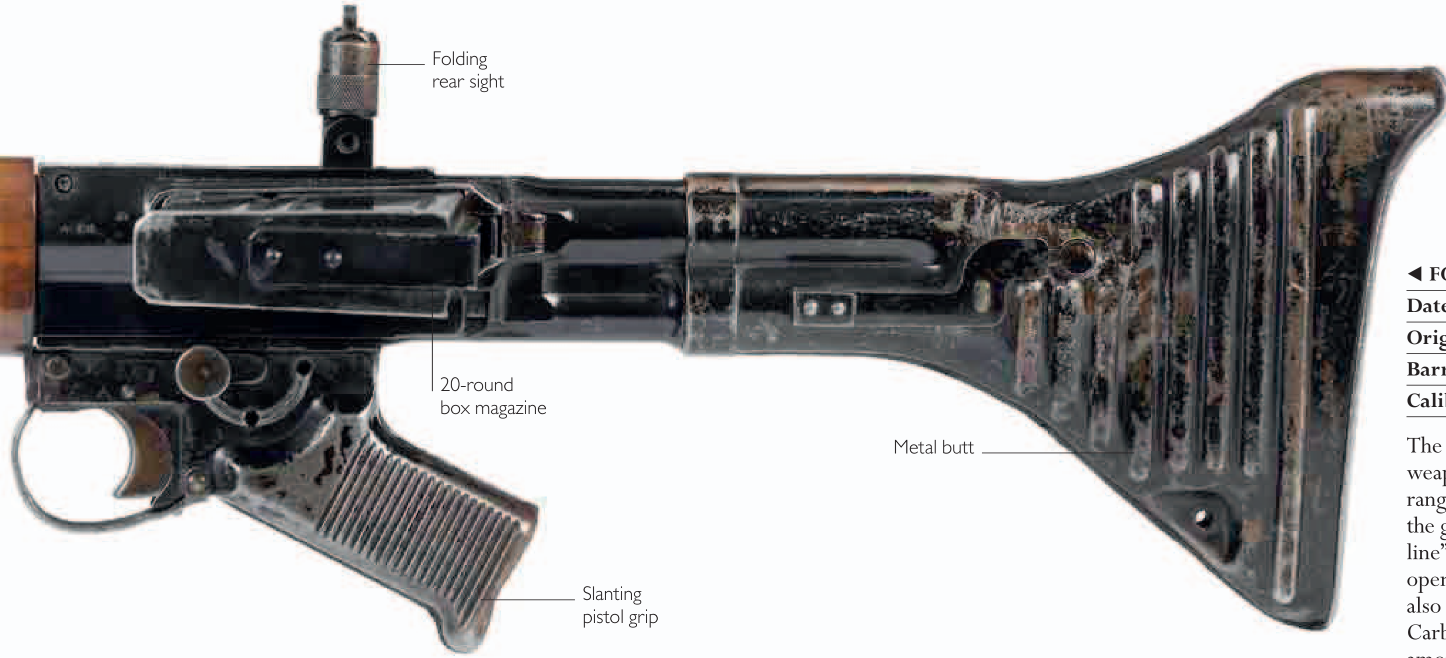
SELF-LOADING AND FULLY AUTOMATIC RIFLES

Machine-guns were well established by the early 20th century, but semiautomatic and automatic rifles were not as universally accepted. However, the outbreak of World War II in 1939 caused a profound change in firearms technology. Self-loading, or semiautomatic, military rifles (those firing one round at a time), which had been treated with some caution by military authorities, were now rapidly accepted for general use. The speed with which this took place is clearly demonstrated by the development of what was to become the M1 Carbine in only 13 days. Equal attention was paid to the design of fully automatic rifles, capable of discharging multiple rounds continuously while the trigger was kept pulled. By 1943, nearly every nation involved in the conflict had either adopted or tested automatic rifles and used them on the battlefield to devastating effect.

▼ STURMGEWEHR 44 WITH KRUMMLAUF DEVICE

Date	1944
Origin	Germany
Barrel	16½in (41cm)
Caliber	7.62 × 33mm

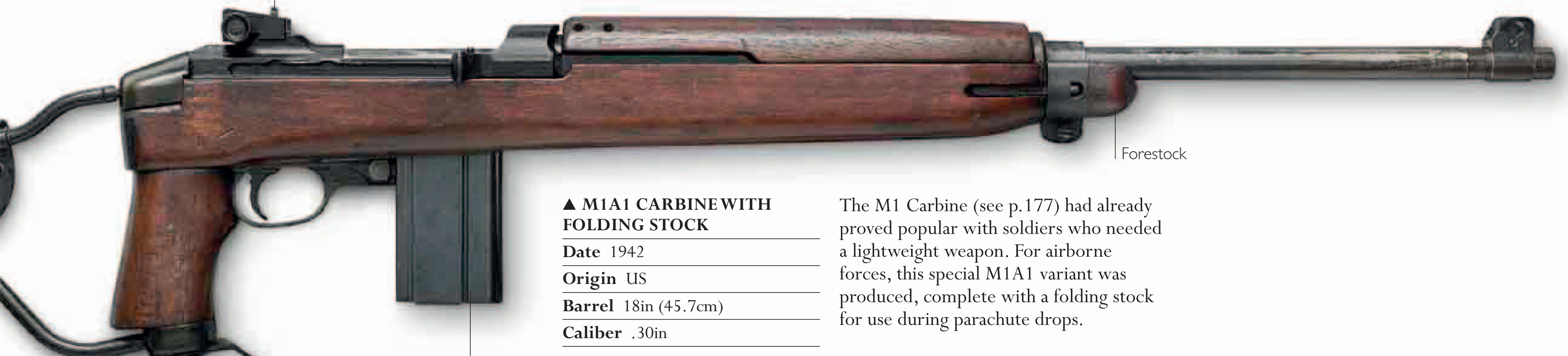
The Sturmgewehr 44, or StG44 (see pp.176–77), was christened by Adolf Hitler and first issued to German troops in 1944. It was the first true assault rifle (see pp.244–45), capable of switching between semiautomatic and fully automatic modes. It was first deployed on the Eastern Front to counter the Soviet infantry armed with the PPSH-41 (see pp.208–09). Some examples of this weapon were equipped with curved barrels (the *Krummlauf* device) so that they could be fired indirectly at targets out of the user's direct line of sight by means of a prismatic sight. This device would prove especially useful in house-to-house fighting.



◀ FG42 AUTOMATIC RIFLE

Date	1943
Origin	Germany
Barrel	19¾in (50.2cm)
Caliber	7.92 × 57mm Mauser

The FG42 was a fully automatic weapon designed to provide long-range firepower to paratroopers on the ground. It pioneered a "straight-line" butt-to-muzzle layout. Its gas-operated rotating bolt mechanism, also seen in the semiautomatic M1 Carbine (see p.177), was unusual among automatic arms. The bolt was unlocked by the carrier, which had a slot that caused the bolt to turn as it was driven rearward.



▲ M1A1 CARBINE WITH FOLDING STOCK

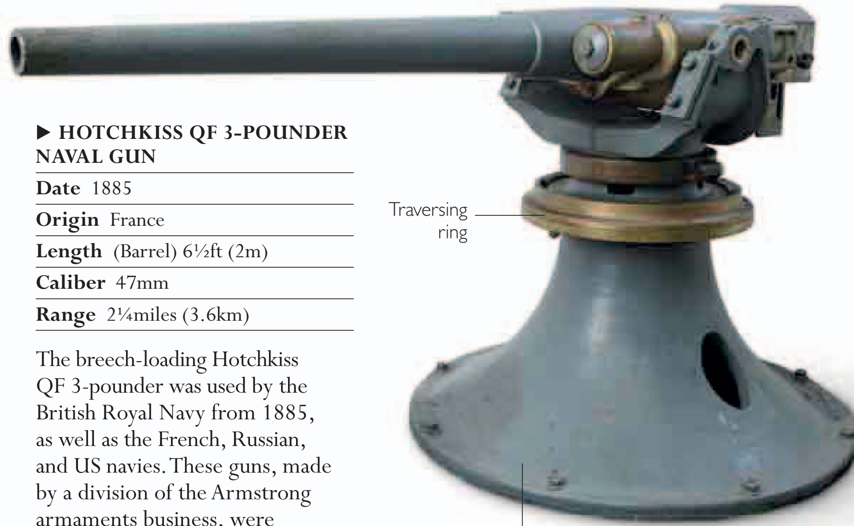
Date	1942
Origin	US
Barrel	18in (45.7cm)
Caliber	.30in

The M1 Carbine (see p.177) had already proved popular with soldiers who needed a lightweight weapon. For airborne forces, this special M1A1 variant was produced, complete with a folding stock for use during parachute drops.

FULL VIEW

ARTILLERY (1885–96)

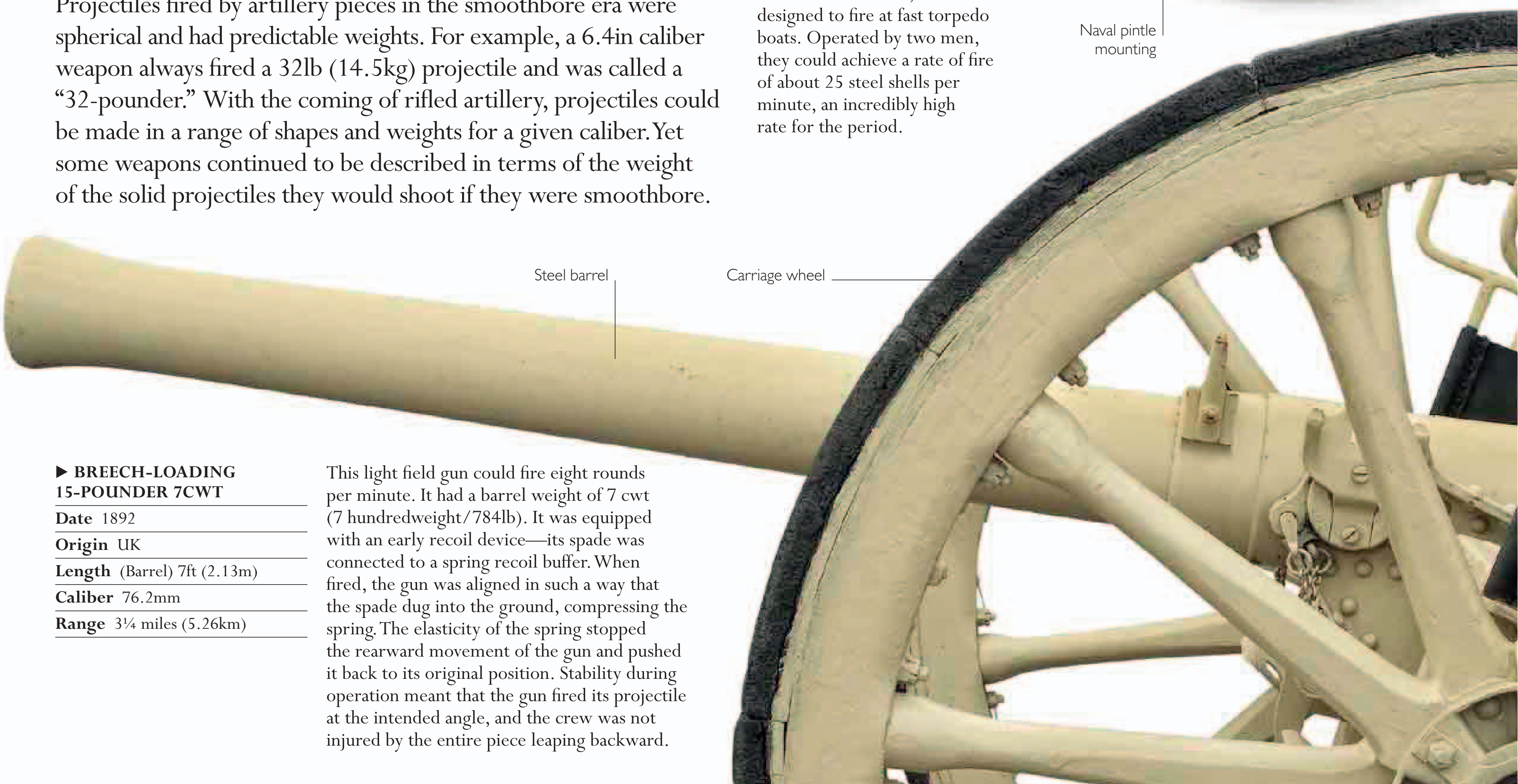
In 1855, British engineer William Armstrong developed the first effective breech-loading, rifled field gun. While breech-loading was quicker than loading via the muzzle, rates of fire increased dramatically after 1885 with the introduction of integrated ammunition. This ammunition consisted of primer, propellant charge, and projectile, all contained in a brass cartridge case, was similar to the small-arms rounds developed only a few years before. Rapidly firing artillery using these new cartridges were described as "Quick-Fire" or "QF" guns. Other breech-loaders used no cartridge case—the explosion of the propellant was contained by a special seal, or obturator, on the breechblock. Projectiles fired by artillery pieces in the smoothbore era were spherical and had predictable weights. For example, a 6.4in caliber weapon always fired a 32lb (14.5kg) projectile and was called a "32-pounder." With the coming of rifled artillery, projectiles could be made in a range of shapes and weights for a given caliber. Yet some weapons continued to be described in terms of the weight of the solid projectiles they would shoot if they were smoothbore.



▶ HOTCHKISS QF 3-POUNDER NAVAL GUN

Date	1885
Origin	France
Length	(Barrel) 6½ft (2m)
Caliber	47mm
Range	2¼miles (3.6km)

The breech-loading Hotchkiss QF 3-pounder was used by the British Royal Navy from 1885, as well as the French, Russian, and US navies. These guns, made by a division of the Armstrong armaments business, were designed to fire at fast torpedo boats. Operated by two men, they could achieve a rate of fire of about 25 steel shells per minute, an incredibly high rate for the period.



▶ BREECH-LOADING 15-POUNDER 7CWT

Date	1892
Origin	UK
Length	(Barrel) 7ft (2.13m)
Caliber	76.2mm
Range	3¼ miles (5.26km)

This light field gun could fire eight rounds per minute. It had a barrel weight of 7 cwt (7 hundredweight/784lb). It was equipped with an early recoil device—its spade was connected to a spring recoil buffer. When fired, the gun was aligned in such a way that the spade dug into the ground, compressing the spring. The elasticity of the spring stopped the rearward movement of the gun and pushed it back to its original position. Stability during operation meant that the gun fired its projectile at the intended angle, and the crew was not injured by the entire piece leaping backward.

FULL VIEW

▶ KRUPP FIELD GUN

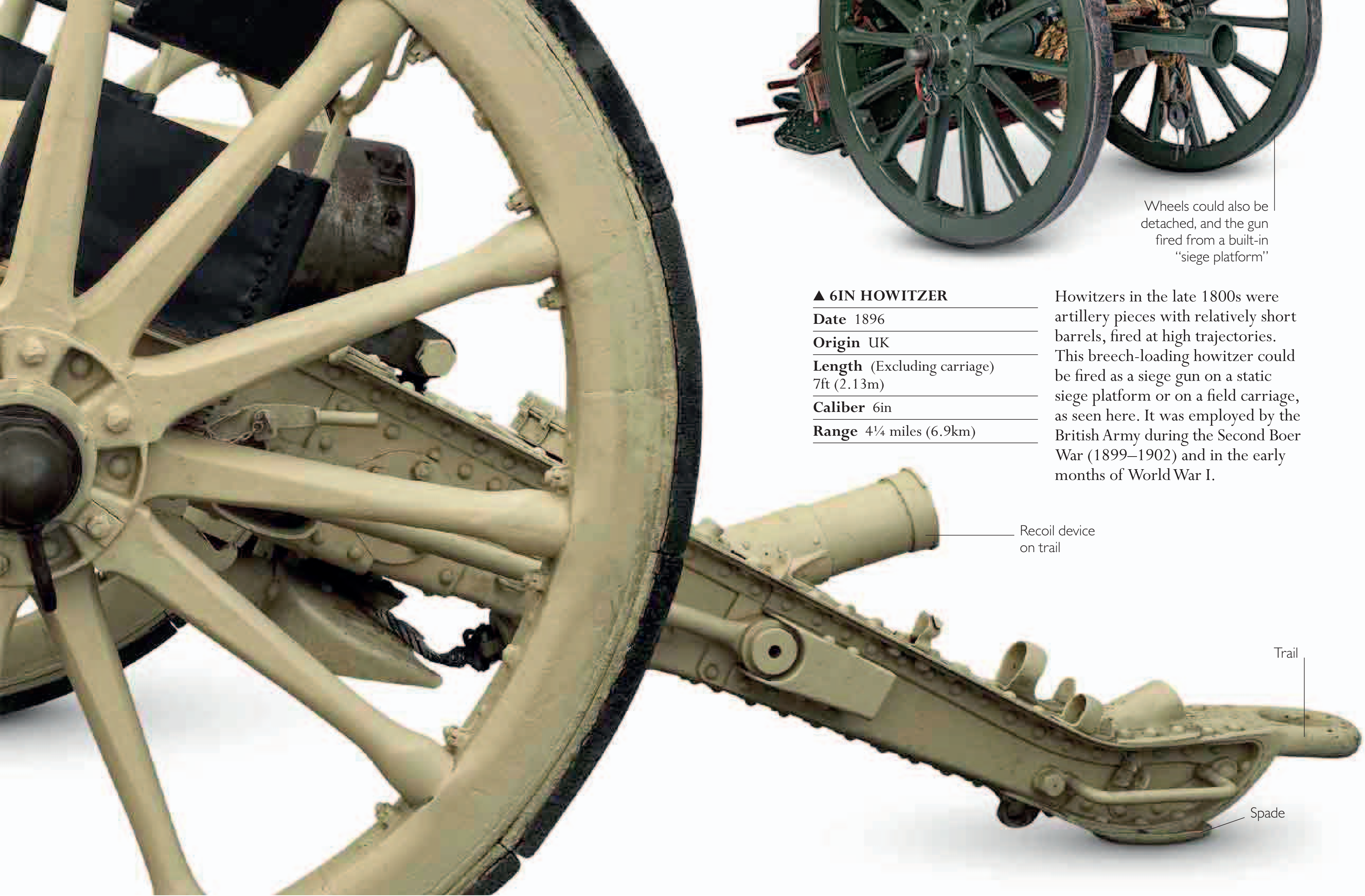
Date	1895
Origin	Germany
Length	(Barrel) 8½ft (2.6m)
Caliber	87mm
Range	1⅓miles (2.3km)

This breech-loading, rifled field gun was fitted with high brackets to make it sit in an elevated position in the carriage. This enabled it to fire over the parapet of a fortified site. It is thought to have been captured by British forces from Boers at Pietersburg (modern-day Polokwanè), South Africa, in 1901.

▲ 6IN HOWITZER

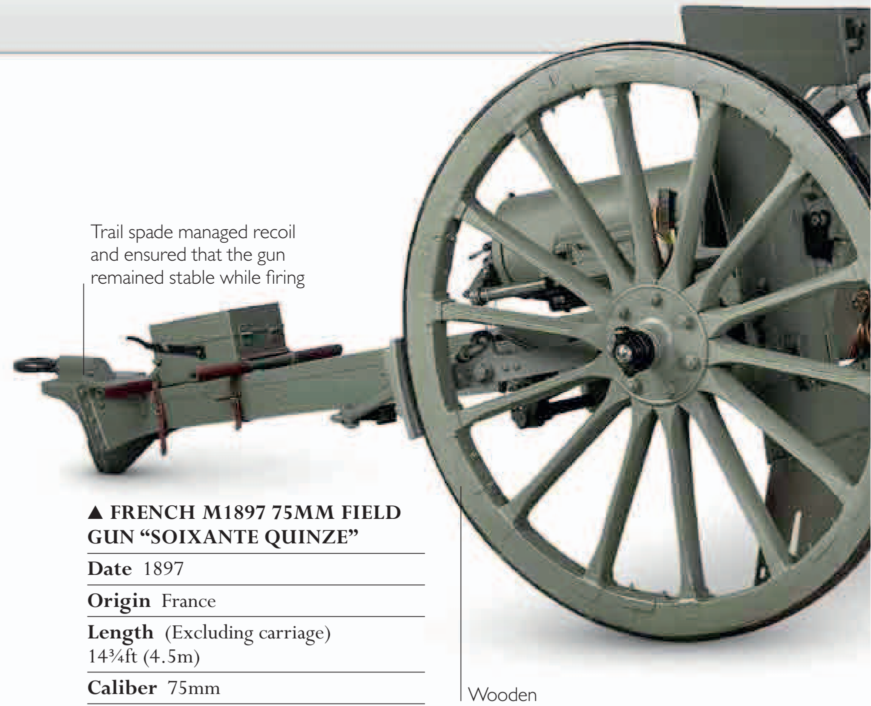
Date	1896
Origin	UK
Length	(Excluding carriage) 7ft (2.13m)
Caliber	6in
Range	4¼ miles (6.9km)

Howitzers in the late 1800s were artillery pieces with relatively short barrels, fired at high trajectories. This breech-loading howitzer could be fired as a siege gun on a static siege platform or on a field carriage, as seen here. It was employed by the British Army during the Second Boer War (1899–1902) and in the early months of World War I.



ARTILLERY (1897–1911)

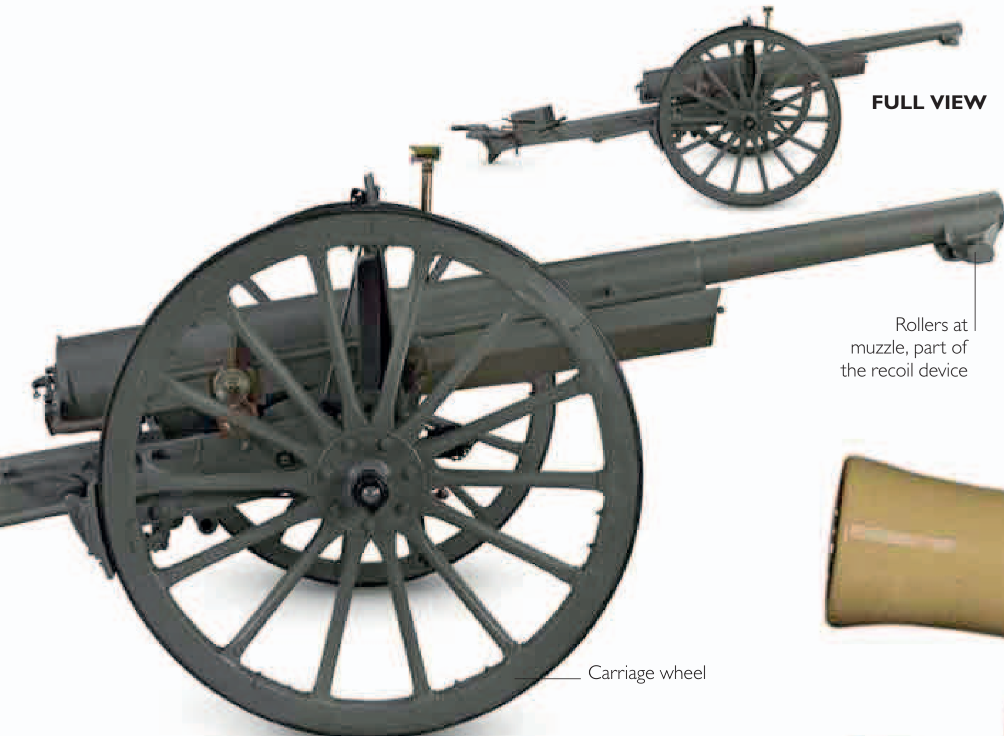
In Europe there were some key requirements that guided the development of field guns at the end of the 19th century. Almost all artillery was horse-drawn, which limited the weight of the gun and its mobility. Armed forces also demanded greater range and accuracy. To achieve this, mechanisms to control the recoil of the gun were developed so that the trail and wheels were still while firing, and all the force of the exploding charge was directed forward. At the same time, Quick-Fire guns (see p.216) evolved, achieving rates of fire of 20 rounds per minute or more.



▲ FRENCH M1897 75MM FIELD GUN "SOIXANTE QUINZE"

Date	1897
Origin	France
Length	(Excluding carriage) 14¾ft (4.5m)
Caliber	75mm
Range	4¼ miles (6.9km)

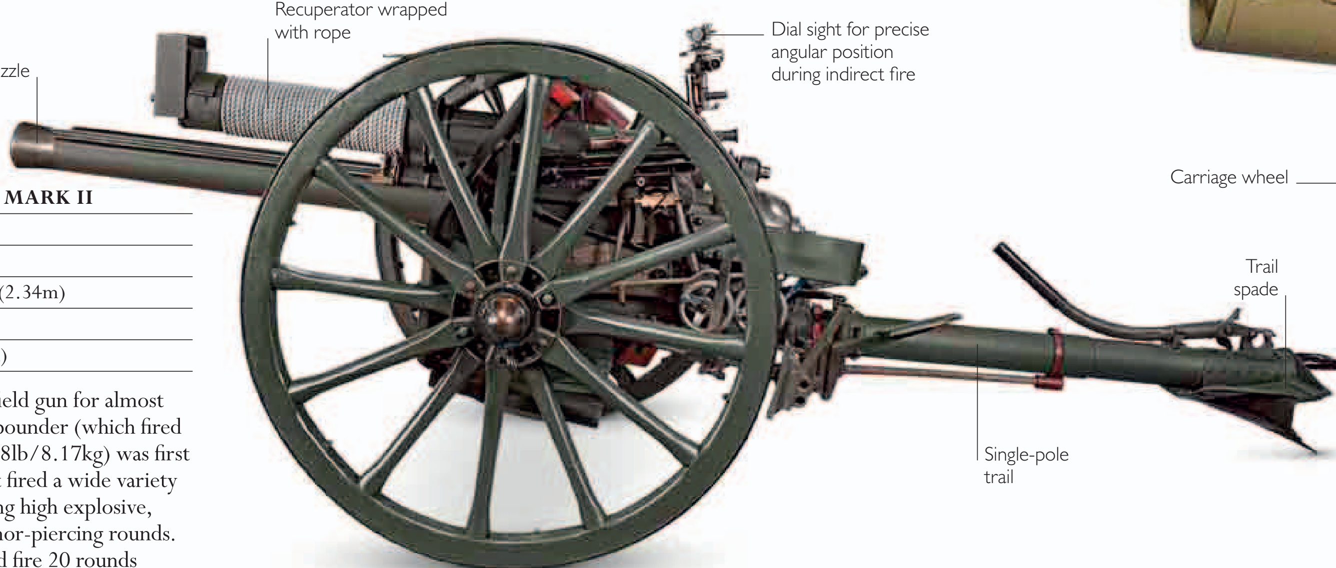
This Quick-Fire gun incorporated a hydropneumatic recoil mechanism, which kept the gun's trail and wheels still during the firing sequence. In addition, the gun had a rapid-opening screw breech. These factors allowed it to achieve a rate of fire of 15 rounds per minute.



▲ FRENCH CANON DE 75MM MODÈLE 1897

Date	1897
Origin	France
Length	(Barrel) 8¾ft (2.7m)
Caliber	75mm
Range	4¼ miles (6.9km)

The Canon de 75mm Modèle 1897 used a hydropneumatic recoil mechanism that worked like a shock absorber and kept the trail and wheels stationary when firing. Widely regarded as the first modern artillery gun, it could fire 15 rounds per minute.



▶ 18-POUNDER QF MARK II

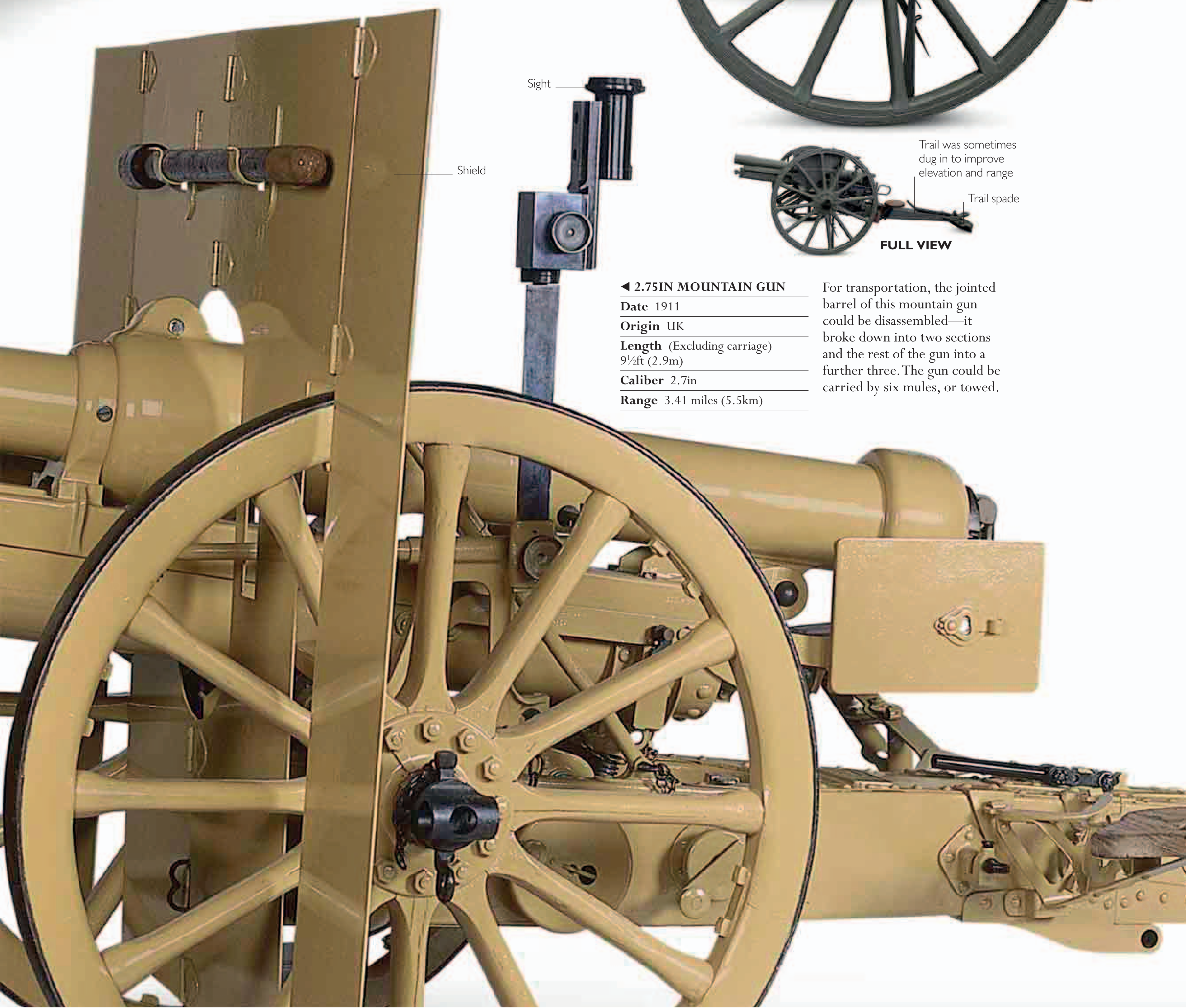
Date	1904
Origin	UK
Length	(Barrel) 7¾ft (2.34m)
Caliber	3.3in
Range	3¾ miles (6km)

The standard British field gun for almost four decades, the 18-pounder (which fired projectiles weighing 18lb/8.17kg) was first introduced in 1904. It fired a wide variety of projectiles, including high explosive, shrapnel, gas, and armor-piercing rounds. Its six-man crew could fire 20 rounds per minute for short periods.

▶ **7.7CM FK 96 NA**

Date	1905
Origin	Germany
Length	(Barrel) 6¾ft (2.1m)
Caliber	77mm
Range	4⅞ miles (7.8km)

The 7.7cm *Feldkanone 96 Neuer Art* was the standard German field gun at the start of World War I, and although reliable, its elevation was limited. A crew of five could fire 10 rounds per minute. It was also widely used by both sides in the Spanish Civil War.



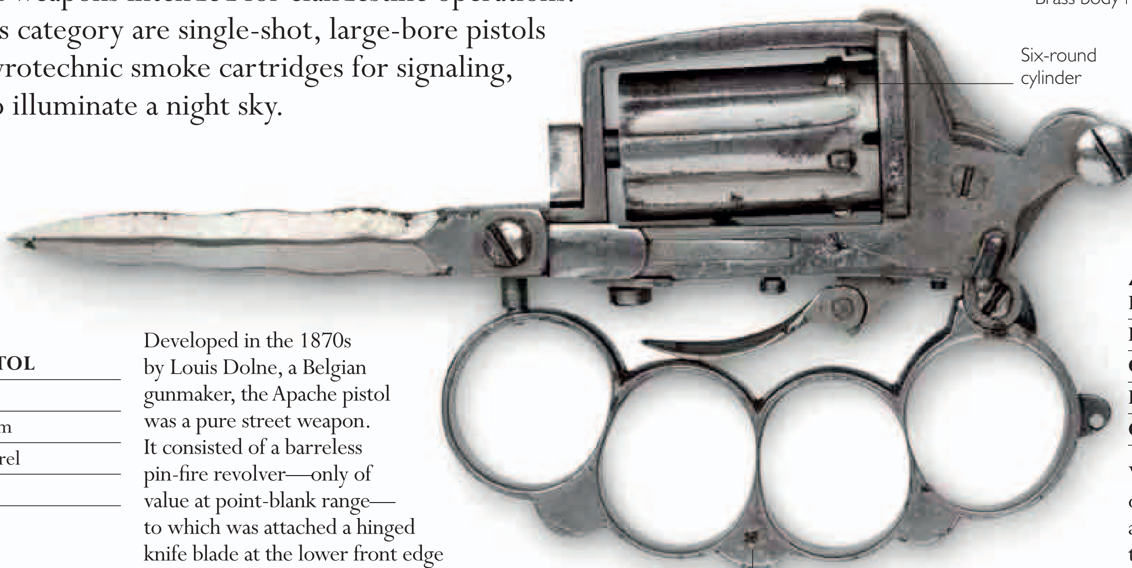
◀ **2.75IN MOUNTAIN GUN**

Date	1911
Origin	UK
Length	(Excluding carriage) 9½ft (2.9m)
Caliber	2.7in
Range	3.41 miles (5.5km)

For transportation, the jointed barrel of this mountain gun could be disassembled—it broke down into two sections and the rest of the gun into a further three. The gun could be carried by six mules, or towed.

SPECIAL-PURPOSE GUNS

Special-purpose firearms range from those designed for personal defence, such as the Dolne Apache Pistol which combines a revolver, dagger, and knuckle-duster, to silenced weapons intended for clandestine operations. Also in this category are single-shot, large-bore pistols that fire pyrotechnic smoke cartridges for signaling, or flares to illuminate a night sky.



▶ **DOLNE APACHE PISTOL**

Date	1890
Origin	Belgium
Barrel	No barrel
Caliber	7mm

Developed in the 1870s by Louis Dolne, a Belgian gunmaker, the Apache pistol was a pure street weapon. It consisted of a barreless pin-fire revolver—only of value at point-blank range—to which was attached a hinged knife blade at the lower front edge of the cylinder frame. Its handle doubled as a set of knuckle-dusters.

▲ **WEBLEY AND SCOTT FLARE PISTOL**

Date	1882–1919
Origin	UK
Barrel	4in (10cm)
Caliber	1in

Visual signals are an important means of communicating during military actions. This was never more the case than during World War I, when the din of battle was ever-present. Breaking open for loading like a shotgun, this brass Webley and Scott Flare Pistol could fire smoke charges or flares to illuminate the battlefield at night.

FLARE CARTRIDGE PACKET

27MM FLARE CARTRIDGE

▲ **FLARE PISTOL**

Date	1907
Origin	Germany
Barrel	4in (10¼cm)
Caliber	27mm

This flare pistol is of simple steel and wood construction. The firing mechanism consists of a sprung cocking handle, which acts as a firing pin when released by the trigger.

▲ WEBLEY AND SCOTT PISTOL WITH SUPPRESSOR

Date	1907
Origin	UK
Barrel	9¼in (23cm) with suppressor
Caliber	7.65 × 17mm

The Webley and Scott 1907 was one of several automatic pistols manufactured by Webley in the first decades of the 20th century. Fitted with a sound suppressor, or a silencer, this gun was carried by agents of British covert forces in World War II.

▲ VZ 27 PISTOL WITH SUPPRESSOR

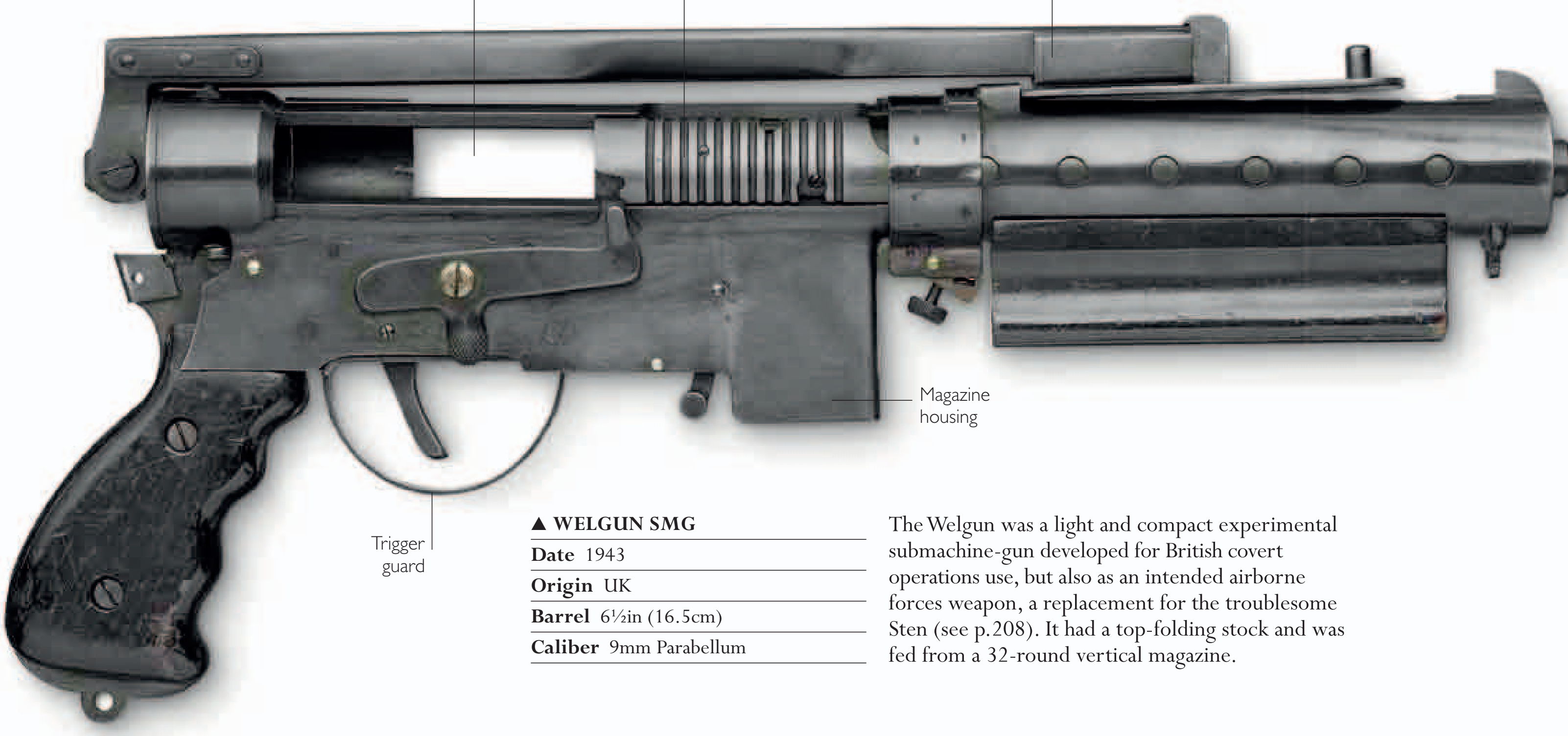
Date	1927
Origin	Czechoslovakia
Barrel	8in (20.3cm) with suppressor
Caliber	7.65 × 17mm

The VZ 27 (*vzor* or Model 27) was a compact self-loading pistol designed by Josef Nickl of the Ceska Zbrojovka. The VZ 27 remained in production until 1955. During World War II, the German intelligence service (*Abwehr*) used VZ 27s fitted with sound suppressors (shown here). Later, they were used by the Czech intelligence services.

◀ LUGER P.08 WITH SUPPRESSOR

Date	1940s
Origin	Germany
Barrel	11¼in (28cm) with suppressor
Caliber	9mm Parabellum

This Luger was used by some British covert forces during World War II. It is fitted with a suppressor for use as an assassination weapon. In many ways, the Luger was best suited to covert, police, and security work, since its mechanical system was vulnerable to the dirt of battlefield use.



▲ WELGUN SMG

Date	1943
Origin	UK
Barrel	6½in (16.5cm)
Caliber	9mm Parabellum

The Welgun was a light and compact experimental submachine-gun developed for British covert operations use, but also as an intended airborne forces weapon, a replacement for the troublesome Sten (see p.208). It had a top-folding stock and was fed from a 32-round vertical magazine.

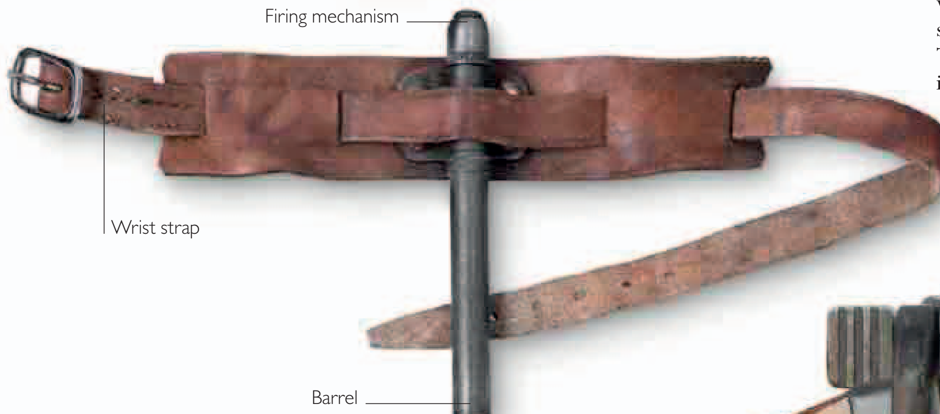
SPY AND COVERT FORCES GUNS

The Special Operations Executive (SOE) was a British organization specializing in covert operations. Along with its American counterpart, the Office of Strategic Services (OSS), the SOE inserted commandoes and agents into Occupied Europe during World War II. These forces were frequently armed with weapons featuring sound suppressors (silencers) that allowed stealth tactics to be implemented. Often, the OSS dropped cheap, single-use pistols, such as the Liberator, from aircraft to arm partisan forces until they could secure standard-issue weapons from enemy forces.

▲ HIGH STANDARD MODEL B WITH SILENCER

Date 1932
Origin US
Barrel 9in (23cm)
Caliber .22in

Of the guns made by the High Standard Manufacturing Company, one of the first was the Model B. It was a highly accurate .22in handgun designed for casual target shooting, but also found military applications. Unlike the Model A target pistol, which was similar but had adjustable sights, the Model B had fixed sights. This gun was used by OSS agents in World War II.



▶ WRIST PISTOL

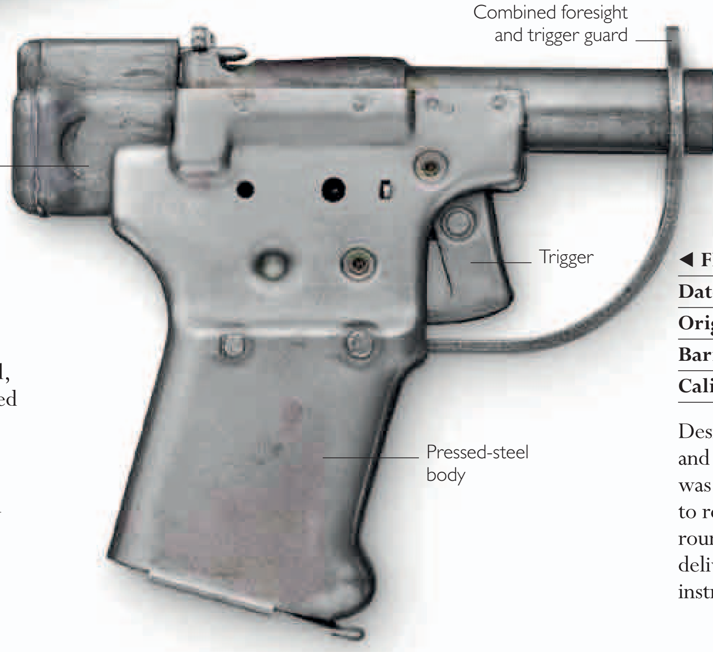
Date 1939–45
Origin UK
Barrel 1in 2.54cm)
Caliber .25in

This small, .25in-caliber firing device was designed to be worn on the wrist of SOE personnel, so that it was readily available without having to be held. It was fired by a string attached to the inside of a shirt or jacket.

▲ DE LISLE CARBINE

Date 1942
Origin UK
Barrel 8¼in (20.9cm)
Caliber .45in

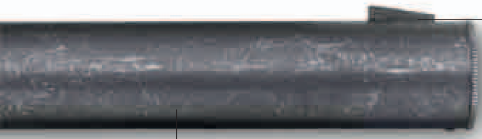
Designed by William Godfrey de Lisle, this carbine is recognized as one of the quietest firearms ever made. It incorporates an integral sound suppressor around its barrel, and the report made when it is fired is inaudible except to the user. Though made in severely limited quantities, it saw service with British commandoes during World War II, as well as afterward.



◀ FP-45 LIBERATOR PISTOL

Date 1942
Origin US
Barrel 4in (10cm)
Caliber .45in

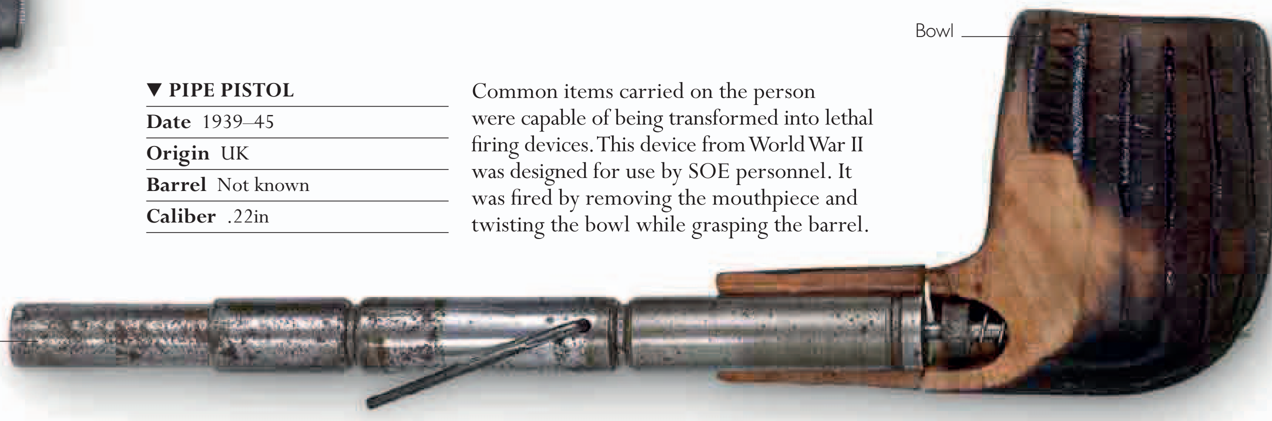
Designed by the OSS as a simple and very cheap gun, the Liberator was intended to be paradropped to resistance groups. It had 10 rounds of ammunition and was delivered with illustrated strip instructions for use.

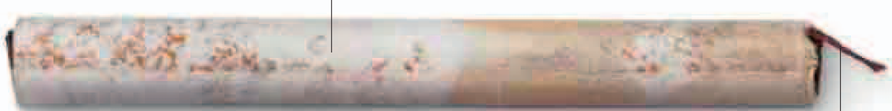


▼ PIPE PISTOL

Date	1939–45
Origin	UK
Barrel	Not known
Caliber	.22in

Common items carried on the person were capable of being transformed into lethal firing devices. This device from World War II was designed for use by SOE personnel. It was fired by removing the mouthpiece and twisting the bowl while grasping the barrel.

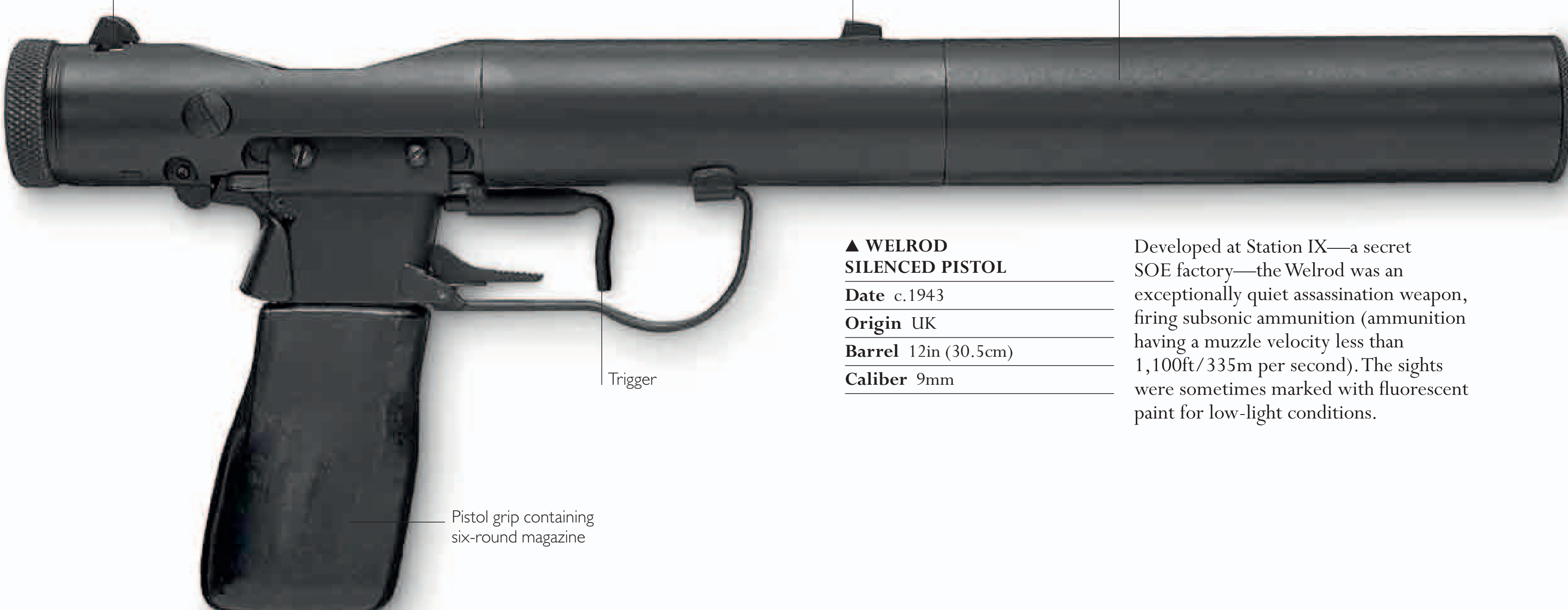




◀ SINGLE-SHOT CIGARETTE PISTOL

Date	1939–45
Origin	UK
Barrel	Not known
Caliber	.22in

This device disguised as a cigarette was developed at an SOE laboratory. The device was fired when the user pulled on a string with his teeth. Because of its short barrel it had a limited range.



▲ WELROD SILENCED PISTOL

Date	c.1943
Origin	UK
Barrel	12in (30.5cm)
Caliber	9mm

Developed at Station IX—a secret SOE factory—the Welrod was an exceptionally quiet assassination weapon, firing subsonic ammunition (ammunition having a muzzle velocity less than 1,100ft/335m per second). The sights were sometimes marked with fluorescent paint for low-light conditions.

SPORTING AND HUNTING FIREARMS

In this period, as previously, hunters required firearms of differing natures for different environments and types of game. A small-caliber repeating rifle firing a revolver cartridge might have been ideal for some circumstances, such as hunting small game, but a heavy-caliber rifle firing powerful cartridges was essential when dealing with large, dangerous animals such as rhinos or elephants. While a higher rate of fire made lever-action guns popular for sporting and hunting, bolt-action weapons were more robust and reliable, and easier to maintain.

▲ WINCHESTER MODEL 1873 SPORTING RIFLE

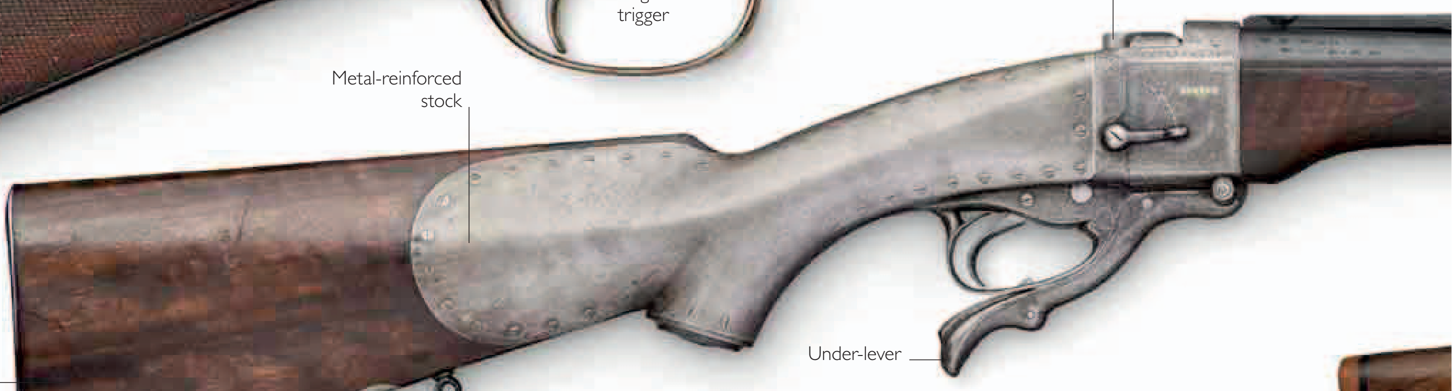
Date	1885
Origin	US
Barrel	23½in (60cm)
Caliber	.44in-40

The Model 1873 was the first repeating rifle of its type to be widely used throughout the world. It was chambered for cartridges of sufficient strength for hunting medium-size game, such as deer. It was favored by hunters in North America, Africa, and India.

▲ DOUBLE-BARRELED RIFLE

Date	1887
Origin	England
Barrel	24in (60.9cm)
Caliber	1.05in

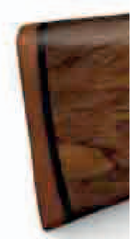
This double-barreled rifle has a short barrel and simple sights, both indicators that it would be best used for the hunting of large or fast game, such as elephants, rhinos, or cape buffaloes, at close ranges. The gun is of a "box-lock" design, the operating mechanism being contained within a box-shaped housing.



▲ GIBBS-FARQUHARSON RIFLE

Date	c.1890
Origin	UK
Barrel	25in (63.5cm)
Caliber	.22in Hornet

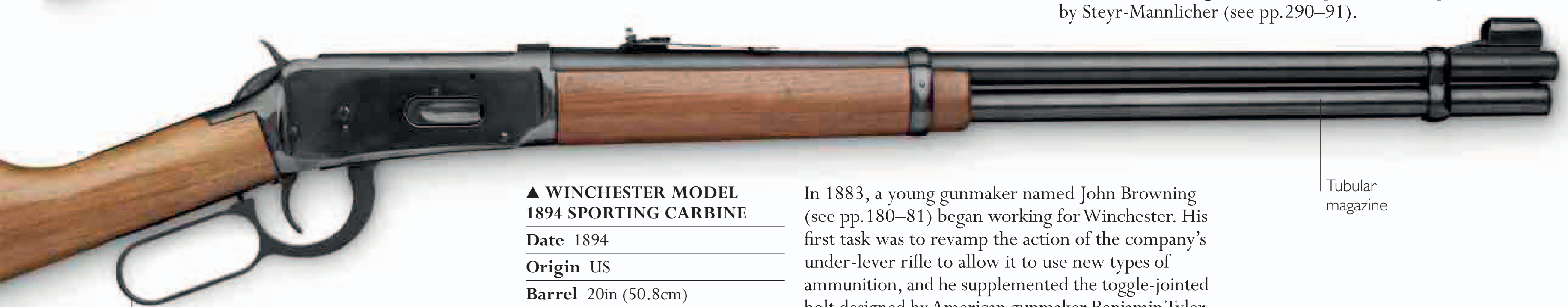
This rifle was made for famous hunter F. C. Selous in .400in/.450incaliber. The grip is fitted with steel plates, a customization requested by Selous to strengthen the gun. The original barrel has been replaced by one made to take a .22in-caliber Hornet round. Despite this small caliber, the velocity of the bullet was ideal for shooting game such as deer.



▲ MAUSER BOLT-ACTION RIFLE

Date	1890
Origin	Germany
Barrel	25in (63.5cm)
Caliber	7.9 × 57mm

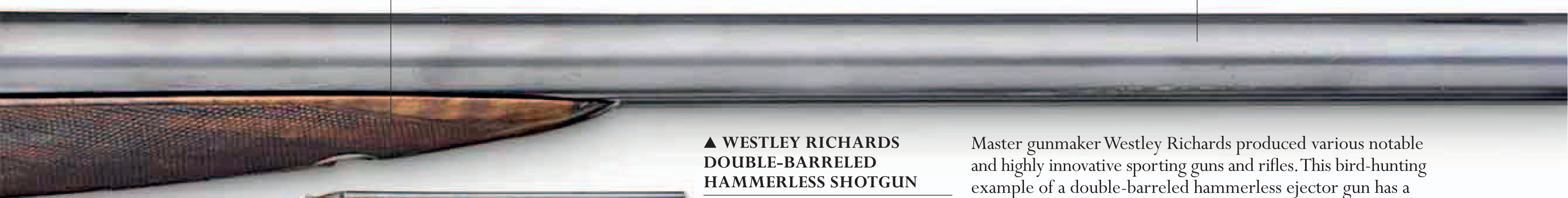
Waffenfabrik Mauser (see pp.164–65) came to dominate the world market for bolt-action rifles for both civilian and military applications, and its hunting rifles set the standard for the type. This rifle employs the action of the Model 1888 infantry rifle as modified for the carbine, with a flattened, turned-down bolt handle. The five-round magazine is of the pattern developed by Steyr-Mannlicher (see pp.290–91).



▲ WINCHESTER MODEL 1894 SPORTING CARBINE

Date	1894
Origin	US
Barrel	20in (50.8cm)
Caliber	.30in-30

In 1883, a young gunmaker named John Browning (see pp.180–81) began working for Winchester. His first task was to revamp the action of the company's under-lever rifle to allow it to use new types of ammunition, and he supplemented the toggle-jointed bolt designed by American gunmaker Benjamin Tyler Henry with additional vertical locking bars. The system was perfected in the Model 1894.



FULL VIEW

▲ WESTLEY RICHARDS DOUBLE-BARRELED HAMMERLESS SHOTGUN

Date	c.1930
Origin	UK
Length	26½in (67.5cm)
Caliber	.74in

Master gunmaker Westley Richards produced various notable and highly innovative sporting guns and rifles. This bird-hunting example of a double-barreled hammerless ejector gun has a patent one-striker mechanism and locks that can be detached by hand. A press-button mechanism enables each barrel to be fired independently. Available in a choice of finishes, the gun could be tailored to suit the individual tastes of purchasers.

▲ RIGBY MAUSER RIFLE

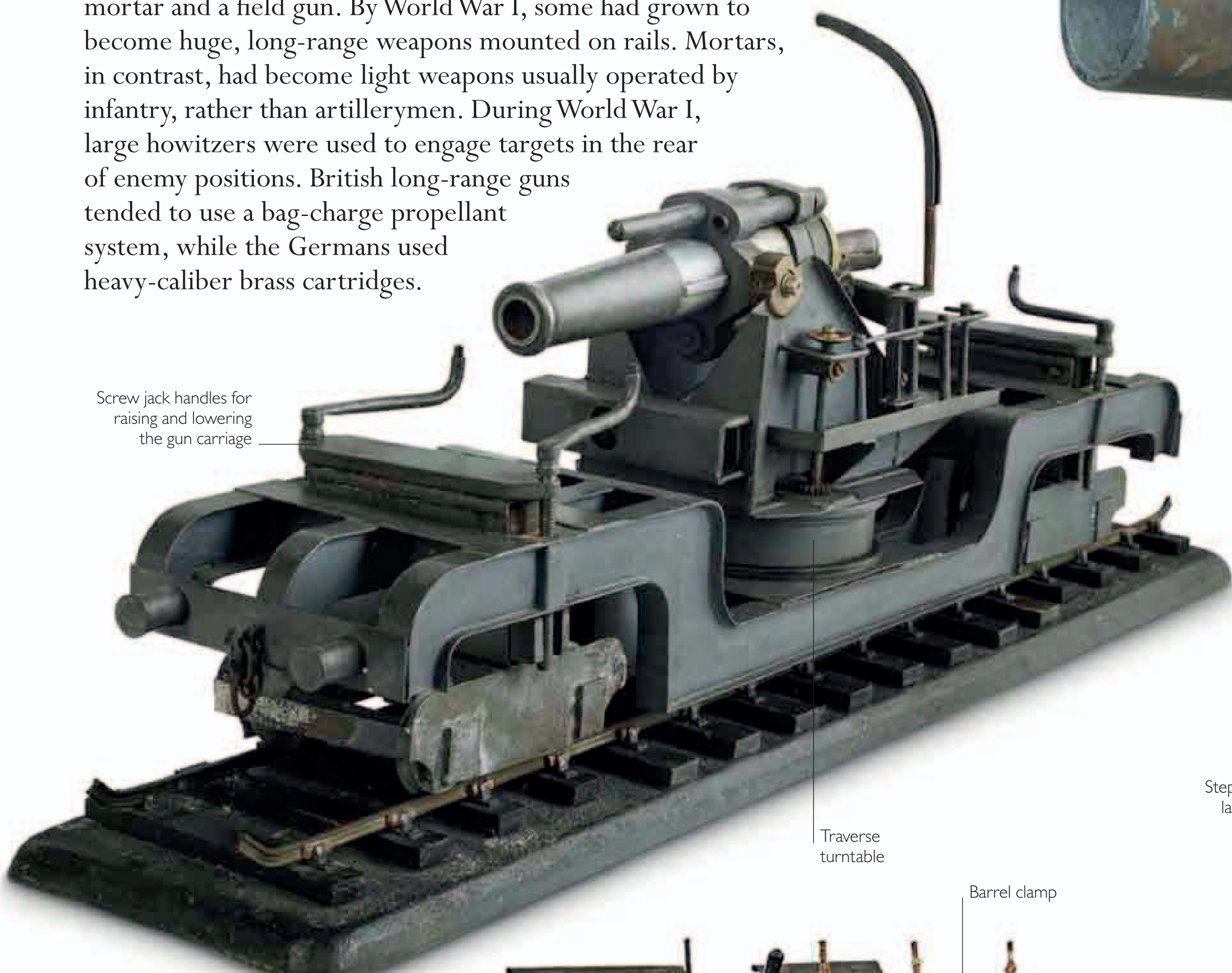
Date	1925
Origin	UK
Barrel	27½in (70cm)
Caliber	.375in

Rigby's began making guns in Dublin, Ireland, in the 18th century. In 1900, now in London, the company was appointed Mauser's UK agent, and began producing bolt-action rifles to its design in a variety of calibers. John Rigby, the company's head, oversaw the design of the British Army's bolt-action rifles.

ELEPHANT-BACK SAFARI
Fine-quality firearms have traditionally been made for nobles and wealthy sportsmen. Pictured here in Nepal, c.1910, is the Prince of Wales, later King Edward VIII, standing in the front of the howdah on an elephant, ready to hunt tigers with his English double-barreled hammerless rifle.

ARTILLERY (1914–36)

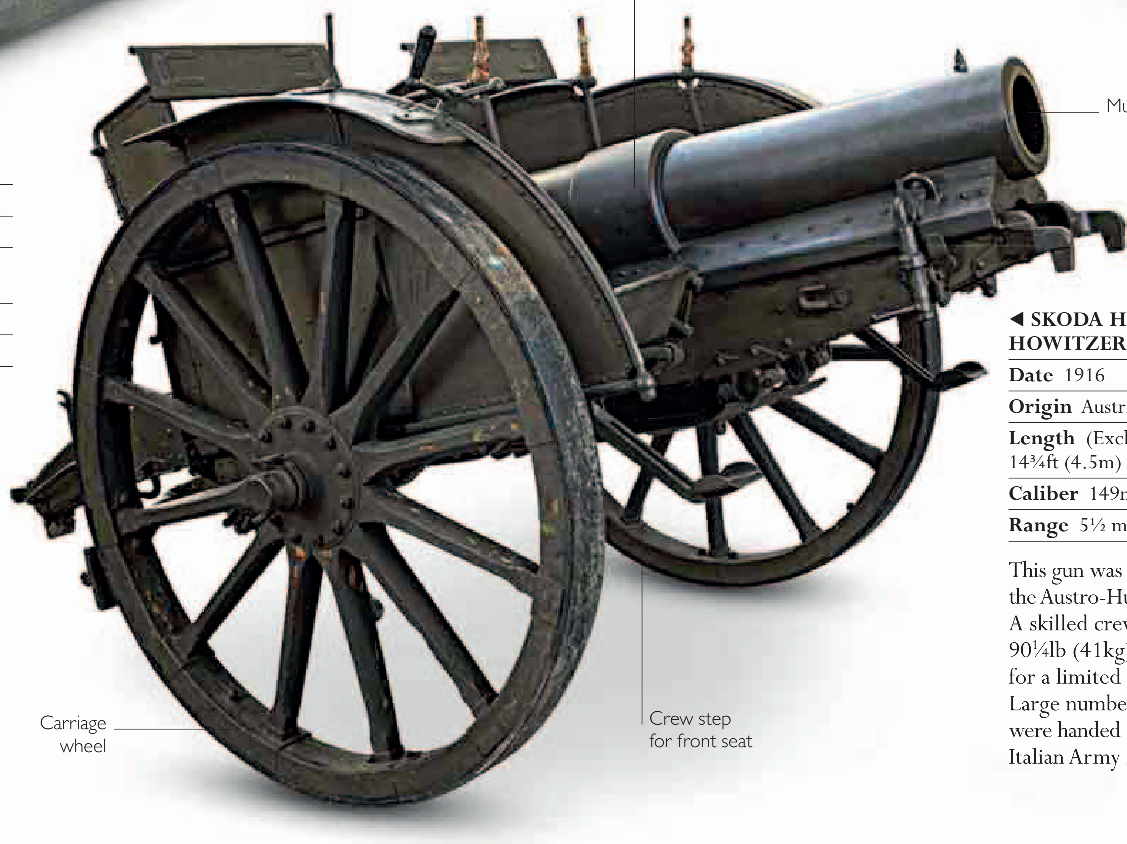
Howitzers and field guns remained in use during this era. Howitzers had first been developed in the 17th century as weapons intermediate in range and firing angle between a mortar and a field gun. By World War I, some had grown to become huge, long-range weapons mounted on rails. Mortars, in contrast, had become light weapons usually operated by infantry, rather than artillerymen. During World War I, large howitzers were used to engage targets in the rear of enemy positions. British long-range guns tended to use a bag-charge propellant system, while the Germans used heavy-caliber brass cartridges.



▲ MODEL 12IN HOWITZER MARK I ON RAILROAD MOUNTING

Date	1916
Origin	UK
Length	(Excluding carriage) 18¾ft (5.71m)
Caliber	12in
Range	6¼ miles (10.17km)

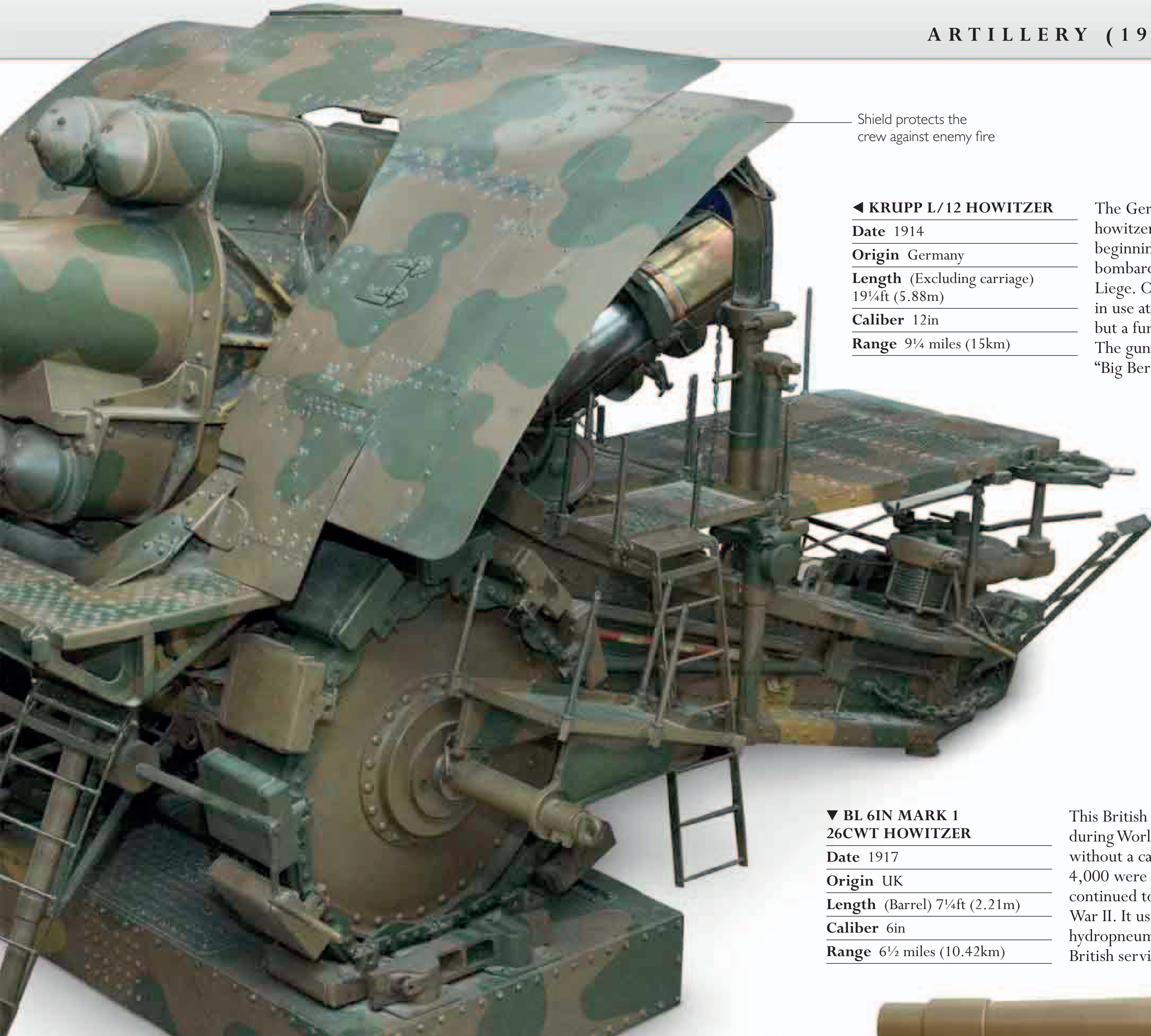
Manufactured by the Elswick Ordnance Company for the British Army, 12in railroad howitzers were operated in pairs by the British Royal Garrison Artillery. The short-barreled Mark I was soon superseded by the longer-barreled Mark III, which had 40 percent greater range, and the Mark V, which had much-improved traverse, or horizontal, field of fire.



◀ SKODA HEAVY FIELD HOWITZER M1914/16

Date	1916
Origin	Austria-Hungary
Length	(Excluding carriage) 14¾ft (4.5m)
Caliber	149mm
Range	5½ miles (8.75km)

This gun was produced for the Austro-Hungarian Army. A skilled crew could fire two 90¼lb (41kg) shells a minute for a limited period of action. Large numbers of the gun were handed over to the Italian Army in World War II.



◀ KRUPP L/12 HOWITZER

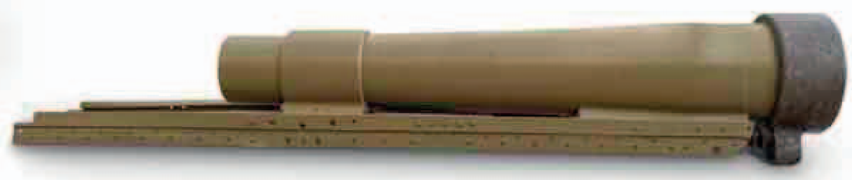
Date	1914
Origin	Germany
Length	(Excluding carriage) 19¼ft (5.88m)
Caliber	12in
Range	9¼ miles (15km)

The Germans used this heavy howitzer made by Krupp at the beginning of World War I to bombard the Belgian forts at Liege. Only two weapons were in use at the outset of the war, but a further 10 were built. The gun came to be called "Big Bertha."

▼ BL 6IN MARK 1 26CWT HOWITZER

Date	1917
Origin	UK
Length	(Barrel) 7¼ft (2.21m)
Caliber	6in
Range	6½ miles (10.42km)

This British howitzer was built during World War I, (seen here without a carriage) and over 4,000 were made. British forces continued to use it during World War II. It used one of the first hydropneumatic recoil systems in British service.

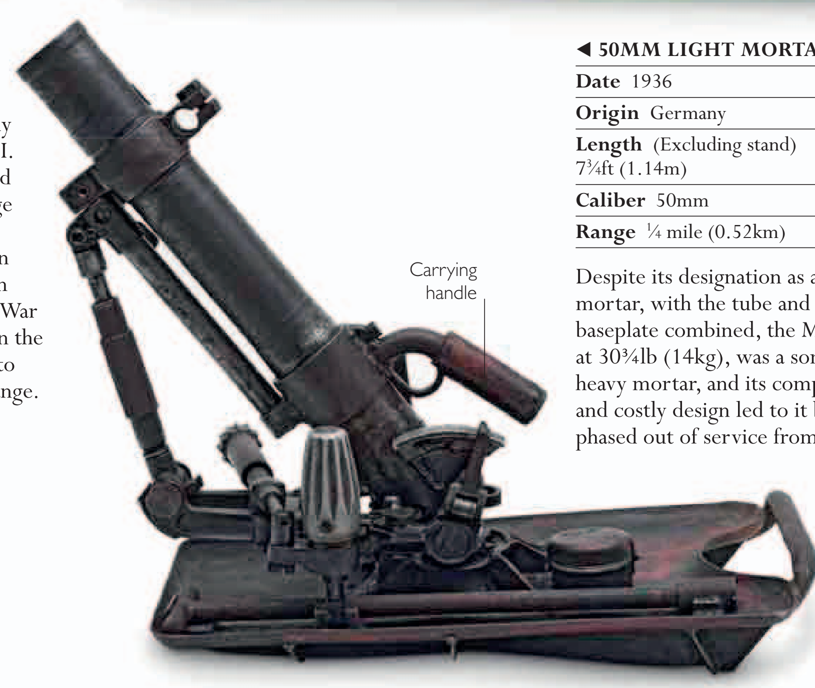


◀ BRITISH 3IN MORTAR

Date	1930
Origin	UK
Length	(Excluding stand) 4½ft (1.4m)
Caliber	3.2in
Range	1 mile (1.6km)

This mortar was officially known as the 3in Mark II. While it was a sturdy and reliable weapon, its range was not as good as its equivalent—the German 8cm Granatwerfer 34. In the early years of World War II, it required a change in the ammunition propellant to increase the weapon's range.

MORTAR BOMB



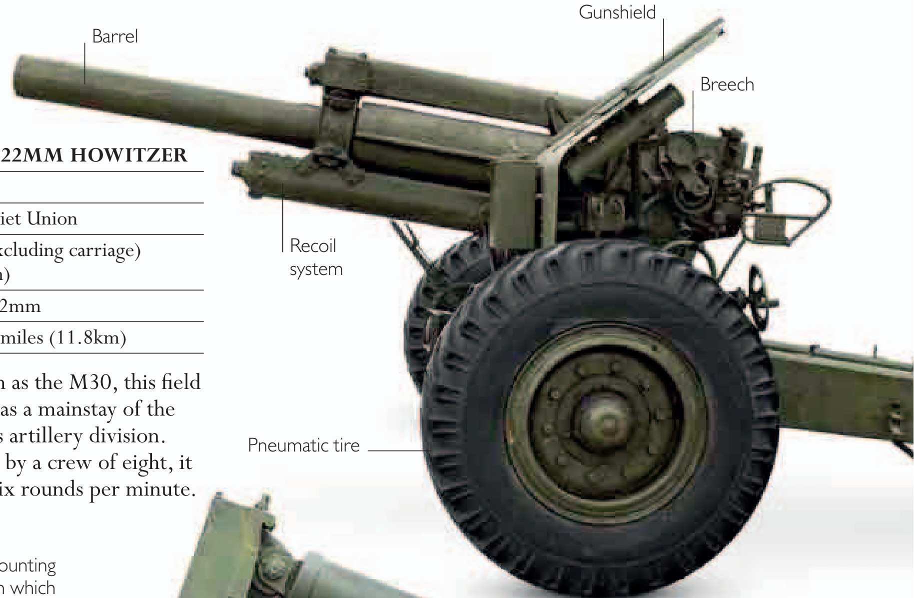
◀ 50MM LIGHT MORTAR 36

Date	1936
Origin	Germany
Length	(Excluding stand) 7¾ft (1.14m)
Caliber	50mm
Range	¼ mile (0.52km)

Despite its designation as a light mortar, with the tube and baseplate combined, the M36, at 30¾lb (14kg), was a somewhat heavy mortar, and its complex and costly design led to it being phased out of service from 1941.

ARTILLERY (1939–45)

Field artillery continued to play an important role during World War II. While artillery manufacture was handled by commercial companies in Germany, in countries such as Britain, artillery was built by the state. A lot of British artillery tactical thinking was still based on ideas from World War I—centered around improving twists in rifling and fire controls—and this restricted the speedy development of new designs. While howitzers and mortars continued to be used, new threats spurred the development of antitank (see pp.232–33) and antiaircraft (see pp.234–35) guns.



▶ M1938 122MM HOWITZER

Date 1939

Origin Soviet Union

Length (Excluding carriage) 19¼ft (5.9m)

Caliber 122mm

Range 7½ miles (11.8km)

Also known as the M30, this field howitzer was a mainstay of the Red Army's artillery division. Maintained by a crew of eight, it could fire six rounds per minute.

▶ BRITISH 7.2IN BL HOWITZER MARK III ON US M8 CARRIAGE

Date 1940

Origin UK

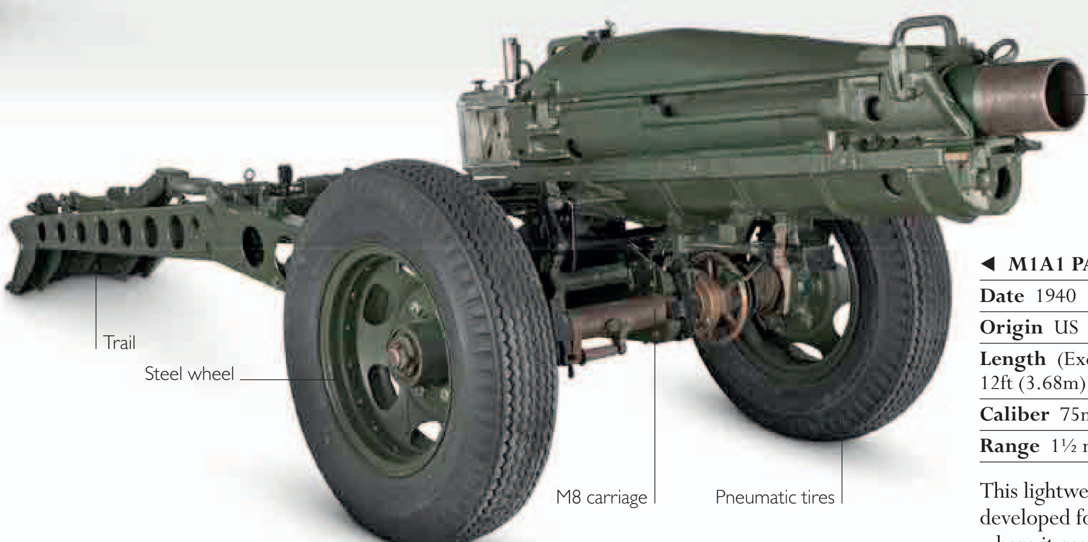
Length (Excluding carriage) 45ft (13.71m)

Caliber 7.2in

Range more than 7 miles (11.26km)

This gun had originally been designed for a two-wheeled box trail carriage. It was found to be too powerful when using a full propellant charge and so was mounted on the more stable M8 gun carriage. The gun was introduced in 1943 and became the main heavy gun of the British Army.

FULL VIEW



◀ M1A1 PACK HOWITZER

Date 1940

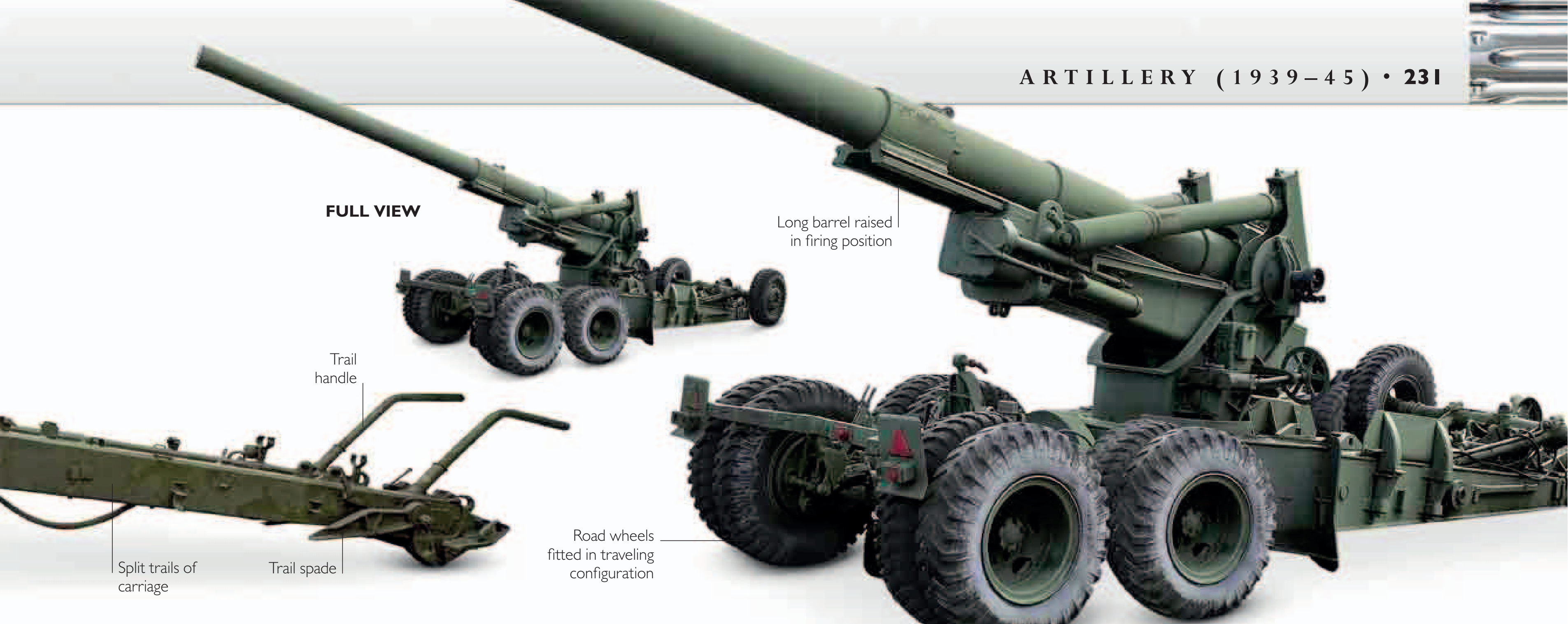
Origin US

Length (Excluding carriage) 12ft (3.68m)

Caliber 75mm

Range 1½ miles (2.56km)

This lightweight howitzer was developed for use on rough terrain, where it could be broken down into separate pieces and carried by pack animals. It was also successfully assigned to US airborne forces.



▲ M1A1 155MM GUN

Date	1941
Origin	US
Length	24ft (7.36m)
Caliber	155mm
Range	14½ miles (23.22km)

The M1A1 was the principal gun of US long-range artillery during World War II. It was capable of firing a 95lb (43kg) high-explosive shell at a speed of 2,800ft (853m) per second. It could also fire other ammunition, including smoke and antitank rounds.

▼ BL 5.5IN MEDIUM GUN MARK III

Date	1942
Origin	UK
Length	(Excluding carriage) 24½ft (7.52m)
Caliber	5.5in
Range	10¼ miles (16.55km) with 80lb (36.2kg) shell

After several design problems, this gun was introduced in 1942. British forces used it in the Western Desert Campaign in Africa and until the end of World War II. At over six tons in weight, it was difficult to maneuver and deploy without a heavy tractor.

▼ BRITISH 4.2IN MORTAR

Date	1942
Origin	UK
Length	6¾ ft (2.1m)
Caliber	4.2in
Range	2½ miles (3.75km)

Unlike most mortars, which were infantry weapons and did not require artillery crews to operate them, the 4.2in Mortar—the British Army's heavy mortar—was manned by crews from the Royal Artillery.

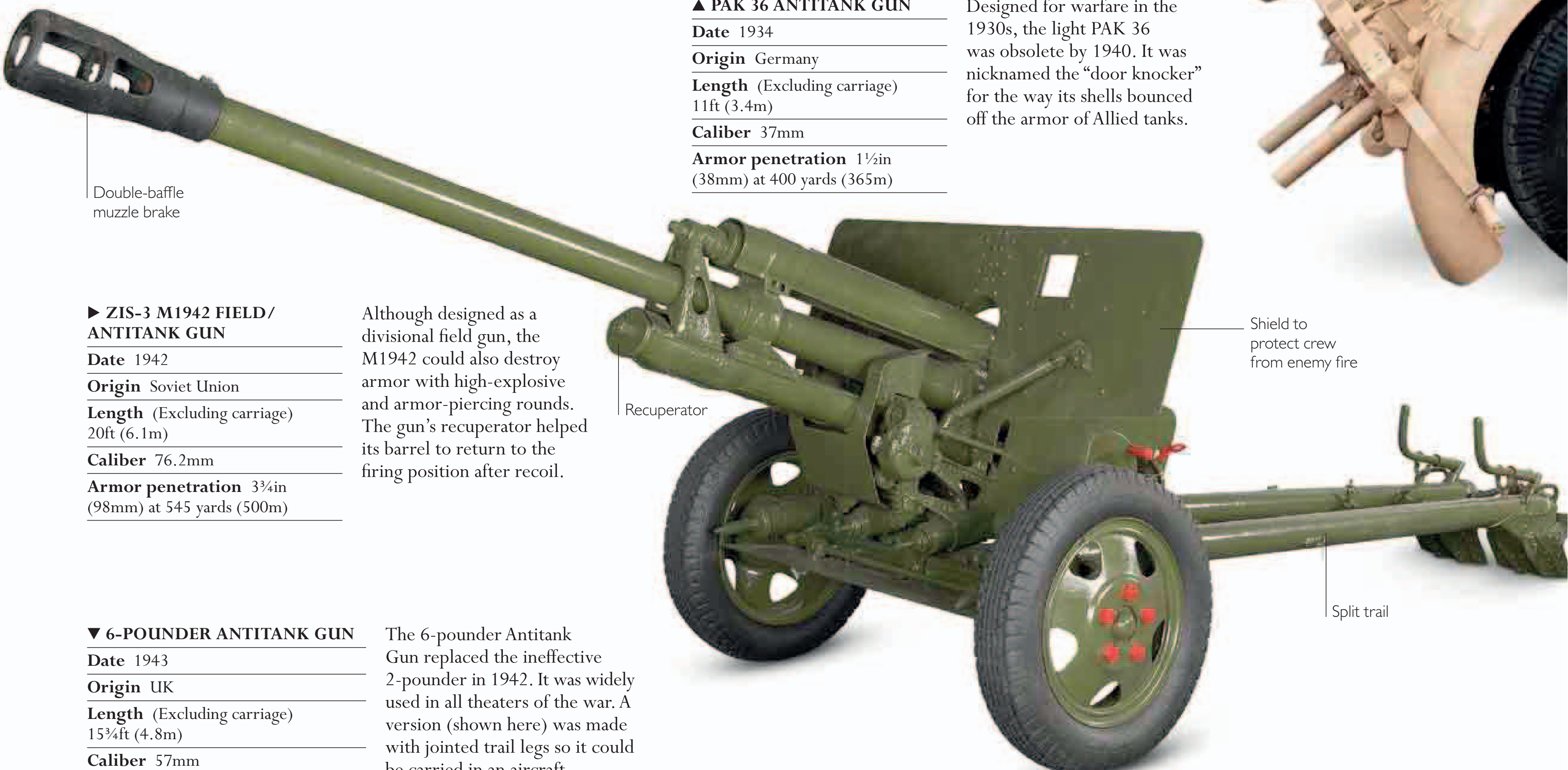
ANTITANK ARTILLERY

The rapid development of the tank during World War I spurred a parallel development in antitank weapons. Most of the designs from before World War II were of small caliber and used a solid projectile fired at high velocity to smash through a tank's defensive armor. In the years leading up to World War II, tank armor became thicker, prompting the need for larger caliber weapons, often using explosive rounds, to counter it. It was not uncommon for weapons designed for other purposes to be used as antitank weapons, the German Flak 36 being an example used in the first years of World War II.

▲ PAK 36 ANTITANK GUN

Date 1934	
Origin Germany	
Length (Excluding carriage) 11ft (3.4m)	
Caliber 37mm	
Armor penetration 1½in (38mm) at 400 yards (365m)	

Designed for warfare in the 1930s, the light PAK 36 was obsolete by 1940. It was nicknamed the "door knocker" for the way its shells bounced off the armor of Allied tanks.



▶ ZIS-3 M1942 FIELD/ ANTITANK GUN

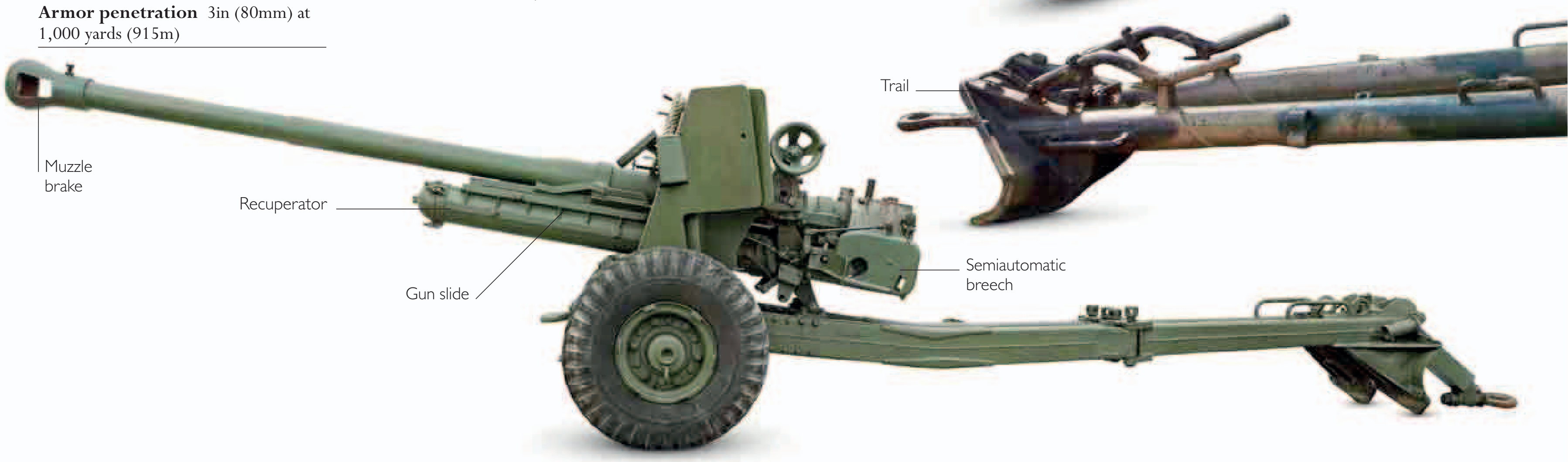
Date 1942	
Origin Soviet Union	
Length (Excluding carriage) 20ft (6.1m)	
Caliber 76.2mm	
Armor penetration 3¾in (98mm) at 545 yards (500m)	

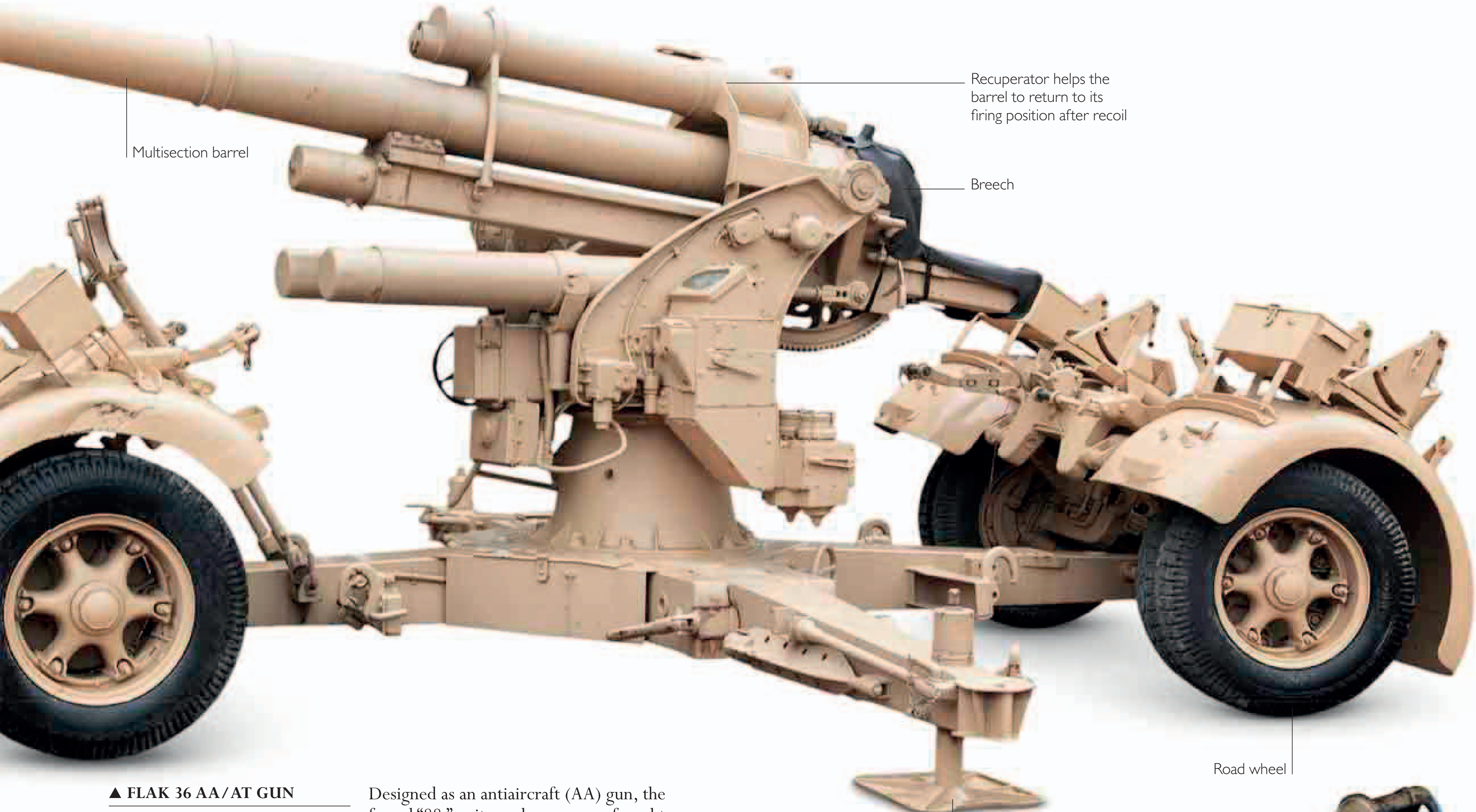
Although designed as a divisional field gun, the M1942 could also destroy armor with high-explosive and armor-piercing rounds. The gun's recuperator helped its barrel to return to the firing position after recoil.

▼ 6-POUNDER ANTITANK GUN

Date 1943	
Origin UK	
Length (Excluding carriage) 15¾ft (4.8m)	
Caliber 57mm	
Armor penetration 3in (80mm) at 1,000 yards (915m)	

The 6-pounder Antitank Gun replaced the ineffective 2-pounder in 1942. It was widely used in all theaters of the war. A version (shown here) was made with jointed trail legs so it could be carried in an aircraft.





▲ FLAK 36 AA/AT GUN

Date	1936
Origin	Germany
Length	(Excluding carriage) 19ft (5.79m)
Caliber	88mm
Armor penetration	6¼in (159mm) at 1,094 yards (1,000m)

Designed as an antiaircraft (AA) gun, the famed "88," as it was known, was found to be highly effective as an antitank gun. It could be put in position very quickly—within three minutes—although its bulk and height made it difficult to conceal. It was able to fire up to 20 rounds per minute.

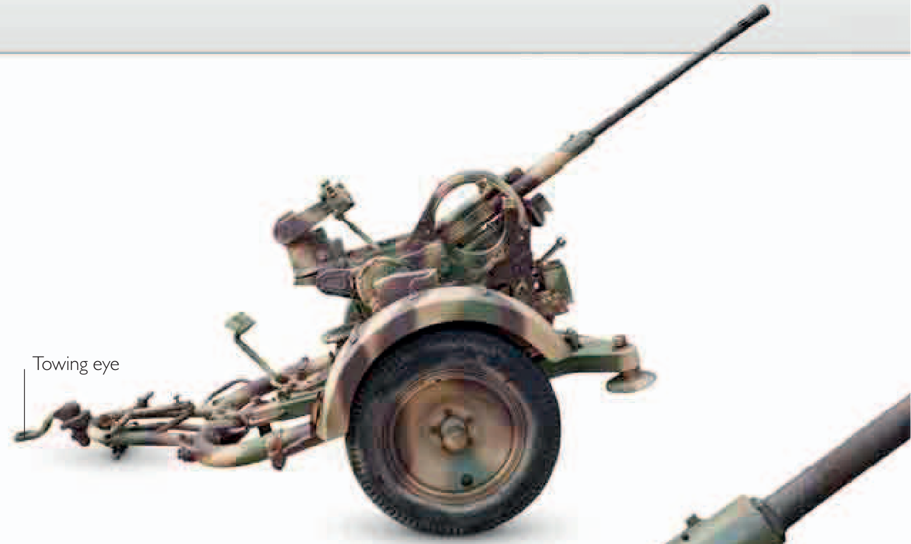
◄ PAK 40 ANTITANK GUN

Date	1942
Origin	Germany
Length	(Excluding carriage) 20¼ft (6.2m)
Caliber	75mm
Armor penetration	3½in (87mm) at 1,094 yards (1,000m)

This gun was a scaled-up version of the Pak 36 (opposite) and was introduced in 1942 to counter heavy Soviet tanks encountered on the Russian Front. Many German armored vehicles were also equipped with this gun.

ANTIAIRCRAFT GUNS

Specialized antiaircraft guns were developed as soon as aircraft became a perceived threat at the beginning of World War I. By the outset of World War II, aircraft had become a major threat to ground forces, and heavy guns were designed to fire projectiles at a high altitude for high-flying aircraft, while light-caliber guns fired rapidly at low-flying aircraft. The target height was measured by optical instruments on the ground. Antiaircraft guns fired shells with fuses timed to explode when they reached target height. Aircraft were not usually brought down by direct hits, but by shrapnel from these bursting shells, which came to be known as "flak."

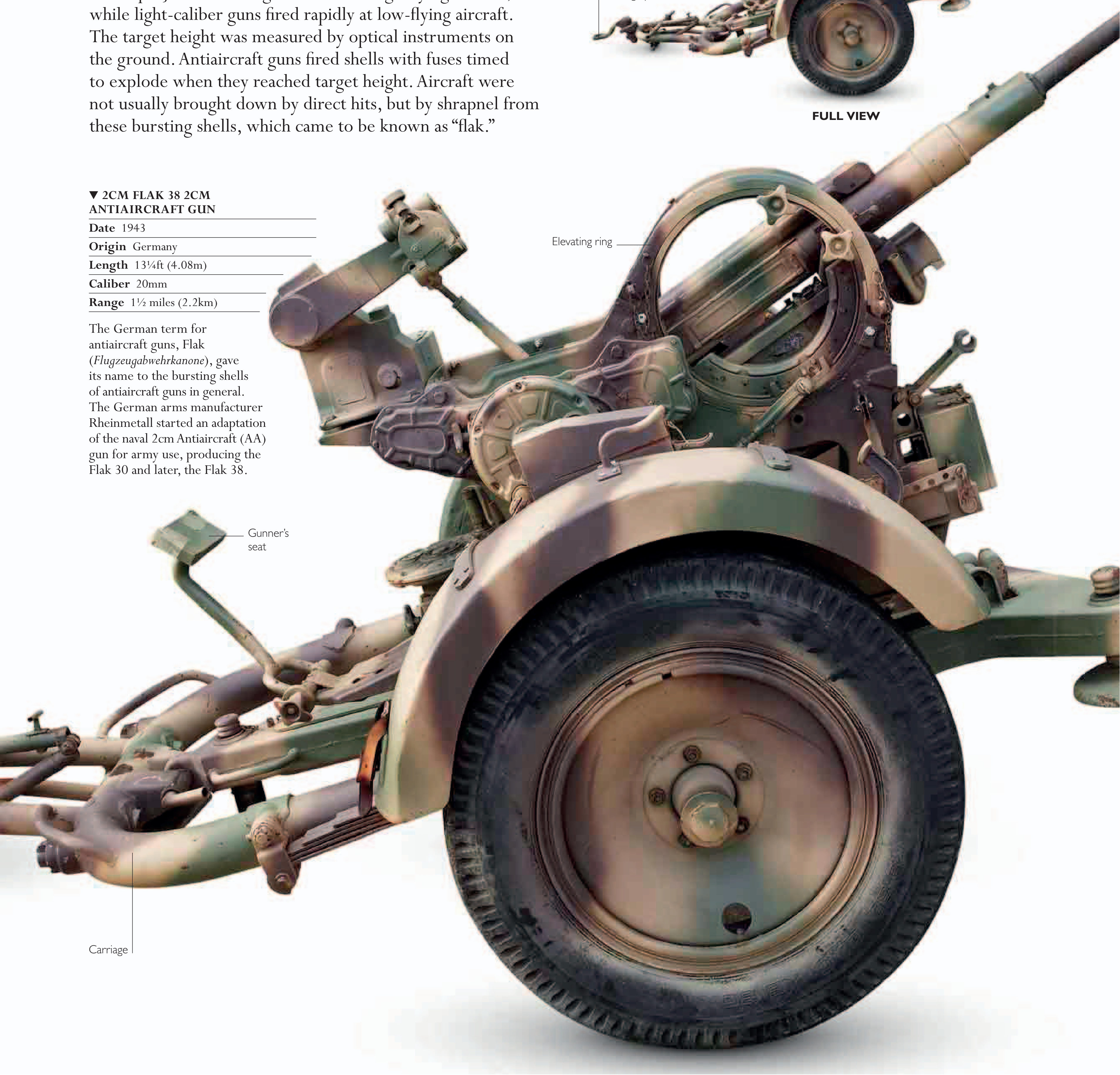


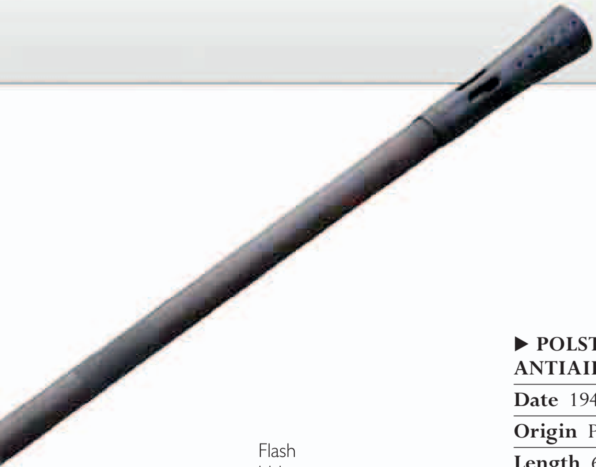
FULL VIEW

▼ 2CM FLAK 38 2CM ANTIAIRCRAFT GUN

Date	1943
Origin	Germany
Length	13¼ft (4.08m)
Caliber	20mm
Range	1½ miles (2.2km)

The German term for antiaircraft guns, Flak (*Flugzeugabwehrkanone*), gave its name to the bursting shells of antiaircraft guns in general. The German arms manufacturer Rheinmetall started an adaptation of the naval 2cm Antiaircraft (AA) gun for army use, producing the Flak 30 and later, the Flak 38.

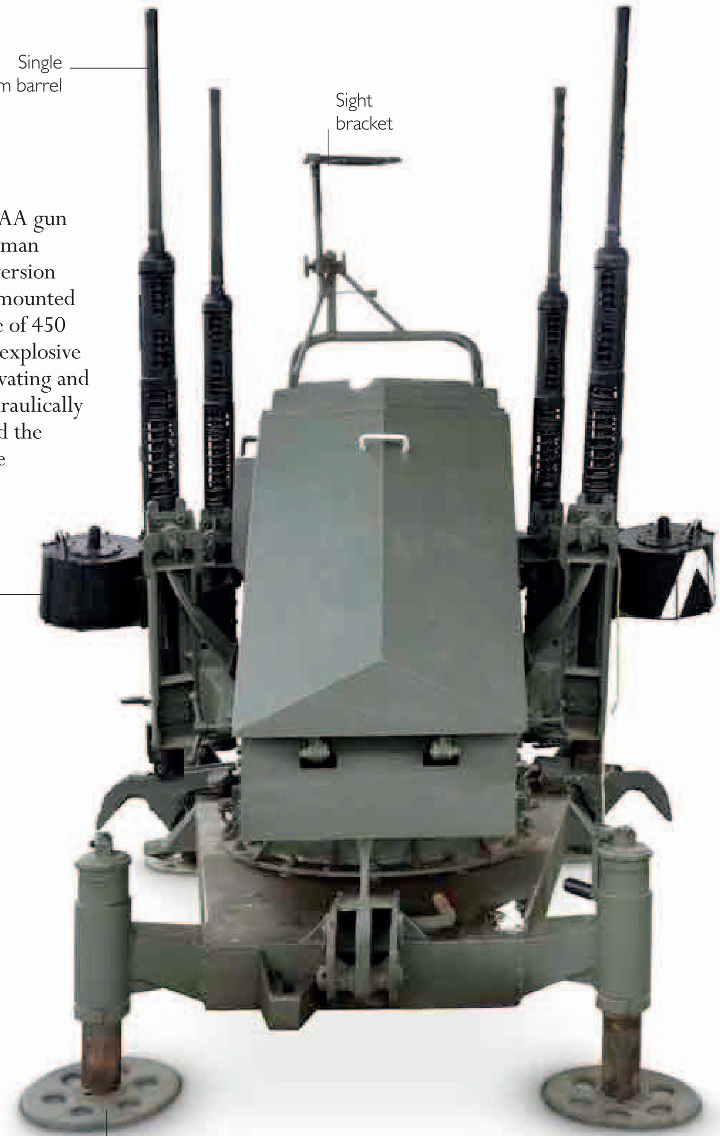




▶ **POLSTEN QUAD 20MM ANTIAIRCRAFT GUN**

Date	1944
Origin	Poland
Length	6¾ft (2.1m)
Caliber	20mm
Range	1¼ miles (2.02km)

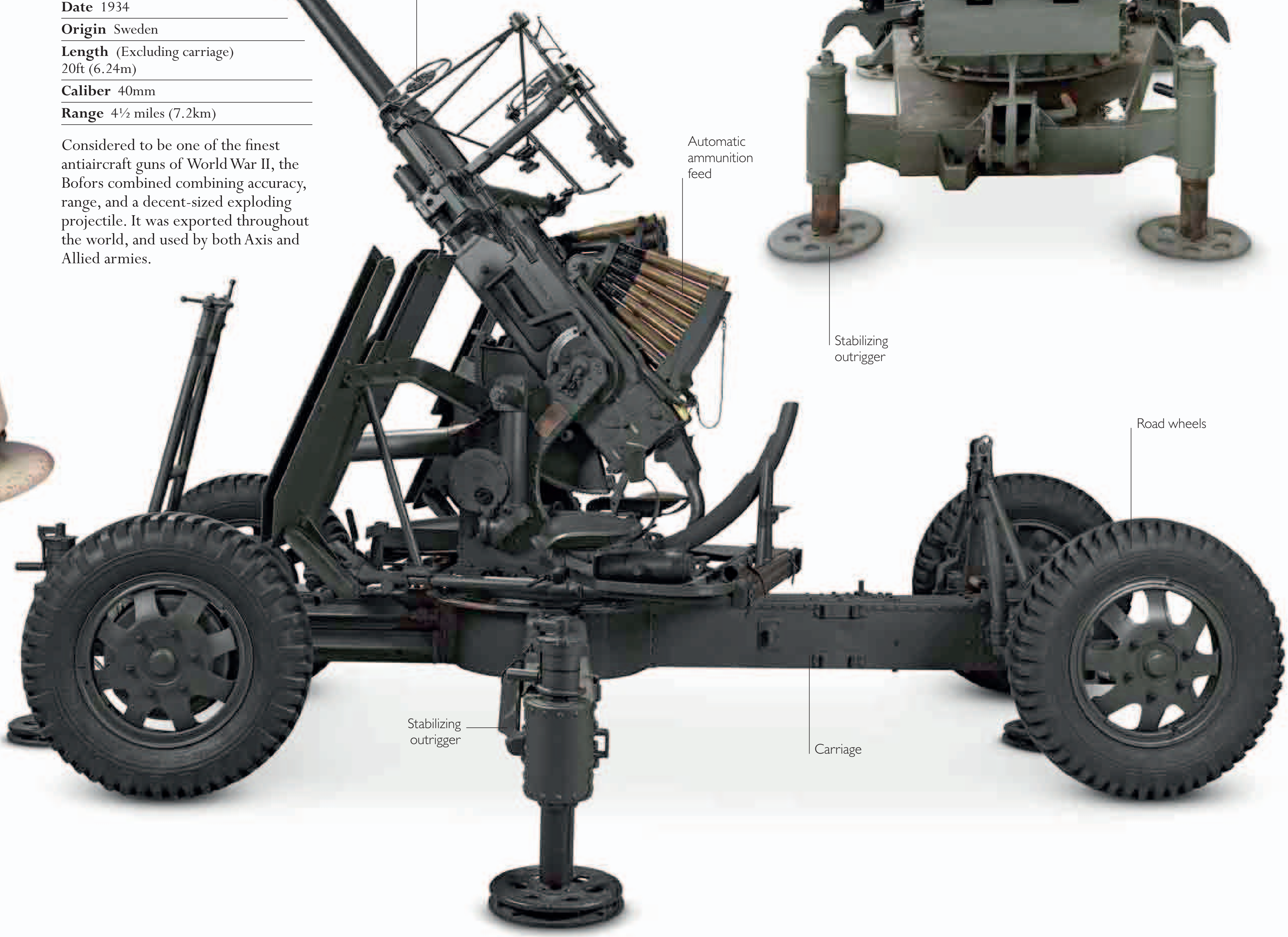
The Polsten was a Polish AA gun similar to the 20mm German Oerlikon gun. The quad version of the Polsten (with four mounted barrels) could fire at a rate of 450 armor-piercing bullets or explosive shells per minute. The elevating and traversing action was hydraulically controlled, which enabled the gunner to have immediate control at his fingertips.



▶ **BOFORS 40MM ANTIAIRCRAFT GUN**

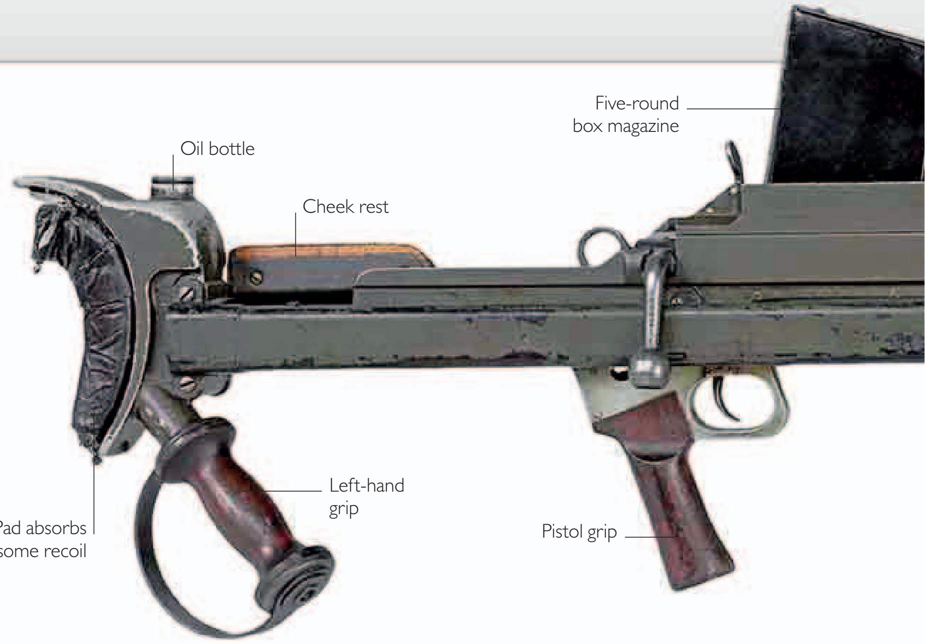
Date	1934
Origin	Sweden
Length	(Excluding carriage) 20ft (6.24m)
Caliber	40mm
Range	4½ miles (7.2km)

Considered to be one of the finest antiaircraft guns of World War II, the Bofors combined combining accuracy, range, and a decent-sized exploding projectile. It was exported throughout the world, and used by both Axis and Allied armies.



MAN-PORTABLE ANTITANK WEAPONS (1930–39)

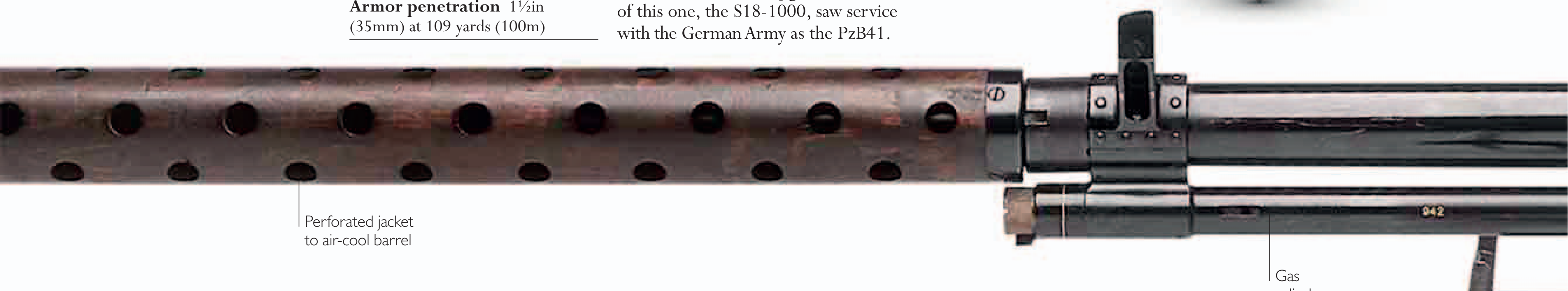
The first portable antitank rifle was developed by Germany in World War I. It was called the Mauser 1918 T-Gewehr and was chambered for 13.2mm cartridges. German forces used this long, heavy weapon effectively against British tanks. Antitank weapons required a heavily constructed breech and barrel to fire a sufficiently heavy and high-velocity round to penetrate armor. All of the designs developed prior to World War II were heavy and needed a support, such as a bipod, so that the operator could fire the weapon.

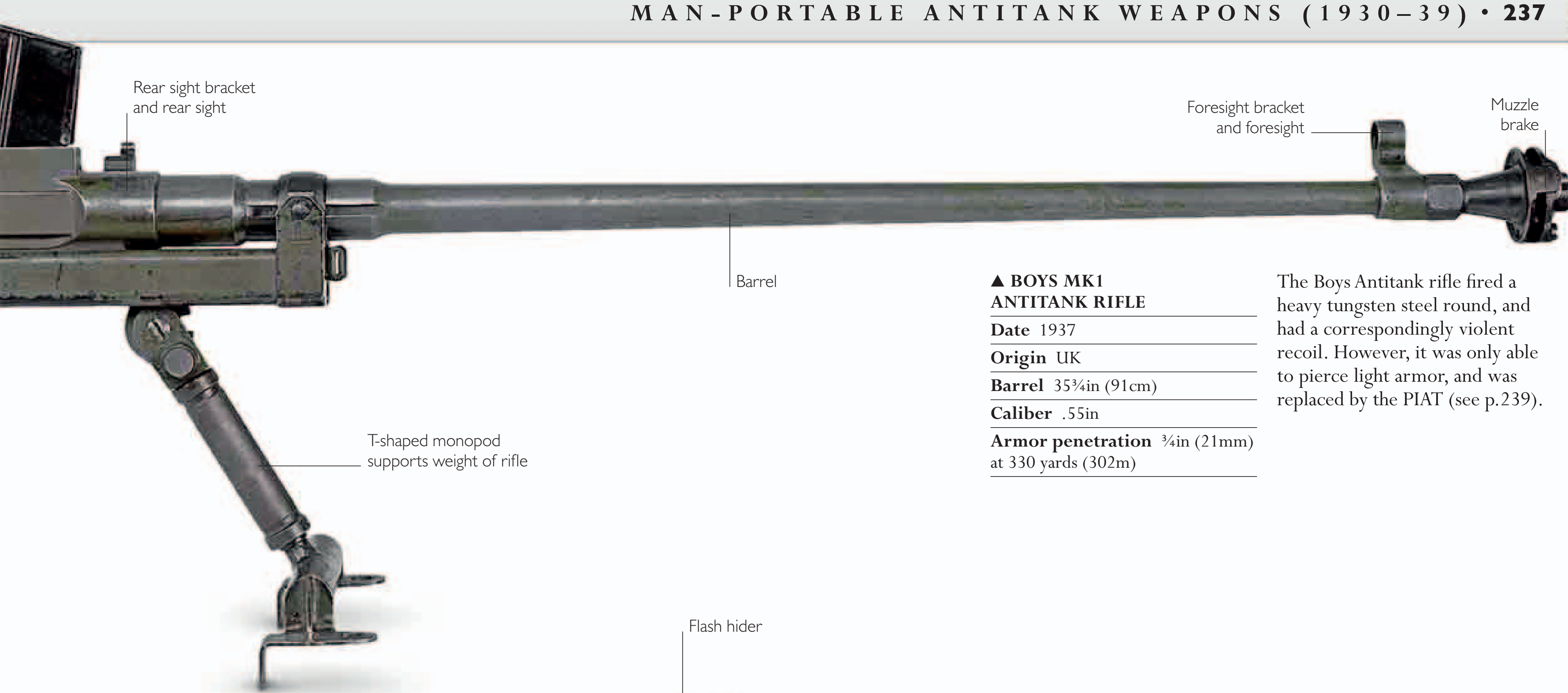


▲ SOLOTHURN S18-100 ANTITANK RIFLE

Date	1930
Origin	Switzerland
Barrel	35½in (90cm)
Caliber	20mm
Armor penetration	1½in (35mm) at 109 yards (100m)

The Solothurn Antitank rifle fired a base-fused shell (an artillery round in miniature) that gave acceptable results against light armor. This gun had a gas-operated, self-loading action similar to that of many self-loading small-arm rifles. An upgraded version of this one, the S18-1000, saw service with the German Army as the PzB41.





▲ BOYS MK1 ANTITANK RIFLE

Date 1937

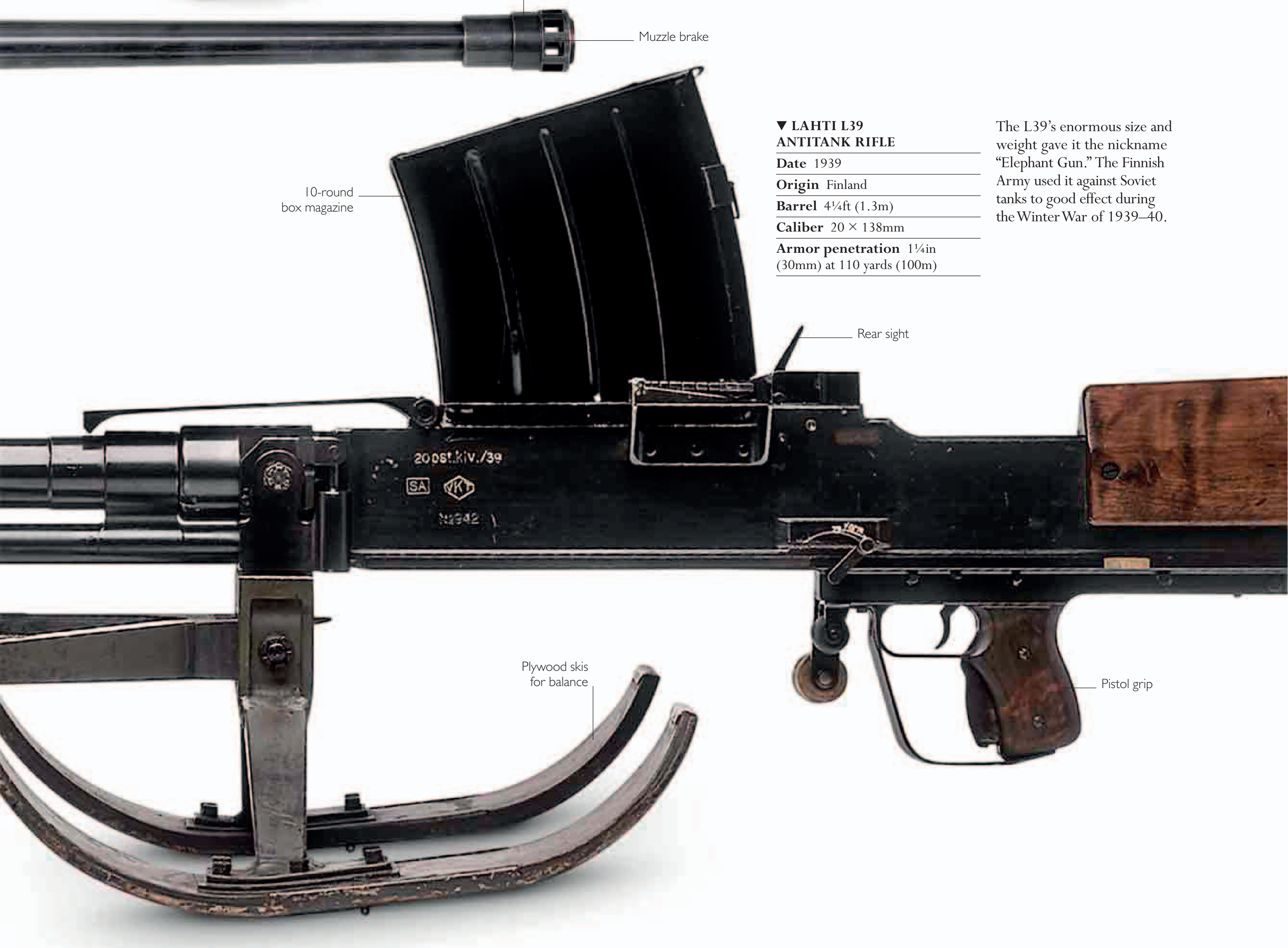
Origin UK

Barrel 35¾in (91cm)

Caliber .55in

Armor penetration ¾in (21mm) at 330 yards (302m)

The Boys Antitank rifle fired a heavy tungsten steel round, and had a correspondingly violent recoil. However, it was only able to pierce light armor, and was replaced by the PIAT (see p.239).



▼ LAHTI L39 ANTITANK RIFLE

Date 1939

Origin Finland

Barrel 4¼ft (1.3m)

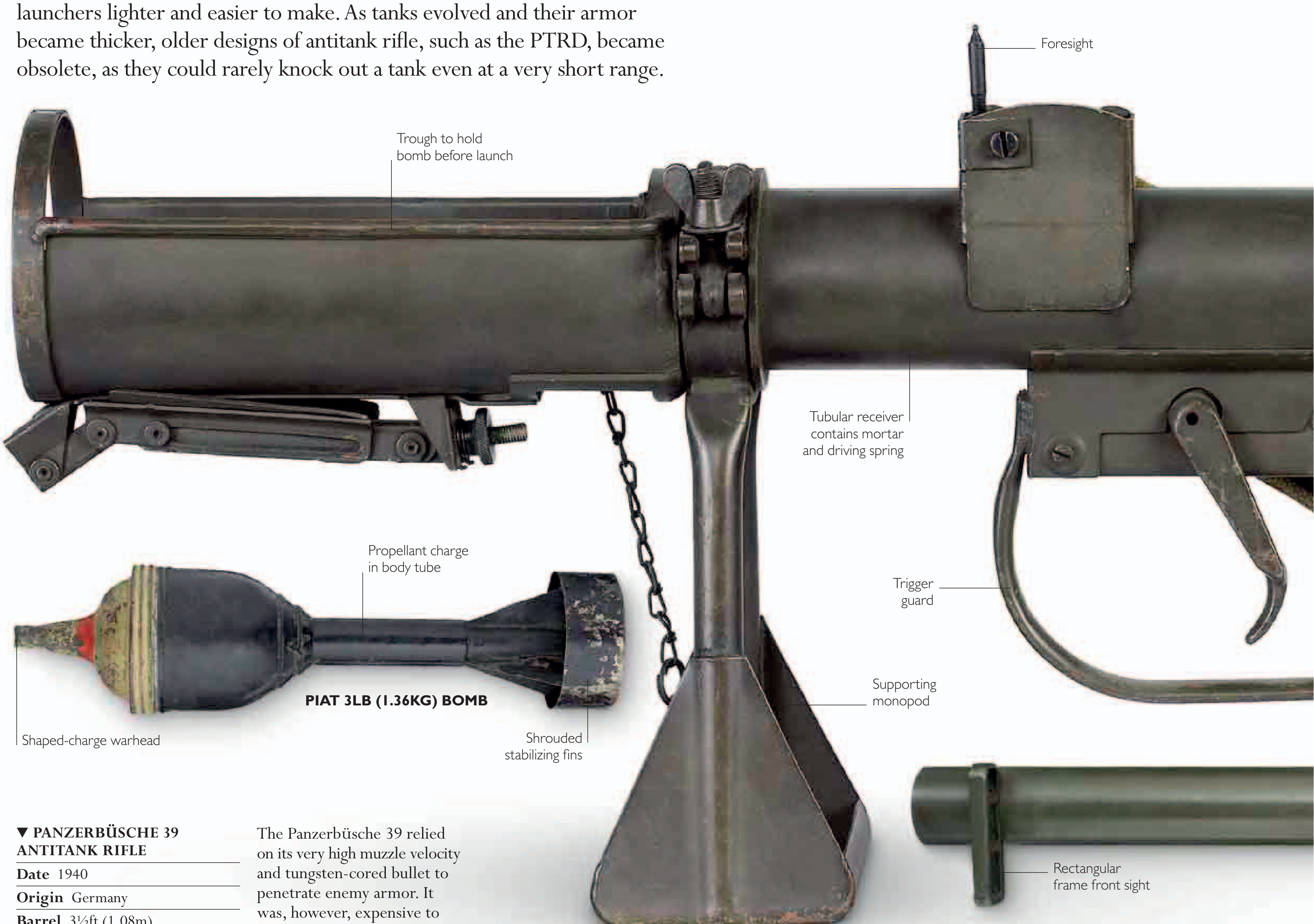
Caliber 20 × 138mm

Armor penetration 1¼in (30mm) at 110 yards (100m)

The L39's enormous size and weight gave it the nickname "Elephant Gun." The Finnish Army used it against Soviet tanks to good effect during the Winter War of 1939–40.

MAN-PORTABLE ANTITANK WEAPONS (1940–42)

Portable antitank weapons continued to be developed as World War II progressed. Some systems, such as the PIAT, relied on a spring-driven firing pin to ignite a propellant charge attached to the base of a self-propelled projectile. Others, such as the bazooka, released projectiles with solid rocket motors. In both cases, when the projectile met its target, a shaped-charge warhead helped to focus the effect of the explosive's energy so that it could penetrate armor effectively. This made launchers lighter and easier to make. As tanks evolved and their armor became thicker, older designs of antitank rifle, such as the PTRD, became obsolete, as they could rarely knock out a tank even at a very short range.

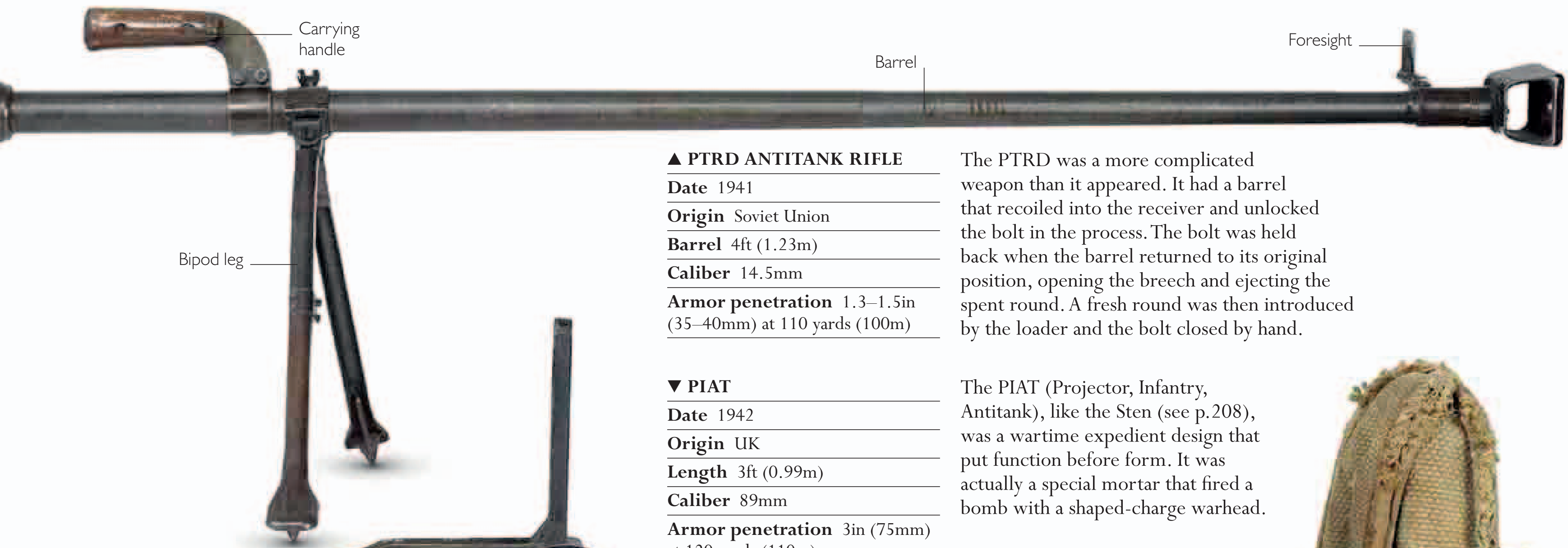


PIAT 3LB (1.36KG) BOMB

▼ PANZERBÜSCHE 39 ANTITANK RIFLE

Date	1940
Origin	Germany
Barrel	3½ft (1.08m)
Caliber	7.92 × 94mm
Armor penetration	1in (25mm) at 330 yards (300m)

The Panzerbüsche 39 relied on its very high muzzle velocity and tungsten-cored bullet to penetrate enemy armor. It was, however, expensive to manufacture, and was only produced in small numbers.



▲ PTRD ANTITANK RIFLE

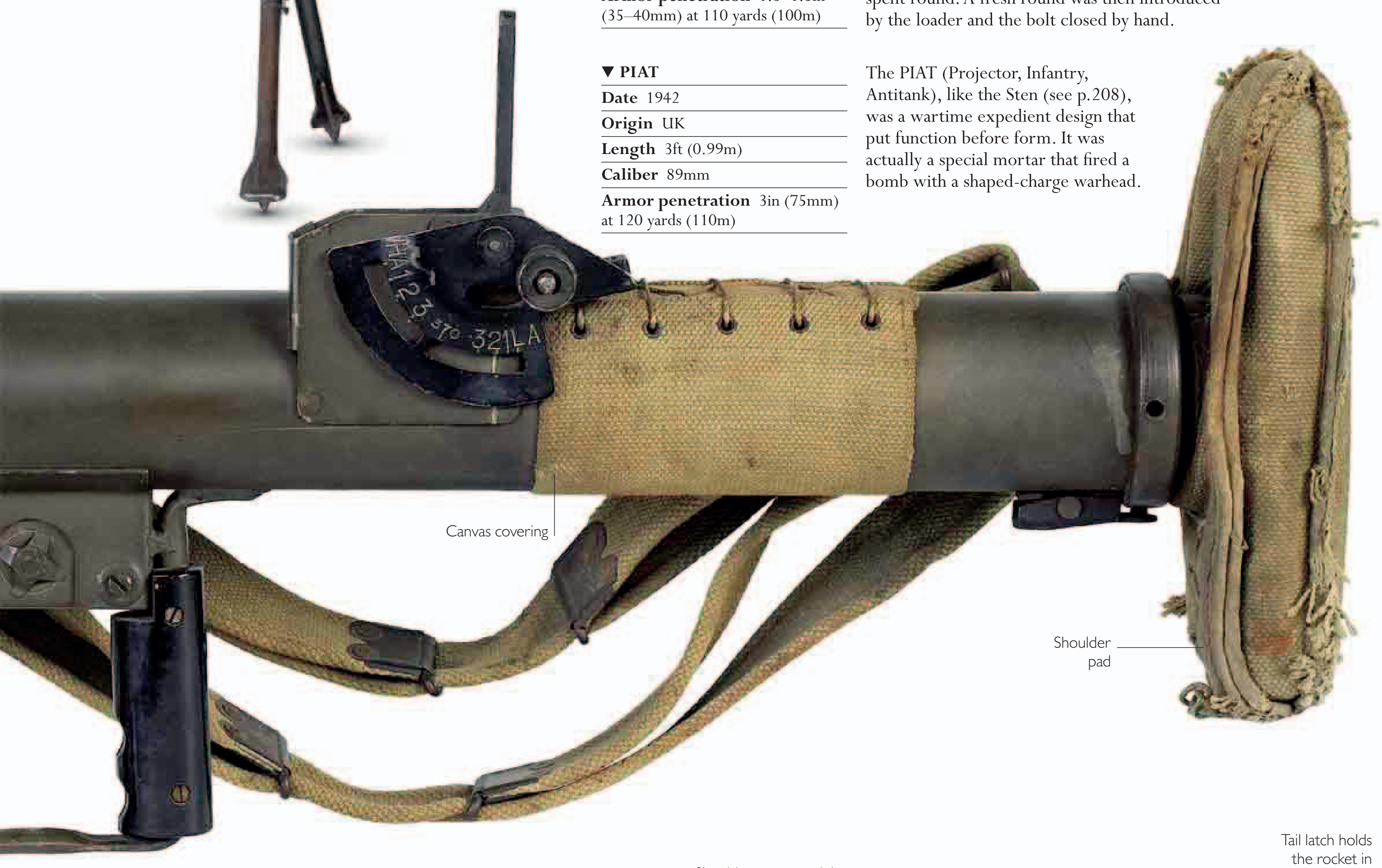
Date	1941
Origin	Soviet Union
Barrel	4ft (1.23m)
Caliber	14.5mm
Armor penetration	1.3–1.5in (35–40mm) at 110 yards (100m)

The PTRD was a more complicated weapon than it appeared. It had a barrel that recoiled into the receiver and unlocked the bolt in the process. The bolt was held back when the barrel returned to its original position, opening the breech and ejecting the spent round. A fresh round was then introduced by the loader and the bolt closed by hand.

▼ PIAT

Date	1942
Origin	UK
Length	3ft (0.99m)
Caliber	89mm
Armor penetration	3in (75mm) at 120 yards (110m)

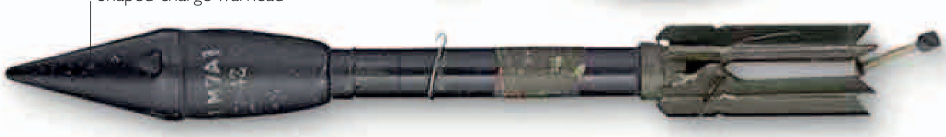
The PIAT (Projector, Infantry, Antitank), like the Sten (see p.208), was a wartime expedient design that put function before form. It was actually a special mortar that fired a bomb with a shaped-charge warhead.



▲ M1A1 BAZOOKA

Date	1942
Origin	US
Length	4½ft (1.37m)
Caliber	60mm
Armor penetration	4¾in (120mm) at 150 yards (138m)

The Bazooka was essentially a tube that launched a solid-fuel rocket with a shaped-charge warhead. It was operated by two men—one who fired and one who loaded.



M1A1 3½LB (1.54KG) ROCKET


COLT M4 CARBINE

THE MODERN ERA

1945–PRESENT DAY

After 1945, the construction and manufacture of firearms changed in key ways—parts made of wood became parts of polymer or synthetic composite materials, and detailed castings replaced components previously machined from blocks of steel. Guns became more robust and production costs dropped. Some truly distinct types of firearm, such as assault rifles and advanced submachine-guns, evolved and became widely used.

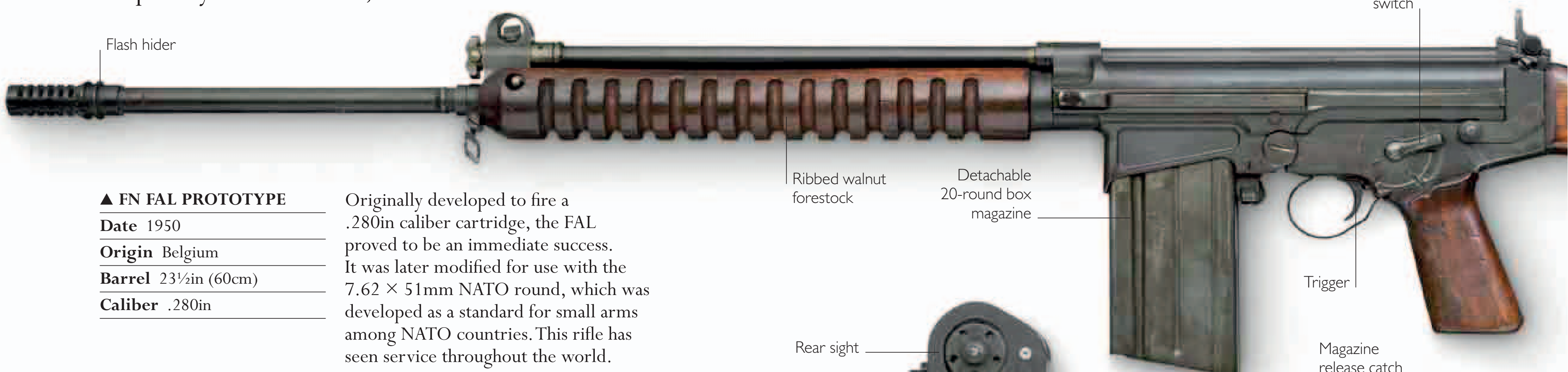
SELF-LOADING RIFLES

Drawing upon the designs developed during World War II, and the performance of the arms made during that conflict, postwar designers further refined self-loading rifles. Improvements were made to their locks, or actions, synthetic materials began to replace wood stocks, and pressed metal components were introduced to reduce weight. Importantly, most of these rifles, which were all gas-operated (including those featured here), were chambered for standardized cartridges adopted by defense unions, such as NATO.

▲ SIMONOV SKS-45 CARBINE

Date 1945
Origin Soviet Union
Barrel 20½in (52cm)
Caliber 7.62 × 39mm

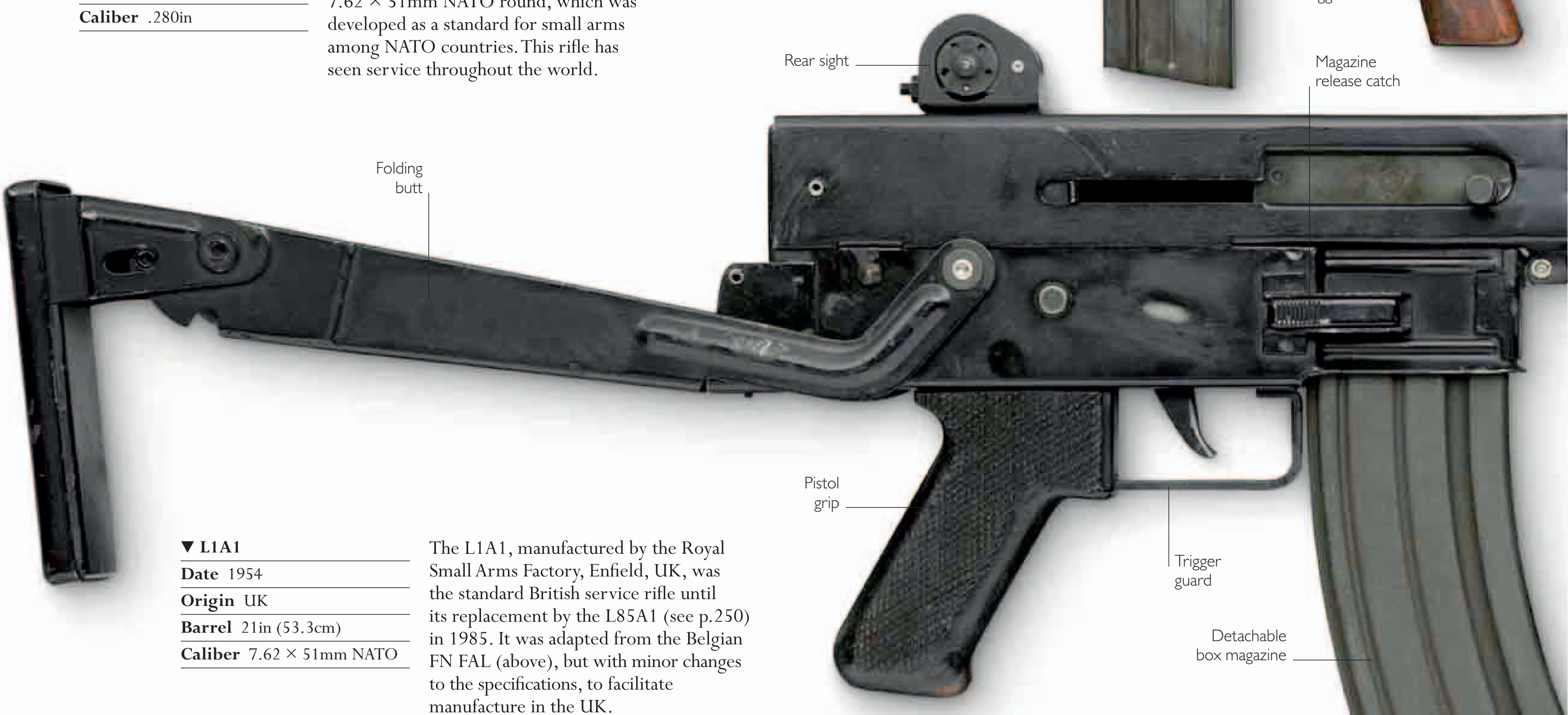
Designed by Sergei Gravilovich Simonov, the SKS entered service in 1945, and variants have been sold throughout the world. It was adopted as China's primary battle rifle. Some variants, such as this example, were equipped with permanently attached bayonets that folded rearward when not in use.



▲ FN FAL PROTOTYPE

Date 1950
Origin Belgium
Barrel 23½in (60cm)
Caliber .280in

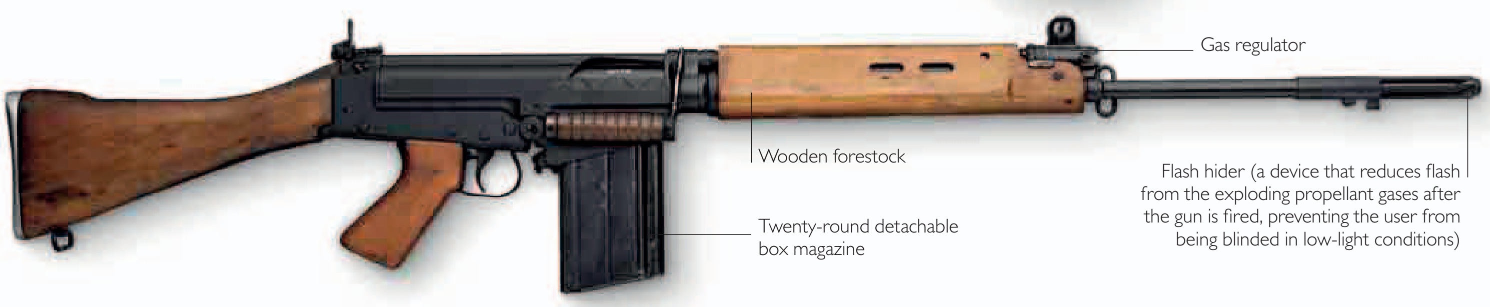
Originally developed to fire a .280in caliber cartridge, the FAL proved to be an immediate success. It was later modified for use with the 7.62 × 51mm NATO round, which was developed as a standard for small arms among NATO countries. This rifle has seen service throughout the world.



▼ L1A1

Date 1954
Origin UK
Barrel 21in (53.3cm)
Caliber 7.62 × 51mm NATO

The L1A1, manufactured by the Royal Small Arms Factory, Enfield, UK, was the standard British service rifle until its replacement by the L85A1 (see p.250) in 1985. It was adapted from the Belgian FN FAL (above), but with minor changes to the specifications, to facilitate manufacture in the UK.



▲ M14 RIFLE

Date	1957
Origin	US
Barrel	22in (55.8cm)
Caliber	7.62 × 51mm NATO

Designed to use the then-standard NATO round, the US M14 replaced the old M1 rifle (see p.176). The M14 possessed fully automatic fire capability and was equipped with a larger magazine. By the late 1960s, it was replaced by the M16 (see p.245).

▲ STONER 63 ASSAULT RIFLE

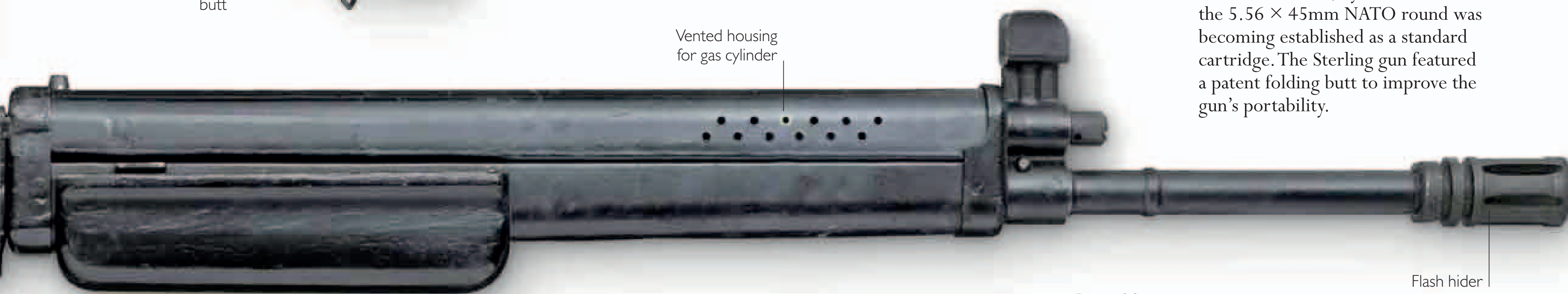
Date	1963
Origin	US
Barrel	20in (50.8cm)
Caliber	5.56 × 45mm NATO

Designed as a modular firearm, the Stoner 63 can be assembled to produce different variants that include a carbine, an assault rifle (shown here), and several machine-gun configurations.

▼ STERLING LIGHT AUTO RIFLE

Date	1970s
Origin	UK
Barrel	19¾in (50cm)
Caliber	5.56 × 45mm NATO

Sterling produced this light automatic rifle in the 1970s, by which time the 5.56 × 45mm NATO round was becoming established as a standard cartridge. The Sterling gun featured a patent folding butt to improve the gun's portability.



▶ HECKLER AND KOCH G3A3

Date	1964
Origin	Switzerland
Barrel	17¾in (45cm)
Caliber	7.62 × 51mm NATO

The G3 series of rifles was developed jointly by Heckler and Koch (see pp.256–57) and Spanish design and development agency (CETME). The rifle's firing mechanism is an improvement on that found in the German StG45 designed by Ludwig Vorgrimler, who worked on the G3. The designation G3A3 refers to the version fitted with a polymer stock.

◀ HECKLER AND KOCH G41

Date	1981
Origin	Germany
Barrel	17¾in (45cm)
Caliber	5.56 × 45mm NATO

The G41 was a rechambered version of Heckler and Koch's 7.62mm G3 rifle. The G41 was designed to take the 5.56 × 45mm NATO round and could be fitted with other NATO standard features including a universal sight mount and magazine. The gun wasn't much used by armed forces.

TURNING POINT

ASSAULT RIFLES

Just as the breech-loading repeating rifle had brought about a change in warfare following its introduction in the late 19th century, the development of reliable self-loading military arms during the 1930s altered tactics again—now a single infantryman could deliver fire equivalent to a squad of 10 or 12. In 1944, the assault rifle magnified this effect almost 50-fold as it mimicked a machine-gun. Easy to use, an assault rifle allowed anyone to become an effective adversary, transforming warfare from a clash between trained armies on a battlefield to a contest between masses, often street-to-street or even house-to-house.

▲ **ASSAULT RIFLE**
An assault rifle is a short-barreled rifle, intended for use by infantry, and capable of selective fire—switching between semiautomatic and automatic modes. It chambers medium- and small-caliber cartridges with short cases. It has a high-capacity magazine that can carry 20 or more rounds. Shown here is a 1954 AK47, which fires 7.62 × 39mm cartridges.

Conflicts at the turn of the 20th century saw the development of groundbreaking weaponry. Firearms were modernized with the invention of the Maxim gun—the first machine-gun (see pp.184–85)—which spurred the refinement of automatic weapons technology at a furious pace. Heavy machine-guns were followed by medium- and light machine-guns, as armies felt need to provide groups of soldiers with portable, automatic firepower. It was not until the invention and use of the assault rifle during World War II (1939–45) that this deadly objective was fully achieved.

EARLY EXPERIMENTS

The precursor to the modern assault rifle—Burton's automatic rifle of 1917—had twin, 20-round magazines for use by a single rifleman. It chambered short-cased, high-velocity cartridges and was a selective-fire weapon—it could be used as a single-shot, self-loading arm or fired in bursts like a machine-gun. Except for its barrel length, it matched all the modern criteria for a weapon to be deemed an assault rifle. However, the design was ahead of its time and was never adopted for production. The first mass-produced assault rifle was the German Sturmgewehr 44, or StG44 (see p.176). It was used extensively in World War II on both the Eastern and Western fronts and provided the German troops with an effective countermeasure to the Soviet submachine-gun, the PPSH-41 (see p.208). Between 1945 and 1946, Soviet arms dealer Mikhail Kalashnikov designed a modern assault rifle, and in 1947, he unveiled the AK47 (see pp.248–49).

▲ **5.56 × 45MM AND 7.62 × 51MM CARTRIDGES**
To prevent heavy recoil, assault rifles fire short-cased, small-caliber or "intermediate" cartridges (left) instead of long-cased, large-caliber rifle cartridges (right).

MODERN ASSAULT RIFLES

The AK47 embodied all the features typical of assault rifles; it had a short barrel, a high-capacity magazine, and full- and semiautomatic fire controls. In the West, development of the assault

"I created a weapon to **defend the borders** of my **motherland**. It's **not my fault** that it's being used where **it shouldn't be**..."

MIKHAIL KALASHNIKOV,
SOVIET AK47 DESIGNER

KEY **FIGURE**

Frank F. Burton
(1871–1939)

Frank F. Burton was the son of the famed civil engineer Col. James Henry Burton. He joined the Winchester Repeating Arms Company as a designer in the 1890s. He designed his assault rifle in response to a need for a light automatic arm for observers in aircrafts prior to the introduction of synchronized machine-guns.

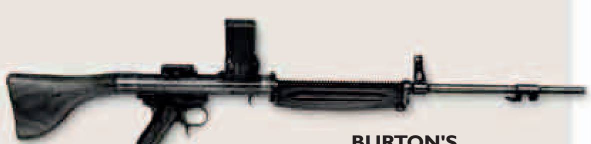
» BEFORE

Prior to the development of the assault rifle, concentrated fire in volume could only be delivered by machine-guns. Their long medium-caliber rounds were capable of accuracy at up to 3,000ft (900m).

- **SOME LIGHT MACHINE-GUNS**, such as the 1918 Browning Automatic Rifle (BAR), were intended to replace heavy machine-guns for small groups of soldiers. However, they were heavy and unwieldy.

BROWNING AUTOMATIC RIFLE

- **SUBMACHINE-GUNS** were intended to be an ideal replacement for the machine-gun. In practice though, their reliance on pistol cartridges meant that they were effective only at close range and were not able to fulfill the functions of a multipurpose combat weapon.



BURTON'S AUTOMATIC RIFLE

- **BURTON'S AUTOMATIC RIFLE**, designed in 1917, was the ancestor of assault rifles. It used a .345-caliber cartridge and was capable of selective fire.

▲ **THE VIETNAM WAR**
The M16 was deployed for warfare in South Vietnam in 1965. Its ability to focus a large volume of fire on a target made it quite effective, especially at close quarters against enemy guerilla tactics. Seen here are US soldiers armed with M16s in a Vietnamese jungle.

rifle proceeded at a much slower pace. In 1956, firearms designers Eugene Stoner and L. James Sullivan developed a small-caliber rifle for the Armalite company of the Netherlands. This became the M16—the US Army's standard assault rifle. The US Army used it in the 1960s against North Vietnamese Communist forces armed with the AK47 in the Vietnam War.

The M16 was lighter, more accurate, and fired more quickly than the AK47, but was prone to jamming in adverse conditions. However, it provided the US troops with a fitting response to the unstoppable AK47 in a bloody jungle war.

THE AK47 AND ITS AFTERMATH

The AK47 was reliable in war conditions—it continued to fire despite exposure to sand, water, and weather. Easy to maintain and simple in design, its workings could be grasped in minutes and, even in untrained hands, it became a formidable weapon that changed the rules of modern warfare. It demystified the gun and its usage for ordinary people, and gave untrained warriors the ability to wield immense firepower. It brought about a new trend in warfare in which irregular combatants (guerillas) and terrorists could hold out against well-trained armies.

The assault rifle has emerged as the main weapon in modern warfare—from civil wars in Africa, to conflicts in the Middle East, to local turf wars—in the hands of militaries, terrorists, militias, and even child soldiers.

AFTER »

Modern assault rifles can provide accurate fire in volume at distances well in excess of 1,600ft (500m). Short-cased, small-caliber cartridges continue to be used. The assault rifle's deadly combination of a light machine-gun's firepower and a machine-pistol's portability makes it a popular weapon with untrained combatants.

- **NEW PRODUCTION METHODS** developed. With the incorporation of synthetic materials into its construction, the modern assault rifle is far less likely to suffer a catastrophic failure of its components due to stress and wear.

- **FIRE CONTROL MECHANISMS** improved. This allowed modern assault rifles to fire a specific number of cartridges in a single burst, increasing accuracy and making the weapons deadlier than ever.

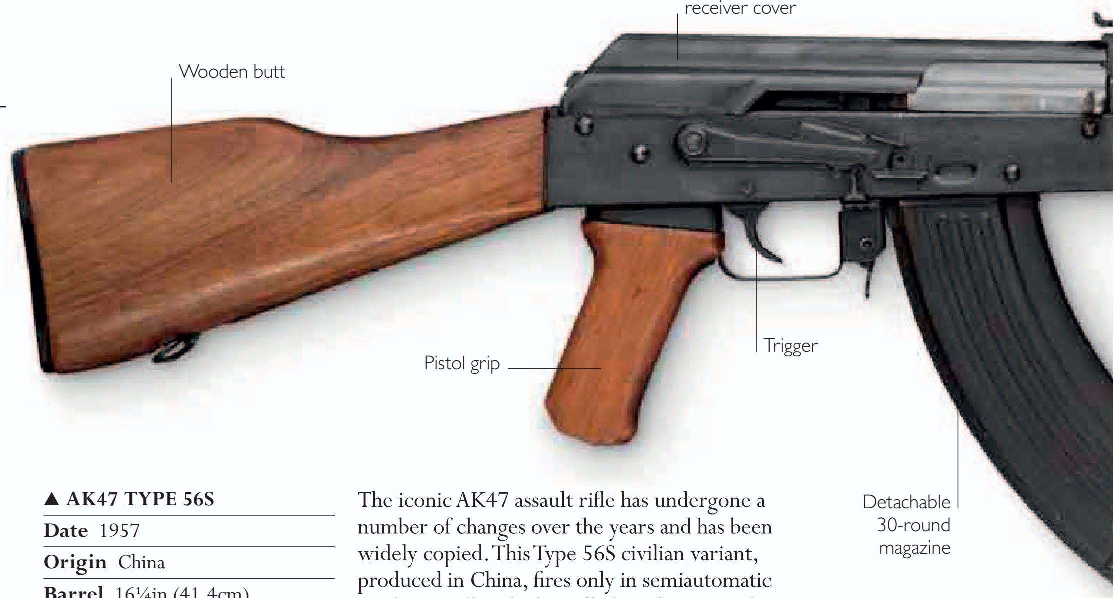
- **THE "BULLPUP" CONFIGURATION** (see pp.250–51), as seen in the Famas F1 assault rifle, served two purposes. It lessened a weapon's overall length and placed the user totally in line with the barrel, thus reducing the effects of recoil.

FAMAS F1 ASSAULT RIFLE

- **HIGH CASUALTIES** have become the norm of modern warfare with the use of the assault rifle. Its move from the battleground to the streets has triggered a debate about its usage by nonmilitary personnel.

ASSAULT RIFLES (1947–75)

If there is a quintessential firearm of the post-World War II period, it is the assault rifle (see pp.244–45). Chambered for short-case, medium- or small-caliber cartridges, the assault rifle is distinguished by its high-capacity magazine and ability to function in semi- or full-automatic modes. Though the idea was first developed at the end of World War I, the assault rifle was technically born in 1949 when the AK47 (see pp.248–49), designed by Soviet arms engineer Mikhail Kalashnikov, entered service. Now the weapon of choice on five continents, the assault rifle has become so well-known that even its blacked-out profile is immediately recognized by most people.



▲ **AK47 TYPE 56S**

Date	1957
Origin	China
Barrel	16¼in (41.4cm)
Caliber	7.62 × 39mm

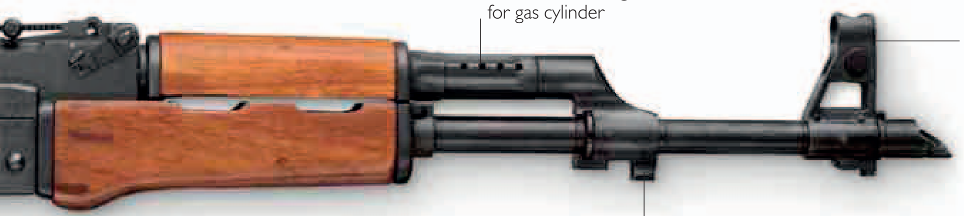
The iconic AK47 assault rifle has undergone a number of changes over the years and has been widely copied. This Type 56S civilian variant, produced in China, fires only in semiautomatic mode. Initially it had a milled steel receiver, but was later adopted for use with a stamped version.

▲ **AK74**

Date	1974
Origin	Soviet Union
Barrel	16¼in (41.5cm)
Caliber	5.45 × 39mm

In 1974, the design of the Kalashnikov (AK47) was modified to improve its performance. The caliber was reduced to 5.45mm, stamped components replaced those that had been previously machined from solid steel, and a plastic magazine was substituted for the earlier metal version. This resulted in a much lighter rifle that still had the reliability of its predecessor.

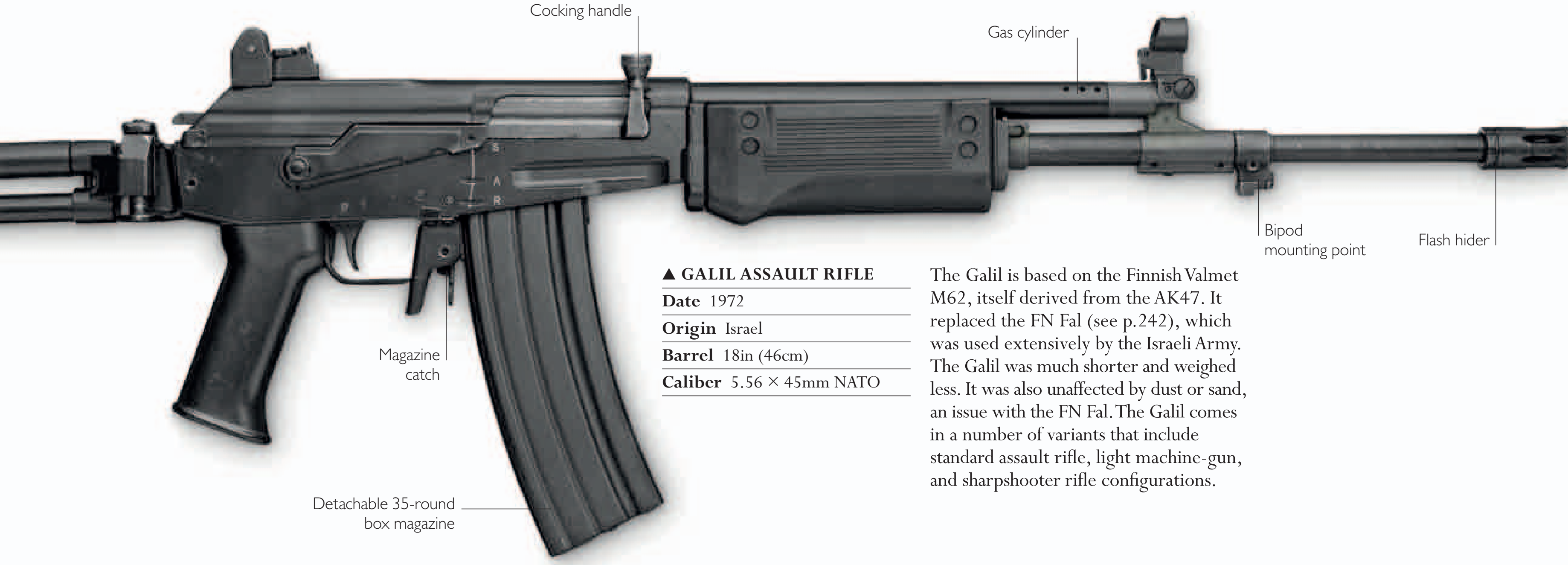
FULL VIEW



▼ CZ58

Date	1959
Origin	Czechoslovakia
Barrel	15½in (39cm)
Caliber	7.62 × 39mm

Though superficially similar to the famous AK47, and later the AKM, the Czech CZ58 is structurally quite different. Designed by Jiri Cermak, it uses a short-stroke piston to cycle the action. Its gas port has a fixed diameter and so the full force of combustion gases is directed toward the piston, driving it rearward. This gun is readily identifiable by its wood-impregnated plastic butt.



▲ GALIL ASSAULT RIFLE

Date	1972
Origin	Israel
Barrel	18in (46cm)
Caliber	5.56 × 45mm NATO

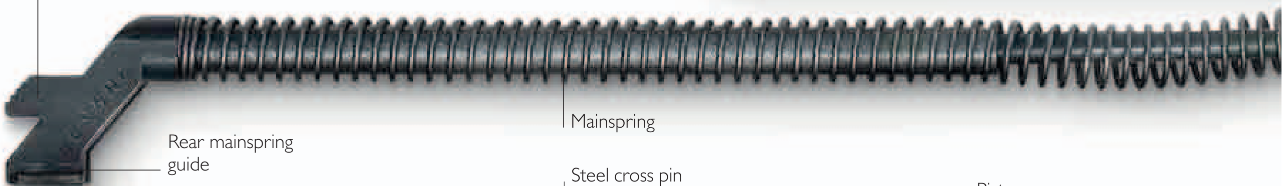
The Galil is based on the Finnish Valmet M62, itself derived from the AK47. It replaced the FN Fal (see p.242), which was used extensively by the Israeli Army. The Galil was much shorter and weighed less. It was also unaffected by dust or sand, an issue with the FN Fal. The Galil comes in a number of variants that include standard assault rifle, light machine-gun, and sharpshooter rifle configurations.

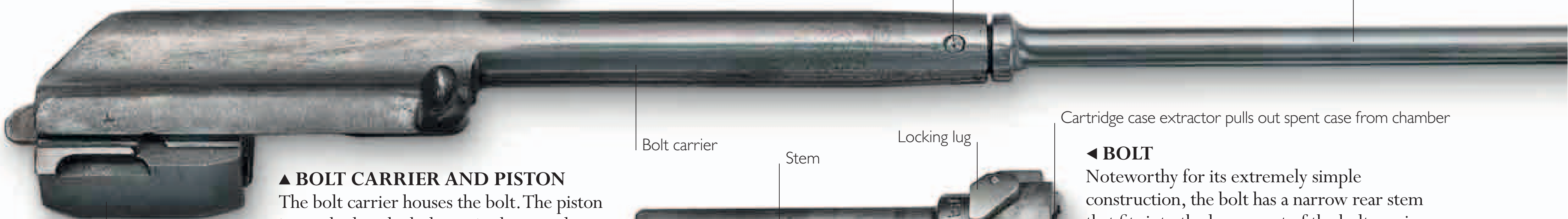
SHOWCASE

AK47

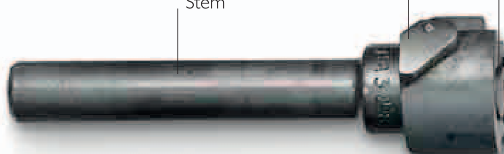
Designed by Mikhail Kalashnikov between 1945 and 1946, the *Avtomat Kalashnikova 47*, or AK47, is the most famous assault rifle in the world. This gun has a gas-operated auto-loading mechanism (see p. 305). Its low number of moving parts has helped greatly to reduce its production costs. The AK47 has been adopted by more than 100 armies throughout the world, and its variants are built in more than 30 countries. Amazingly, more than 75 million units have been produced.

▸ MAINSPRING
The mainspring fits inside the rear portion of the bolt carrier (the bolt carrier is covered by the action cover). The mainspring's rear is fitted with a ribbed lug that serves as a locking piece for the action cover. When the lug is pushed, the mainspring moves slightly forward so that the cover can be removed.

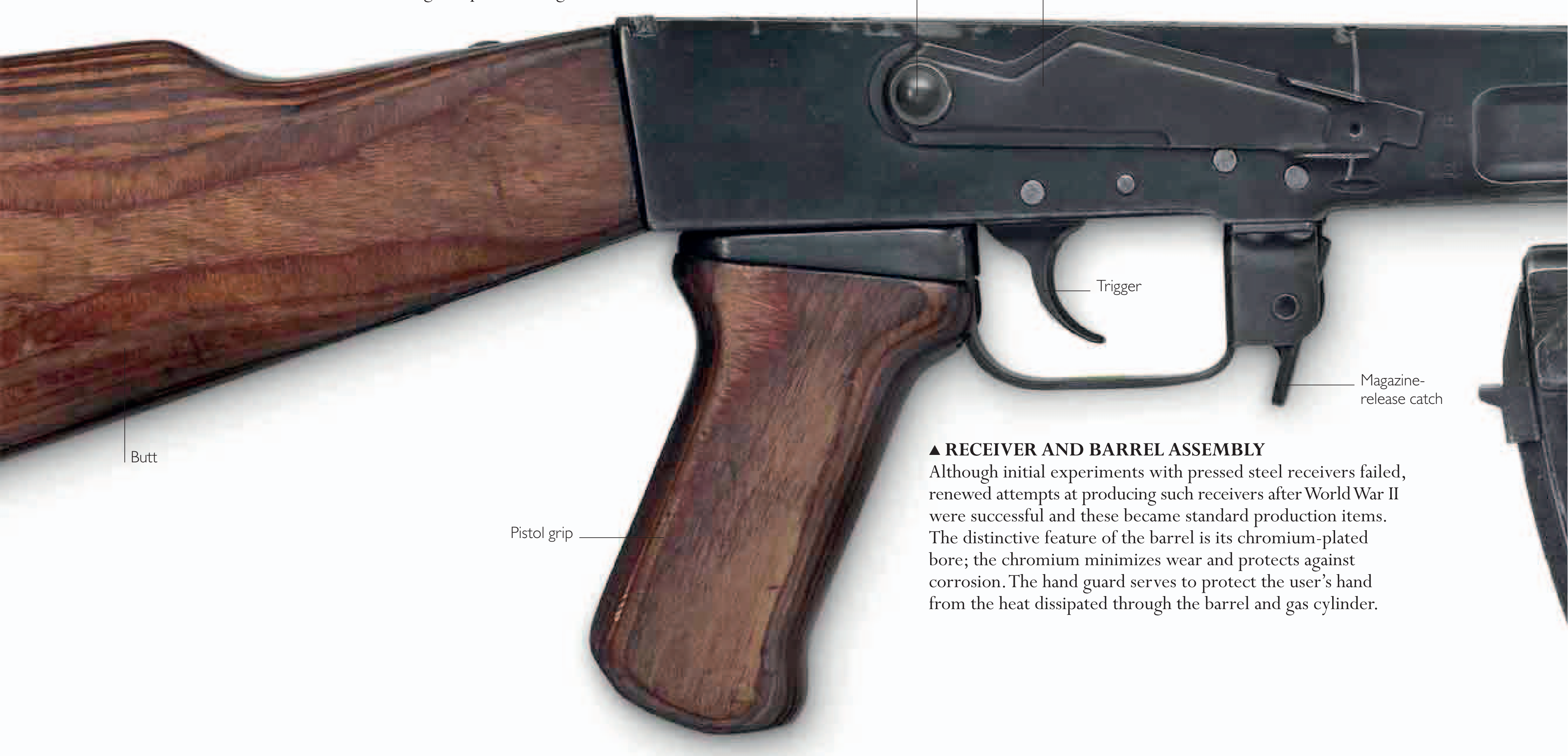




▴ BOLT CARRIER AND PISTON
The bolt carrier houses the bolt. The piston is attached to the bolt carrier by a steel cross pin. The piston fits in the gas cylinder. When the gun is fired, some of the exploding gases are vented toward the piston, pushing it rearward, driving the bolt backward, and extracting the spent cartridge.



◂ BOLT
Noteworthy for its extremely simple construction, the bolt has a narrow rear stem that fits into the lower part of the bolt carrier. Its head is machined with locking lugs, which slightly retard the rearward movement of the bolt to avoid loss of combustion gas pressure (and consequent bullet velocity) before the bullet leaves the muzzle.



▴ RECEIVER AND BARREL ASSEMBLY
Although initial experiments with pressed steel receivers failed, renewed attempts at producing such receivers after World War II were successful and these became standard production items. The distinctive feature of the barrel is its chromium-plated bore; the chromium minimizes wear and protects against corrosion. The hand guard serves to protect the user's hand from the heat dissipated through the barrel and gas cylinder.

AK47

Date 1954

Origin Soviet Union

Barrel 12in (30.5cm)

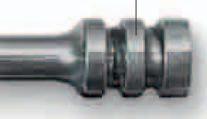
Caliber 7.62mm

The AK47 has earned a reputation for being a near-perfect military weapon due to its low cost of production, durability, and simplicity. More AK47s have been produced than any other assault rifle. The rifle entered service in 1949 and was used extensively by Soviet forces from the 1950s, gaining significant popularity during the conflicts of the Cold War. The unit seen here was manufactured in 1954.

FULL VIEW

◂ ACTION COVER
To prevent dirt from getting into the moving parts of the rifle's mechanism (bolt, mainspring, and trigger assembly), the uppermost part of the receiver is fitted with a removable pressed steel cover. It is held in place by spring tension from the mainspring. When the safety lever is in the uppermost position, the action cover blocks dirt from entering the rear part of the action.

▾ GAS CYLINDER
Some of the exploding gases released on firing a cartridge are vented from the barrel, through the gas port, into the gas cylinder, which contains the piston. The pressure of the exploding gases drives the piston and the bolt backward against the mainspring. This withdraws the empty case from the chamber and ejects it, cocking the weapon ready for the next round to be fired. When the bolt begins to advance again, driven by the mainspring, it feeds a new cartridge into the chamber from the magazine.



◂ MAGAZINE
The AK47 uses a relatively short cartridge. The cartridges, when stacked, form a tight curve, resulting in the pronounced curve of the magazine. The magazine-release catch is a simple pressed steel lever, easy to operate when wearing gloves, and situated just in front of the trigger guard.

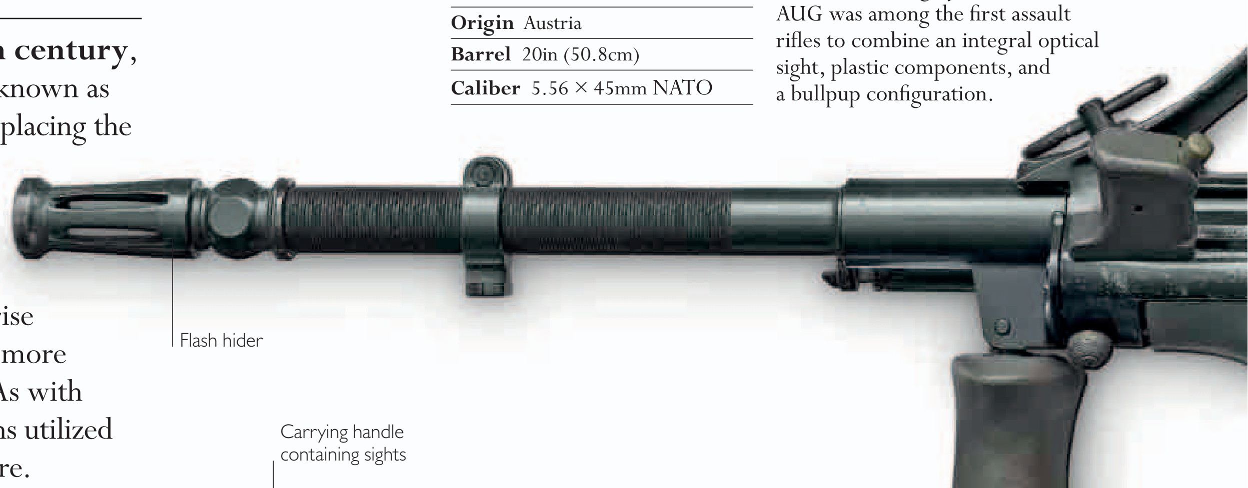
◂ EJECTION PORT (OPEN)
The ejection port is the cutaway part of the action cover positioned above the lower receiver. It remains closed during firing. After firing, when the bolt moves rearward, the ejection port opens to eject the spent cartridge case.

ASSAULT RIFLES (1976–PRESENT)

During the final quarter of the 20th century, assault rifles increasingly utilized what is known as the "bullpup" configuration. This involved placing the bolt and the recoil mechanism in the butt so that the magazine could be placed behind the trigger. In addition to reducing the overall length of the firearm, this design also reduced muzzle rise considerably since the force of recoil was more fully absorbed by the shooter's shoulder. As with other arms of the period, these new designs utilized plastics to a greater degree than ever before.

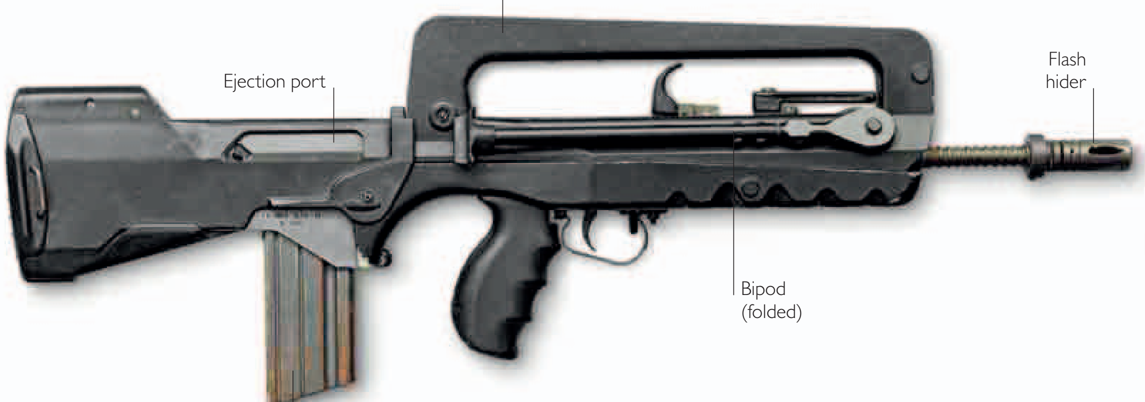
▼ STEYR AUG
Date 1978
Origin Austria
Barrel 20in (50.8cm)
Caliber 5.56 × 45mm NATO

Dating back to the 1970s, the futuristic and highly successful AUG was among the first assault rifles to combine an integral optical sight, plastic components, and a bullpup configuration.



▶ FAMAS F1
Date 1978
Origin France
Barrel 19¼in (48.8cm)
Caliber 5.56 × 45mm NATO

A bullpup design, the FAMAS F1 is a very compact weapon and has been used by the French armed forces since the late 1970s. Like many modern assault rifles, it makes use of plastics and stamped metal components.



▼ L85A1
Date 1985
Origin UK
Barrel 20½in (51.8cm)
Caliber 5.56 × 45mm NATO

The L85A1 was the last weapon system to be developed and produced at the Royal Small Arms Factory, Enfield, UK, before it closed in 1988. It was dogged with problems during the development stage, and trials continued even after its adoption in 1985. It was designed from the start to use an optical sight. The body and many other parts are steel stampings. All the furniture is high-impact plastic.

◀ SA80	
Date	1985–1994
Origin	UK
Barrel	20½in (51.8cm)
Caliber	5.56 × 45mm NATO

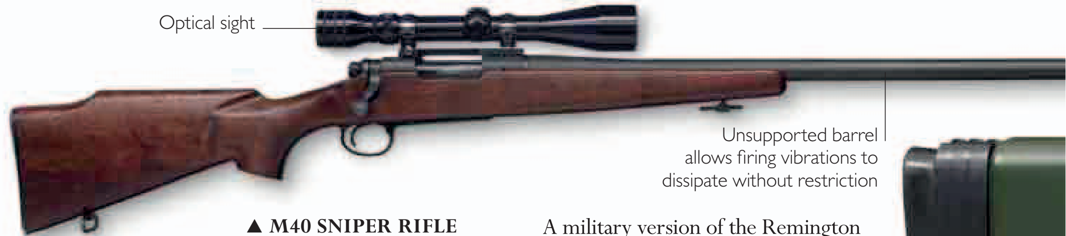
Developed at the Royal Small Arms Factory, Enfield, UK, until 1988 and then British Aerospace (BAE) until 1994, the SA80 represented the culmination of a design program that had begun in the late 1940s. Aside from its use of plastic, the SA80 is also notable for its incorporation of sheet metal parts.

▶ FN2000 BULLPUP RIFLE	
Date	2001
Origin	Belgium
Barrel	16in (40.6cm)
Caliber	5.56 × 45mm NATO

The FN2000 is undoubtedly one of the most futuristic-looking weapons to have been developed. Of modular construction, it consists of a barrel/receiver unit attached to a frame by a single pin. The rifle is fitted with an optical sight and has a chromed barrel to resist wear and corrosion.

SNIPER RIFLES (BOLT ACTION)

Whether used by military forces or the police, bolt-action sniper rifles represent the epitome of accuracy. Though some, such as the US M40, are quite plain and closely resemble sporting arms, others are equipped with stocks that can be adjusted to the personal preferences of their users and bipods to provide steady support. For normal field use, they are chambered for standard-issue cartridges that are loaded to precise specifications, including weight of charge, and bullet type and weight. Long-range sniper rifles are normally chambered for .50in BMG cartridges, first developed for the Browning machine-gun in the late 1910s.



▲ M40 SNIPER RIFLE

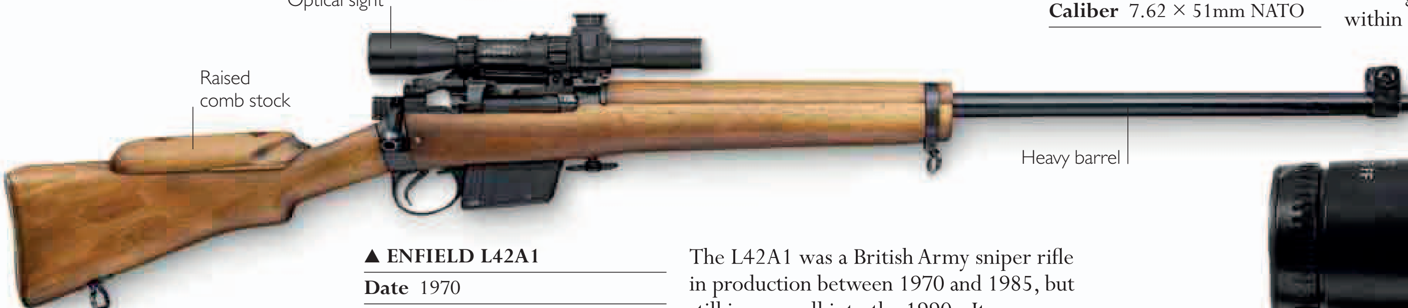
Date	1966
Origin	US
Barrel	24in (61cm)
Caliber	7.62 × 51mm NATO

A military version of the Remington 700 sporting rifle, the M40 was first used by the US Marine Corps in the Vietnam War. Subsequent models were equipped with a fiberglass stock.

▲ STEYR SSG-69

Date	1969
Origin	Austria
Barrel	25½in (65cm)
Caliber	7.62 × 51mm NATO

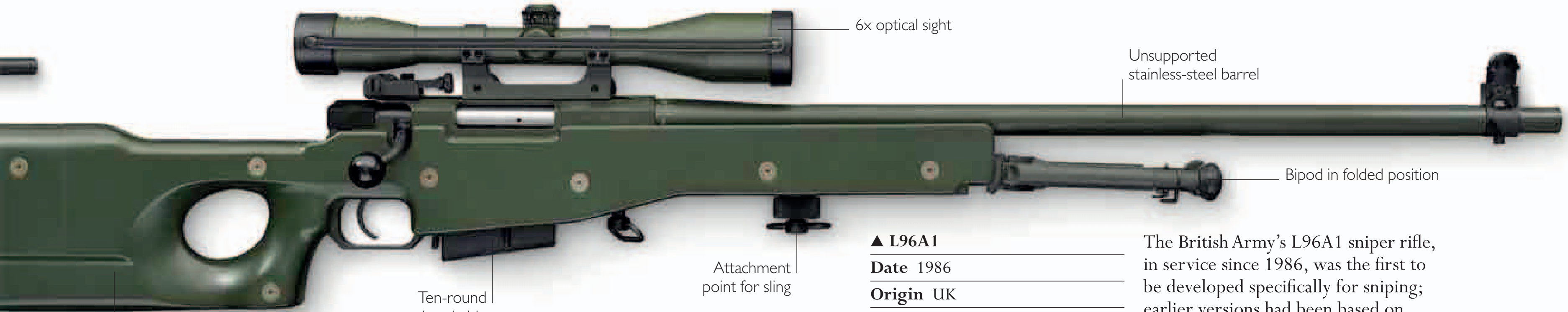
Developed for the Austrian army, the SSG also proved popular with police organizations. The SSG-69 was unusual in its use of a five-round rotating spool magazine housed within the rifle body.



▲ ENFIELD L42A1

Date	1970
Origin	UK
Barrel	27½in (70cm)
Caliber	7.62 × 51mm NATO

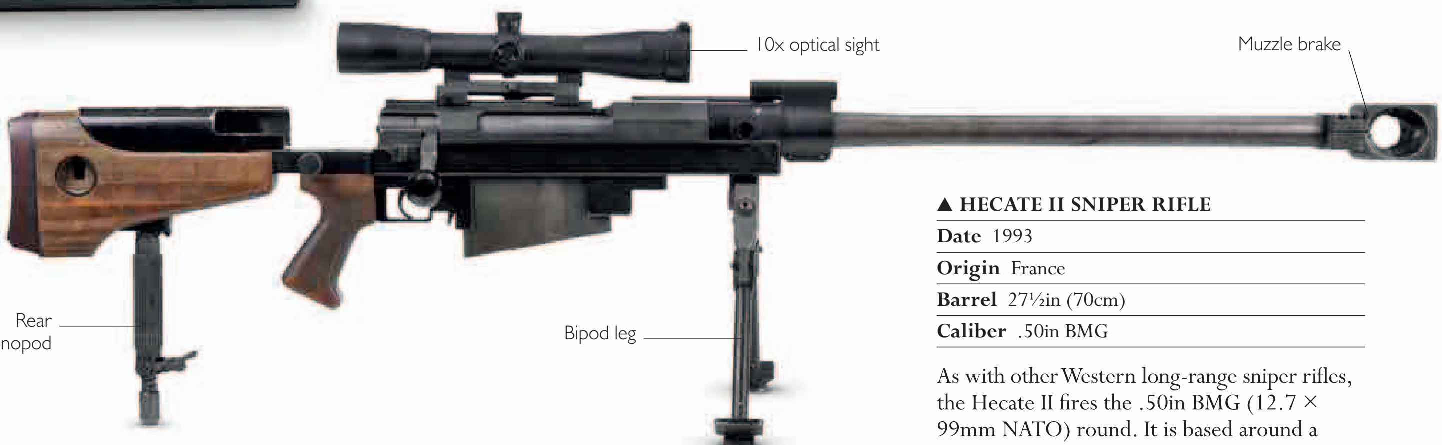
The L42A1 was a British Army sniper rifle in production between 1970 and 1985, but still in use well into the 1990s. It was built using the standard Lee-Enfield action, but was fitted with a heavy barrel chambered for the 7.62 × 51mm NATO cartridge.



▲ **L96A1**

Date	1986
Origin	UK
Barrel	25¾in (65.5cm)
Caliber	7.62 × 51mm NATO

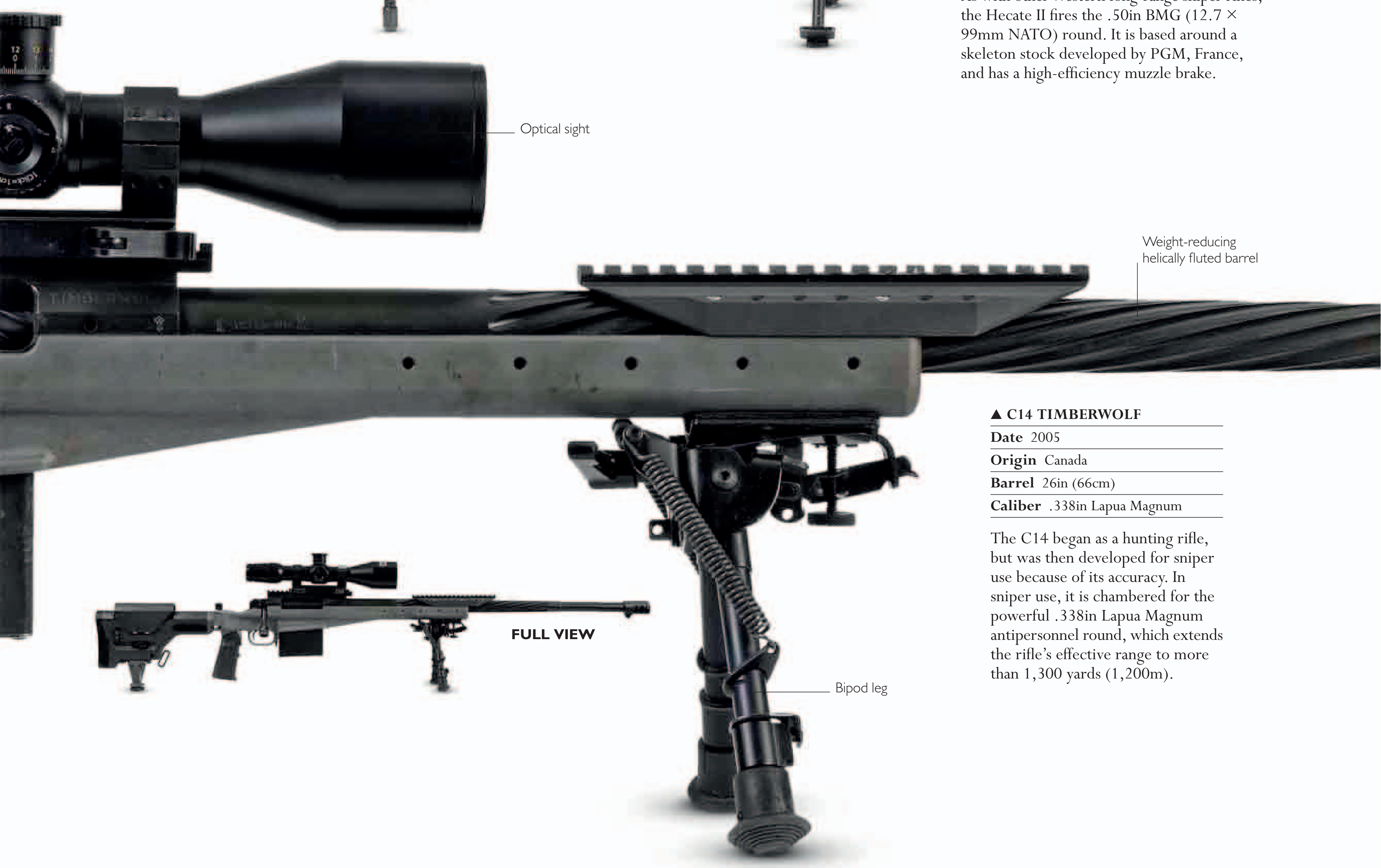
The British Army's L96A1 sniper rifle, in service since 1986, was the first to be developed specifically for sniping; earlier versions had been based on various models of the Lee-Enfield. It has an aluminum frame to which its components are attached. Each rifle is individually fitted with a Schmidt and Bender six-power optical sight.



▲ **HECATE II SNIPER RIFLE**

Date	1993
Origin	France
Barrel	27½in (70cm)
Caliber	.50in BMG

As with other Western long-range sniper rifles, the Hecate II fires the .50in BMG (12.7 × 99mm NATO) round. It is based around a skeleton stock developed by PGM, France, and has a high-efficiency muzzle brake.



FULL VIEW

▲ **C14 TIMBERWOLF**

Date	2005
Origin	Canada
Barrel	26in (66cm)
Caliber	.338in Lapua Magnum

The C14 began as a hunting rifle, but was then developed for sniper use because of its accuracy. In sniper use, it is chambered for the powerful .338in Lapua Magnum antipersonnel round, which extends the rifle's effective range to more than 1,300 yards (1,200m).

SNIPER RIFLES (SELF-LOADING)

In common with their single-shot counterparts, self-loading sniper rifles are designed to provide accurate fire at long distances—up to 1,000 yards (900m) in the hands of a well-trained marksman. Sniper rifles are identifiable by their optical sights and a butt with adjustable cheek rests. Self-loaders have, in addition, a cycling action that autoloads ammunition from a magazine. Such rifles are capable of firing multiple rounds in quick succession, and on the battlefield they can be used to disrupt enemy command posts at long range.

▲ GALIL 7.62MM SNIPER RIFLE

Date	1960s
Origin	Israel
Barrel	20in (50.8cm)
Caliber	7.62 × 51mm NATO

The semiautomatic Galil Sniper Rifle features a folding butt with an adjustable comb, as well as a folding bipod and a 25-round box magazine. The example illustrated is equipped with a six-power Nimrod optical sight.

▼ DRAGUNOV SVD

Date	1963
Origin	Soviet Union
Barrel	24in (61cm)
Caliber	7.62 × 54mm

The SVD came to be used as a sharpshooter platoon-support weapon by Warsaw Pact armies in the 1960s. Its four-power PSO-1 optical sight has limited infrared capability.

▲ WALTHER WA2000

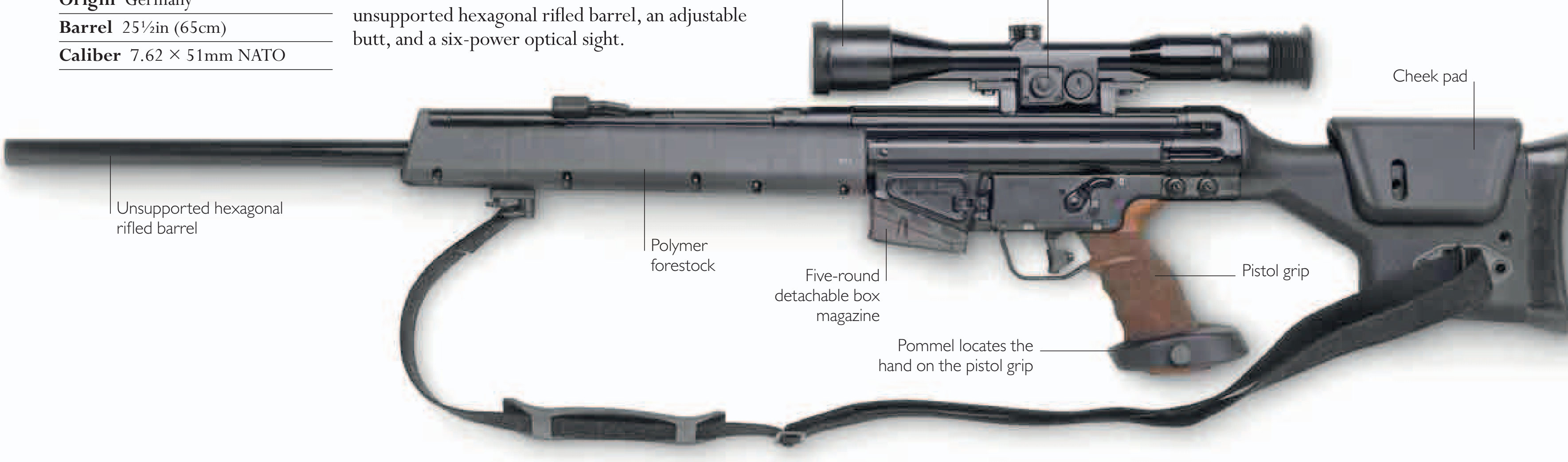
Date	1978
Origin	Germany
Barrel	25½in (65cm)
Caliber	.300in Win Mag/7.62 × 51mm NATO

Developed primarily for police use, the WA2000 employed a "bullpup" configuration (see p.250) and a semiautomatic action fed by a six-round magazine. High manufacturing costs ended its production in 1988.

▼ HECKLER AND KOCH PSG-1

Date	1985
Origin	Germany
Barrel	25½in (65cm)
Caliber	7.62 × 51mm NATO

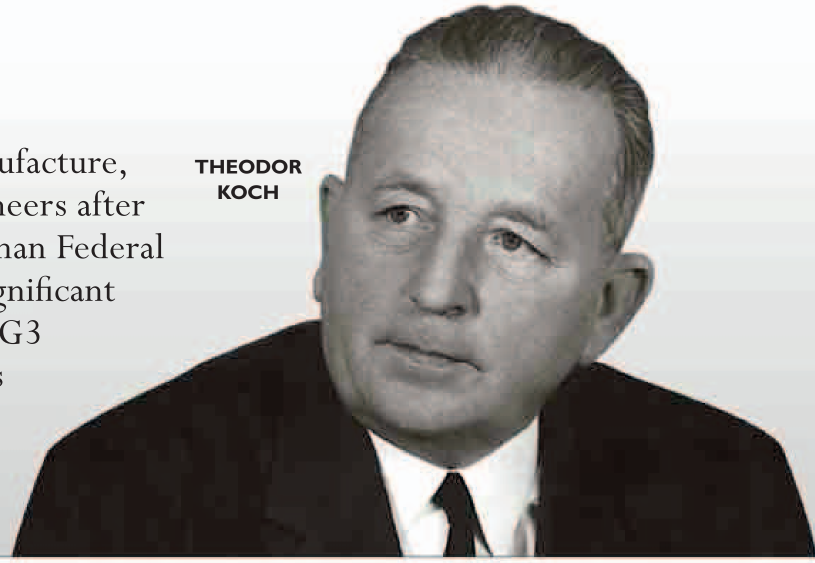
Intended as a sniper rifle for the German police, the Heckler and Koch PSG-1 employed a semiautomatic action and was fitted with an unsupported hexagonal rifled barrel, an adjustable butt, and a six-power optical sight.



GREAT GUNSMITHS

HECKLER AND KOCH

Rooted in the long tradition of German firearms manufacture, Heckler and Koch was founded by three former Mauser engineers after World War II. A major contract to provide a rifle for the German Federal Army brought the company early success, and it has been a significant force in weapons production ever since. Products such as the G3 and HK33 rifles have sold very widely and spawned numerous variants, making the Heckler and Koch brand one of the most familiar in the world of weapons.



THEODOR KOCH

In the years following World War II, the Allied forces (UK, US, and others) put severe restrictions on industry in Germany and, although some of these curbs were soon lifted, the ban on arms production remained well into the 1950s. The Mauser weapons factory at Oberndorf was shut down by the French occupying forces, but three former Mauser employees, Edmund Heckler, Theodor Koch, and Alex Seidel, salvaged some of the machinery. All three were seasoned engineers with experience in firearms manufacture and the metalworking industry, and they needed all their skill and adaptability in the tough economic conditions of postwar Germany. Their new business—originally named after Heckler, but renamed Heckler and Koch—began as a manufacturer of bicycles, machine tools, and precision parts for items such as sewing machines. Many of their workers had formerly been Mauser employees.

> "The **MP5** deserves its reputation for excellence."
>
> *CHRIS MCNAB,* **THE SAS TRAINING MANUAL**

▼ **OBERNDORF FACTORY**
Part of the Heckler and Koch factory at Oberndorf, Germany, consisted of low-rise prefabricated buildings put up in the period after the end of World War II.

IN THE BEGINNING

When Germany began to reconstruct its economy after the war, there was a large demand for the items originally produced by Heckler and Koch. But the founders' roots were in the firearms business and they waited patiently for a chance to return to the industry in which they had once flourished. The opening did not come until the mid-1950s, when the ban on weapons production was finally lifted. The big opportunity for Heckler and Koch arrived in 1956, when tenders were invited to produce a new assault rifle for the infantry of the German Federal Army. The successful weapon was based on a rifle that had been developed at the old Mauser factory in the 1940s, before being modified by the Spanish design and development agency CETME and then refined still further by Heckler and Koch. The army preferred their design to the competitors' on offer at that time—one rifle from America and another from Switzerland—and in 1959, Heckler and Koch were awarded a contract to produce the rifle, which became known as the G3 (see p.243). The G3 was based on a roller-delayed recoil action developed by the engineer Ludwig Vorgrimler. The weapon has a modular design, allowing the user to swap parts at speed to reconfigure the rifle. In addition, Heckler and Koch made a host of variants on the basic design. Versions with different trigger groups, sights, stocks, deflectors, and other parts have been produced, making the G3 highly versatile and helping it to become widely used.

ADVANCES IN TECHNOLOGY

The G3 provided Heckler and Koch with a hugely successful start in firearms manufacturing. Armed forces from Norway to South Africa have bought it, the weapon has seen service all over the world, and some models remain in production today. It also provided the basis for further firearms that proved highly successful for Heckler and Koch. There are four main groups of these, each sharing the G3's roller-delayed action, but each chambered for a different cartridge and consisting of a large subfamily of weapons. A prime example is the MP5 submachine-

HECKLER AND KOCH G3A3, 1964

HECKLER AND KOCH MP5A5, 1966

HECKLER AND KOCH G41, 1981

1945 Occupying French forces dismantle the Mauser weapons factory at Oberndorf, Germany.
1949 Heckler and Koch begins to manufacture items for non-military use, such as components for domestic appliances and bicycles.
1959 The contract for the new infantry rifle for the West German army is awarded to the company. The G3 follows, and later, the G3A3 (see p.243).
1966 The MP5 is developed. The MP5A5 (see p.292) follows.
1968 The HK33 assault rifle is launched. It is a 5.56mm weapon intended for the export market.
1981 The G41 rifle (see p.243), originally designed as a replacement for the HK33, is introduced.
1990 The company's long-running project to develop the G11 assault rifle, with high-velocity caseless ammunition, is canceled due to political changes surrounding Germany's reunification.
1991 The British company Royal Ordnance purchases Heckler and Koch.
2002 Heckler and Koch is sold to private investors and receives substantial orders for the British SA80 assault rifle (see p.251) and other firearms.

gun, which, like the G3, is a modular design so that the user can adapt it with ease; it has spawned many variants. The MP5 has been bought by military and law-enforcement customers all over the world and is one of the most ubiquitous submachine-guns.

The company also worked with materials which were new and unusual for firearms, such as polymers. While these materials had been used for nonstructural parts such as grips, Heckler and Koch (as well as companies such as Glock) pioneered their use for gun frames, making huge weight savings, and once the precision molds for the parts had been made, savings in manufacturing costs, too. Polygonal rifling is another technology in which Heckler and Koch have expertise. This old idea had fallen out of favor, but Heckler and Koch applied it to modern weapons, replacing the traditional grooved barrel with a rounded polygonal internal surface to give a better gas seal around the projectile. Heckler and Koch have successfully tethered these technological ideas to the development of versatile families of weapons, making them one of the leading firearms manufacturers of the 21st century.

▶ **MP5 IN USE**
Members of the US Special Operations Response Team (SORT), who operate in prisons and are specialists in handling tense and dangerous situations among the inmates, were frequent users of the MP5 between 2000 and 2010.

LIGHT MACHINE-GUNS (1945–65)

The development of light machine-guns in the years following World War II drew heavily on designs that had been created during the war, particularly in Germany. This is most evident in the US M60 and the Mauser-CETME arms, which parallel the wartime German MG42 (see p.193), StG44 (see p.177), and StG45. These light machine-guns also began to use sheet metal stampings and light-weight metal alloys extensively in their construction.

▲ DEGTYAREV RP46

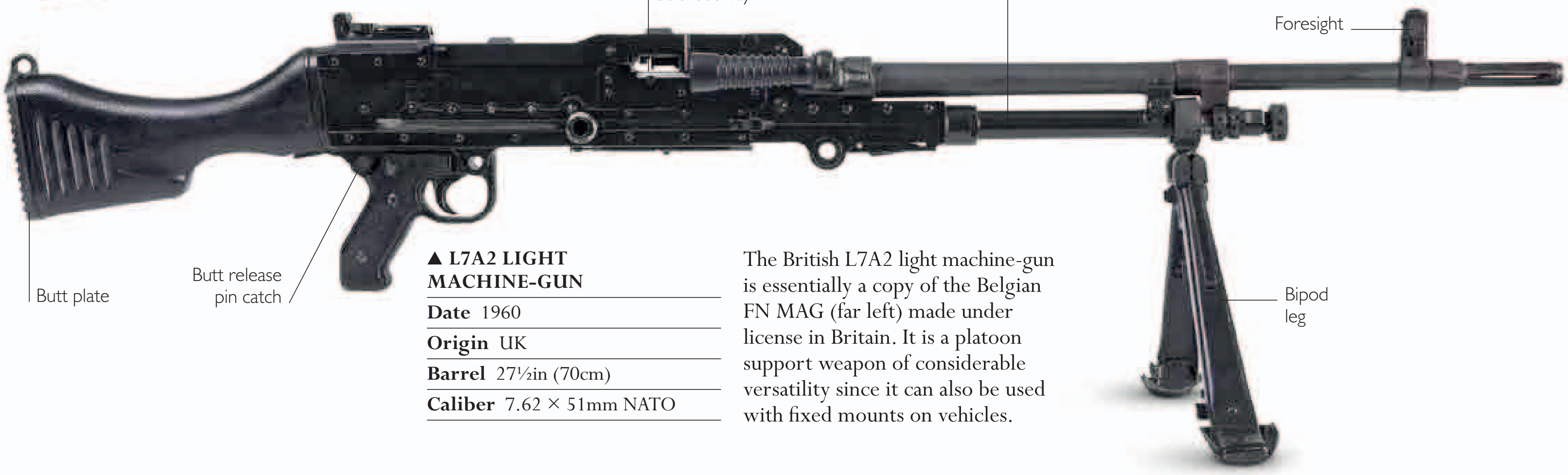
Date	1946
Origin	Soviet Union
Barrel	23¾in (60.5cm)
Caliber	7.62 × 54mm

The Red Army adopted the Degtyarev DP in 1928. It was modified in 1945, and the following year, it received a heavier barrel and was adapted to take belts as well as drum magazines, evolving into the RP46. It was still not entirely satisfactory, however, and was soon replaced by the RPD.

▶ FN MAG

Date	1958
Origin	Belgium
Barrel	21½in (55cm)
Caliber	7.62 × 51mm NATO

The MAG (*Mitrailleuse à Gaz*, meaning gas-operated machine-gun), produced by FN, used a modified form of the locking system developed by John Browning for his Automatic Rifle (see p.194); this was married to the feed mechanism of the MG42. This gun could fire 650–1,000 rounds per minute and was adopted by the British Army as their General-Purpose Machine-Gun (GPMG).



▲ L7A2 LIGHT MACHINE-GUN

Date	1960
Origin	UK
Barrel	27½in (70cm)
Caliber	7.62 × 51mm NATO

The British L7A2 light machine-gun is essentially a copy of the Belgian FN MAG (far left) made under license in Britain. It is a platoon support weapon of considerable versatility since it can also be used with fixed mounts on vehicles.

▲ M60 LIGHT MACHINE-GUN

Date	1963
Origin	US
Barrel	23½in (59.9cm)
Caliber	7.62 × 51mm NATO

In the early 1960s, the US Army replaced its Browning M1917 (see p.188) derivatives with a new, gas-operated GPMG whose rate of fire are 500–600 rounds per minute. The M60 used the feed system of the MG42 (see p.193) and the locking system of the German FG42 assault rifle (see p.215). It was unsatisfactory to begin with, because it was heavy, bulky, had poor balance and a complex barrel changing system. In early versions, some components, such as the bolt, experienced failure due to wear. Modifications were carried out over the next two decades to correct most of the gun's faults.

▲ MAUSER-CETME LMG

Date	1960s
Origin	Spain/Germany
Barrel	23¼in (59cm)
Caliber	7.62 × 51mm NATO

The Mauser–CETME light machine-gun was a joint German-Spanish development of the German MG42, although chambered for the 7.62 × 51mm NATO round. The gun was not a success with this chambering, because the fluted chamber caused spent cartridge cases to stick—in some instances, the extractor would pull the base of a spent case off its body—a major problem in the field. CETME later achieved a good workable design in their 5.56 × 45mm NATO Ameli machine-gun.

LIGHT MACHINE-GUNS (1966–PRESENT)

Modern light machine-guns are either gas- or recoil-operated. They continue to be characterized by their extensive use of plastic or resin-impregnated components, stamped parts, and light weight. With a few exceptions, they are designed for individual use to provide squad support fire. Increasingly they have been fitted with optical sights to improve their effectiveness in the field. While the Gatling Minigun was intended for use from a fixed mount, its short overall length qualifies it as a light machine-gun.

▲ GATLING MINIGUN M134

Date	1960s
Origin	US
Barrel	22in (56cm)
Caliber	7.62 × 51mm NATO

The M134 is a Gatling-type rotary weapon that is powered by an electric motor to achieve extremely high rates of fire—up to 6,000 rounds per minute, although typically the rate is limited to around 4,000 rounds per minute. The weight and bulk of the external power source mean that the gun is usually used in helicopters, on armored vehicles, or on boats.

▲ PKM

Date	1969
Origin	Soviet Union
Barrel	25¼in (64cm)
Caliber	7.62 × 54mm

A General-Purpose Machine-Gun (GPMG), the PKM is gas-operated, belt-fed, and air-cooled. Its rate of fire is around 650–750 rounds per minute. It is an improved variant of the Mikhail Kalashnikov-designed PK. Its butt plate is hinged.

▶ FN MINIMI

Date	1975
Origin	Belgium
Barrel	18¼in (46.5cm)
Caliber	5.56 × 45mm NATO

An outstanding gas-operated, air-cooled light machine-gun, the Minimi has a rate of fire of around 700–1,150 rounds per minute. It was adopted by the British Army and the US Army, among others. In the US Army, it was designated the M249 Squad Automatic Weapon (SAW).

▲ RPK74

Date	1976
Origin	Soviet Union
Barrel	23¼in (59cm)
Caliber	5.45 × 39mm

The light machine-gun version of the infantryman's AK74 assault rifle (see p.246), this weapon features a heavier barrel, which is chrome-lined like the band of the AK74. It also has a modified receiver, a bipod, and an extended magazine. It fires up to 650 rounds per minute.

▼ STEYR AUG LMG

Date	1980
Origin	Austria
Barrel	24½in (62cm)
Caliber	5.56 × 45mm NATO

By fitting a bipod and a heavy barrel, Steyr produced a light machine-gun from its AUG assault rifle (see p.250). The AUG LMG can be fitted either with the AUG's standard optical sight/carrying handle combination (as seen here) or without the handle for fitting of a different sight on a rail. It fires around 680–750 rounds per minute.

◀ L86A1 LIGHT SUPPORT WEAPON

Date	1986
Origin	UK
Barrel	25½in (64.5cm)
Caliber	5.56 × 45mm NATO

The L86A1 has a heavier and larger barrel than the earlier L85A1 (see p.250), and a rear grip to aid sustained firing. There is no quick-change barrel, so the gun must be fired in short, controlled bursts to prevent overheating. It fires around 610–775 rounds in one minute.

▲ NEGEV

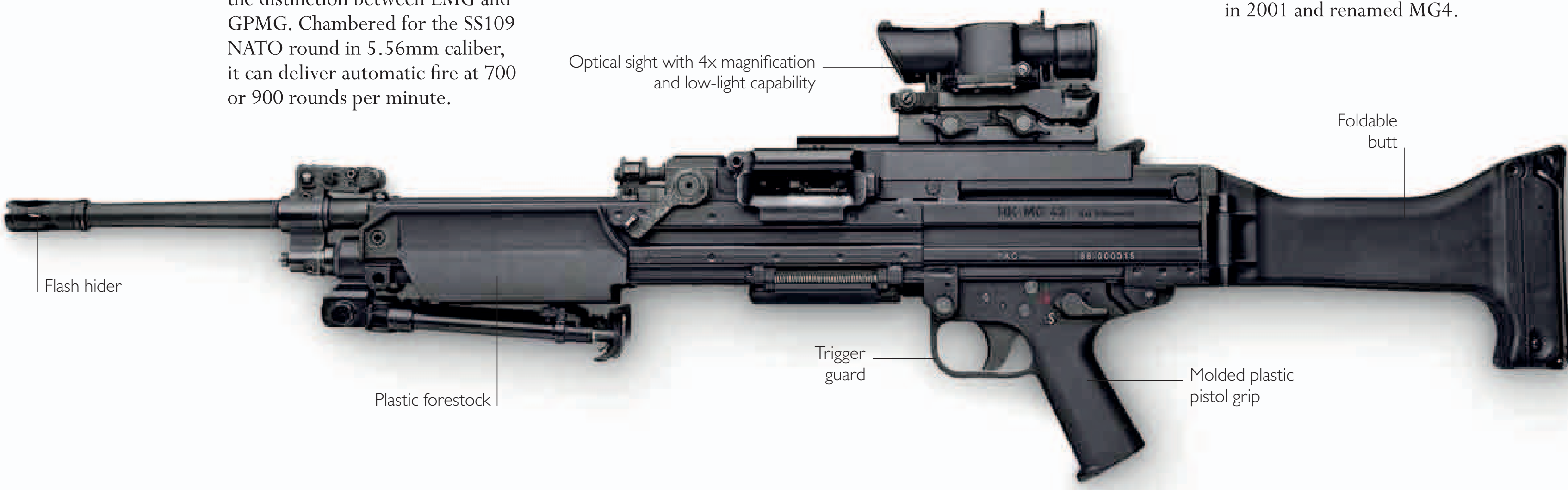
Date	1988
Origin	Israel
Barrel	18in (46cm)
Caliber	5.56 × 45mm NATO

Israel Military Industries' Negev is one of the breed of lightweight automatic weapons that has blurred the distinction between LMG and GPMG. Chambered for the SS109 NATO round in 5.56mm caliber, it can deliver automatic fire at 700 or 900 rounds per minute.

▼ MG43

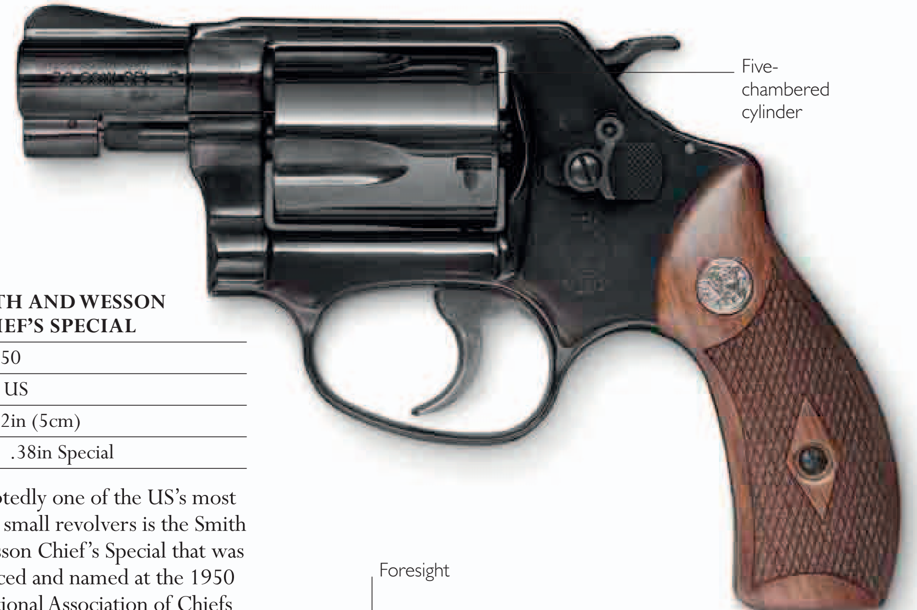
Date	2001
Origin	Germany
Barrel	18¾in (48cm)
Caliber	5.56 × 45mm NATO

A rival to the FN Minimi (left), the MG43 is a belt-fed light machine-gun that features a foldable butt and a quick-change barrel. Its rate of fire is about 880 rounds per minute. A slightly modified form was adopted by the German Army in 2001 and renamed MG4.



MODERN REVOLVERS

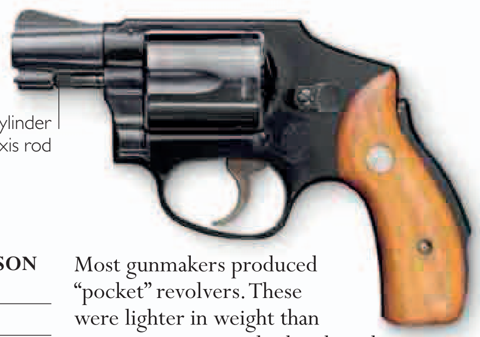
Despite the fact that their basic lock work was designed in the 19th century, revolvers remain extremely popular to this day. The reasons for this are their dependability, the ease with which they can be loaded, and their compact size. As self-defense weapons, their major assets are their light weight and the fact that they can be readily concealed. In addition, their construction allows them to use powerful cartridges that would place unacceptable strains on semiautomatic arms.



▶ SMITH AND WESSON .38 CHIEF'S SPECIAL

Date	1950
Origin	US
Barrel	2in (5cm)
Caliber	.38in Special

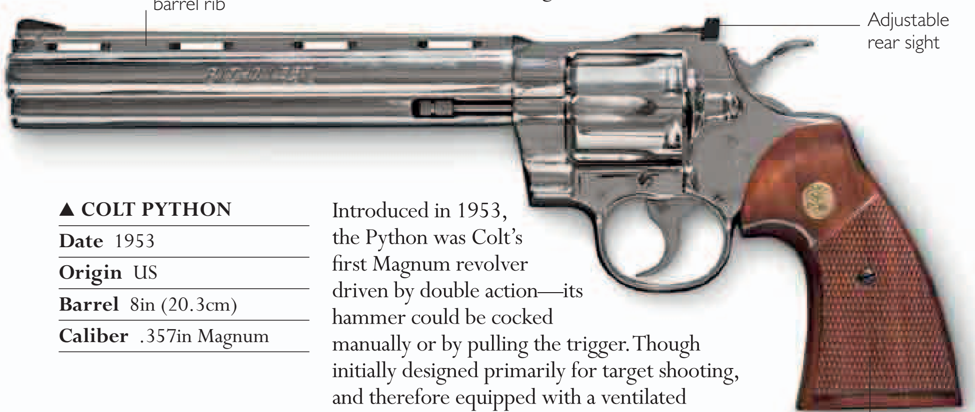
Undoubtedly one of the US's most popular small revolvers is the Smith and Wesson Chief's Special that was introduced and named at the 1950 International Association of Chiefs of Police Convention. Although its cylinder holds only five cartridges, rather than the more usual six, its small frame and short barrel makes it ideal for carrying in either a pocket or handbag.



▲ SMITH AND WESSON AIRWEIGHT

Date	1952
Origin	US
Barrel	2in (5cm)
Caliber	.38in Special

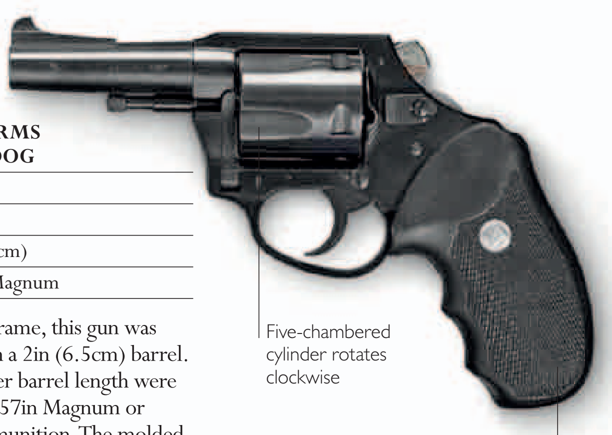
Most gunmakers produced "pocket" revolvers. These were lighter in weight than semiautomatic pistols chambered for the same ammunition, and to ensure easy concealment, they were fitted with an extremely short barrel. Smith and Wesson's Centennial range, which included the Airweight, carried five rounds and had shrouded hammers. One version of the Airweight was made with an aluminum frame to reduce its weight.



▲ COLT PYTHON

Date	1953
Origin	US
Barrel	8in (20.3cm)
Caliber	.357in Magnum

Introduced in 1953, the Python was Colt's first Magnum revolver driven by double action—its hammer could be cocked manually or by pulling the trigger. Though initially designed primarily for target shooting, and therefore equipped with a ventilated sighting rib, the model was also made with short barrels to be issued to police.



▶ CHARTER ARMS POLICE BULLDOG

Date	1971
Origin	US
Barrel	4in (10.1cm)
Caliber	.357in Magnum

Built on a heavy frame, this gun was also available with a 2in (6.5cm) barrel. Revolvers of either barrel length were chambered for .357in Magnum or .44in Special ammunition. The molded rubber grip reduced the amount of recoil transferred to the user's hand.

▲ SMITH AND WESSON MODEL 29

Date	1980s
Origin	US
Barrel	8¾in (22cm)
Caliber	.44in Magnum

Introduced in 1955, the Model 29 was one of Smith and Wesson's N-frame revolvers, specially designed for shooting heavy loads. It came with a variety of barrel lengths, from 4in (10cm) up to 10½in (27cm), and all featured adjustable rear sights since the .44in Magnum cartridge was accurate at ranges well beyond those of standard pistol cartridges.

▼ RUGER GP-100

Date	1987
Origin	US
Barrel	4in (10.2cm)
Caliber	.357in Magnum

Sturm, Ruger and Co. was a latecomer to the world of gun manufacture, opening for business in 1949. The double-action GP-100 is a well-built revolver that incorporates an automatic hammer safety to prevent accidental discharges and an ergonomic grip that makes it easier to hold.

▲ SMITH AND WESSON TIFFANY MAGNUM

Date	1989
Origin	US
Barrel	6in (15cm)
Caliber	.44in Magnum

Smith and Wesson has produced various decorated "Tiffany-style" revolvers. This gun, based on a .44in Magnum Model 29 (above), features a grip decorated in silver, and a gold-inlaid barrel.

▲ MODEL 500 X-FRAME

Date	2003
Origin	US
Barrel	8¾in (22cm)
Caliber	.500in Smith and Wesson Magnum

This massive five-shot revolver is the largest commercially made handgun in the world. Weighing 72½oz (2kg) unloaded, it fires a bullet weighing ¾oz (22.7g), designed for use against the heaviest of game. The barrel is equipped with a muzzle brake to reduce recoil.

▲ SMITH AND WESSON .357 MAGNUM

Date	2000
Origin	US
Barrel	4¾in (12 cm)
Caliber	.357in Magnum

This Smith and Wesson revolver has, apart from exquisite grip decoration, a gold-plated cylinder, trigger, and hammer. The barrel and much of the frame remain conventional, undecorated Smith and Wesson parts. As with most Smith and Wesson special editions, the revolver is fully functional.

SELF-LOADING PISTOLS (1946–80)

In the years following World War II, the design of self-loading handguns more or less followed the patterns set down earlier. By the 1970s, however, these pistols began to take on more streamlined profiles such as those seen in Heckler and Koch's VP70M. At the same time, components made from investment castings—wax models placed in molds so that finely detailed castings can be produced in metal—began to appear. Concurrently, plastic became the material of choice for pistol grips due to its stability in all weather conditions.

▲ M20 SILENCED

Date 1950s
Origin China
Barrel 9in (23cm) (including silencer)
Caliber 7.62 × 25mm

The M20 was a Chinese copy of the Soviet 7.62 × 25mm Tokarev TT Model 1933 (see p.174). It differed from the original in having more slide grip cuts. The model here features a suppressor (silencer).

◀ MAKAROV PM

Date 1950s
Origin Soviet Union
Barrel 3¾in (9.7cm)
Caliber 9mm Makarov

The Tokarev TT Model 33 (see p.174) was replaced by this copy of the Walther PP as the Red Army's standard sidearm. It was a double-action weapon and had a two-stage safety device. Its ammunition was about as powerful as could safely be used in a recoil design at that time.

▲ HELWAN

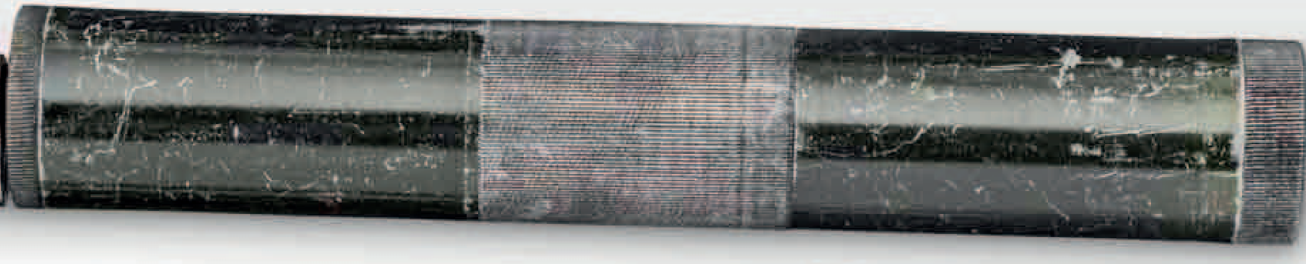
Date 1965
Origin Egypt
Barrel 4¼in (11cm)
Caliber 9mm Parabellum

The Helwan is an Egyptian licensed version of the Beretta Model 1951 Brigadier, a single-action (the hammer has to be cocked manually) 9mm automatic handgun with an eight-round magazine capacity.

▲ TYPE 67

Date 1968
Origin China
Barrel 3½in (8.9cm)
Caliber 7.62 × 17mm

The Type 67 was a recoil pistol with an integral suppressor, or silencer. It featured a manual slide locking system, which stopped ejection of the spent cartridge after firing, making the pistol quieter during operation.



▶ HECKLER AND KOCH VP70M

Date	1970s
Origin	Germany
Barrel	4½in (11.6cm)
Caliber	9mm Parabellum

The VP70M, the first pistol to make extensive use of plastic, was an attempt to produce a fully automatic handgun, although limited to firing three-round bursts. The mechanism that controlled this was housed in the detachable butt; when it was removed, the pistol reverted to normal semiautomatic operation.

FULL VIEW

▶ CZ75

Date	1975
Origin	Czechoslovakia
Barrel	4¾in (12cm)
Caliber	9mm Parabellum

The CZ75 had several derivatives, such as the CZ97 in .45in caliber and the CZ75 P-07 featuring a polymer frame rather than a steel one. These models quickly established reputations for reliability, and they were adopted by a number of military and police forces.

▶ BERETTA MODEL 92FS

Date	1976
Origin	Italy
Barrel	4¼in (10.9cm)
Caliber	9mm Parabellum

The Beretta 92 was chosen as the US military's official sidearm to replace the Colt M1911A1 (see p.169) in the 1980s. Its frame was forged from aluminum to reduce weight. The slide top was cut away to allow single rounds to be loaded manually.

SELF-LOADING PISTOLS (1981–90)

Self-loading pistols from this period all display the squared profile that has become the accepted norm for these weapons. Structurally, they increasingly incorporated components made of lightweight metal alloys or synthetic polymers. The use of the latter initially caused unease among both users and law enforcement officials. Users feared that parts made entirely of polymers would not withstand the stresses generated during firing, while the police were worried that such arms would be invisible to metal detectors. But these concerns proved to be unfounded—the so-called "plastic pistols" were here to stay.

▶ GLOCK 17

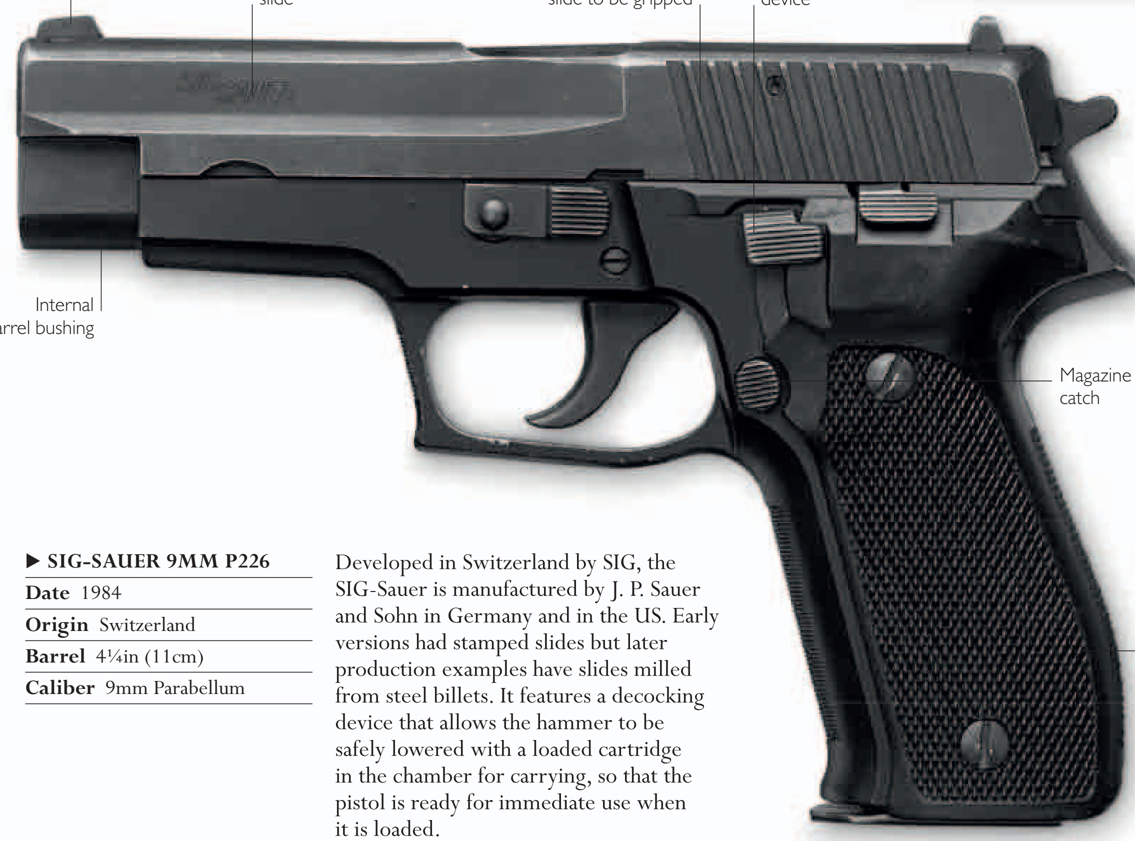
Date 1982
Origin Austria
Barrel 4½in (11.4cm)
Caliber 9mm Parabellum

Designed by Gaston Glock, this pistol utilized a polymer frame and had metal parts treated with a proprietary formula finish that prevented surface oxidation. It also had three independent safety locking systems, including the Browning locking system (see p. 270), that prevented accidental firing. Though treated with skepticism when introduced, the Glock is now used worldwide by police forces and military personnel.

▲ IMI DESERT EAGLE

Date 1983
Origin Israel
Barrel 10in (25.4cm)
Caliber .44in Magnum (as shown here)

Unlike almost all other self-loading pistols, the Desert Eagle, made by Israel Military Industries (IMI), was gas-operated (see p.305), and of modular design. Its standard frame was able to accept sets of components for different ammunition, from .357in Magnum to .5in Action Express (AE), and barrels of different lengths.



▶ SIG-SAUER 9MM P226

Date 1984
Origin Switzerland
Barrel 4¼in (11cm)
Caliber 9mm Parabellum

Developed in Switzerland by SIG, the SIG-Sauer is manufactured by J. P. Sauer and Sohn in Germany and in the US. Early versions had stamped slides but later production examples have slides milled from steel billets. It features a decocking device that allows the hammer to be safely lowered with a loaded cartridge in the chamber for carrying, so that the pistol is ready for immediate use when it is loaded.

▲ LAR GRIZZLY MK IV

Date	1985
Origin	US
Barrel	6½in (16.5cm)
Caliber	.44in Magnum

The LAR Grizzly handgun was developed as a high-power hunting or target shooting weapon. It is based upon the classic Colt M1911 (see pp.178–79), most of the differences being related to size and minor external features (such as the form of the trigger guard, the spur on the rear grip strap, and the forward grip strap). The Mk 1 came with caliber conversion kits; the Mk IV, by contrast, is available only in .44in Magnum.

▲ BERETTA 89 TARGET

Date	1989
Origin	Italy
Barrel	6in (15cm)
Caliber	.22in

The Beretta 89 is an automatic recoil-powered handgun designed for competitive target shooting. It is a single-action gun (its hammer must be cocked manually) and is built for high accuracy, with a heavy barrel and an adjustable rear sight.

▶ IMI JERICHO 941

Date	1990
Origin	Israel
Barrel	4¾in (12cm)
Caliber	9mm/.41in AE

The Jericho 941 entered production with IMI in 1990. The "941" designation refers to the way it was originally supplied with interchangeable barrels, magazines, and recoil springs to swap between 9mm and .41in AE cartridges.

AMPHIBIOUS FIREARMS

The creation of the ADS Amphibious Rifle by Russian engineers was made public in 2009. Amazingly, this assault rifle for combat divers can fire under water—by using a special cartridge filled with a powder that releases oxygen on ignition, allowing the powder to burn.

SELF-LOADING PISTOLS (1991–PRESENT)

Modern self-loading pistols differ little from their predecessors visually. However, their construction now involves an increased use of carbon composites, plastics, and lightweight metal alloys. Another key development is that their grips are designed to allow the use of high-capacity magazines capable of holding up to 20 rounds. The profile of the forward trigger guard bow has also become more vertical and grooved, a configuration that allows shooters to hold a pistol securely with both hands.

Vertical forward bow of trigger guard facilitates two-handed shooting

▲ SIG-SAUER P226

Date 1991
Origin Switzerland
Barrel 4½in (11.5cm)
Caliber 9mm Parabellum

The SIG-Sauer P226 is a development of the SIG P220, one of the postwar period's finest semiautomatic handguns. The P226's higher-capacity magazines store up to 20 9mm Parabellum cartridges in a staggered column. This example is decorated with white gold, blue enamel, and 1,517 diamonds.

Forward portion of slide houses end of mainspring

Double-action trigger

Butt houses 15-round box magazine

▲ COLT ALL AMERICAN 2000

Date 1991
Origin US
Barrel 4½in (11cm)
Caliber 9mm Parabellum

The All-American emerged from Colt in 1991, the brainchild of Reed Knight Jr. and Eugene Stoner. It was a 9mm gun with a frame made of either polymer or aluminum, hence it was extremely light. Colt ceased production of the gun in 1994.

Frame-mounted safety catch

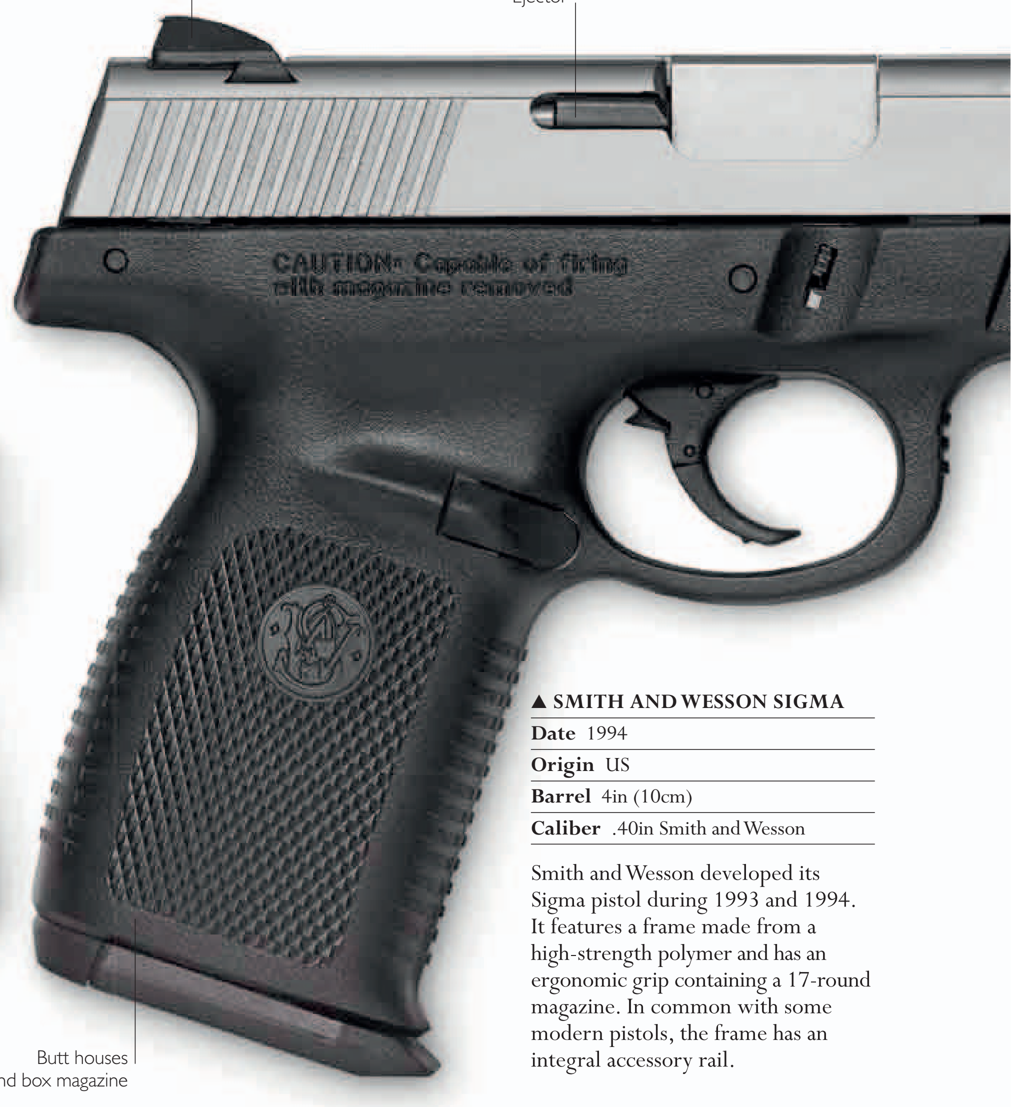
Enlarged trigger guard

Butt houses 10-round box magazine

▲ HECKLER AND KOCH USP

Date 1993
Origin Germany
Barrel 4¼in (10.7cm)
Caliber 9mm Parabellum

The Universal Service Pistol (USP) was Heckler and Koch's answer to the Glock 17 (see p.266), and it, too, was largely made of plastic and employed the tried-and-tested Browning locking system. The USP could be configured in nine different ways—for instance, the trigger assemblies and magazines could be changed quickly.



Rear sight

Ejector

Butt houses 17-round box magazine

▲ SMITH AND WESSON SIGMA

Date 1994
Origin US
Barrel 4in (10cm)
Caliber .40in Smith and Wesson

Smith and Wesson developed its Sigma pistol during 1993 and 1994. It features a frame made from a high-strength polymer and has an ergonomic grip containing a 17-round magazine. In common with some modern pistols, the frame has an integral accessory rail.

▼ STEYR SPP

Date 1993

Origin Austria

Barrel 5in (13cm)

Caliber 9mm Parabellum

A cut-down version of Steyr's TMP submachine-gun, the SPP—or Special Purpose Pistol—fires on semiautomatic only, and can take either a 15- or 30-round box magazine housed in the pistol grip.

▲ GLOCK 19 GEN 4 9MM

Date 2000s

Origin Austria

Barrel 4in (10.2cm)

Caliber 9mm Parabellum

The fourth generation series of Glock pistols is identifiable by the thumb rest on the upper part of the grip, the finger grooves on the forward edge of the grip strap, and the pattern of roughening cast into the grip plates themselves. The most distinctive feature, however, is the accessory rail forward of the trigger guard for installing a laser sight.

▲ BERETTA 9000S

Date 2001

Origin Italy

Barrel 3¼in (8cm)

Caliber .40in Smith and Wesson/9mm Parabellum

The Beretta 9000S is a 9mm or .40in Smith and Wesson semiautomatic handgun with a polymer frame and a 10-shot magazine. It is both single- and double-action (its hammer must be cocked either manually or by pulling the trigger), and it has good safety features, such as an automatic firing pin block alongside a manual safety switch.

SUBMACHINE-GUNS (1946–65)

In the years following World War II, submachine-gun design was focused on the reduction of weight through the use of stampings, normally reinforced by ribbing. The French MAT 49, with its pivoting magazine, is an excellent example of this idea in use. Though most submachine-guns were chambered for the 9mm Parabellum cartridge, police versions, such as the Czech Skorpion, were usually designed for use with the less powerful 7.65mm pistol round. One of the more unusual designs was the Russian Stechkin APS, which, due to its modest weight, proved to be almost uncontrollable during use.

▼ **UZI 9MM STEEL STOCK**

Date	1950
Origin	Israel
Barrel	10¼in (26cm)
Caliber	9mm Parabellum

While the original version of the UZI (right) was fitted with a conventional wooden butt, this proved unwieldy in confined quarters, such as aircraft or armored vehicles. Consequently, a modified model was designed that had a collapsible metal butt that greatly reduced the firearm's overall length when folded.

◀ MANUFACTURE NATIONALE D'ARMES DE TULLE (MAT) 49

Date 1950s

Origin France

Barrel 9in (23cm)

Caliber 9mm Parabellum

The MAT 49's distinctive feature is its pivoting magazine housing; in addition to making the weapon easier to conceal, it's a very positive safety device because it takes the magazine out of the firing position. The gun saw widespread combat use during the First Indochina War (1946–54) and the Algerian War (1954–62), as well as in the 1956 Suez Crisis.

▲ UZI

Date 1950s

Origin Israel

Barrel 10¼in (26cm)

Caliber 9mm Parabellum

The secret of the UZI's legendary stability lies in its bolt being wrapped around its barrel; this brings the center of gravity forward and helps to cure the tendency for the barrel to rise during automatic fire. Heavy moving parts keep its rate of fire to a manageable 600 rounds per minute.

▶ SKORPION VZ61

Date 1959

Origin Czechoslovakia

Barrel 4½in (11.43cm)

Caliber 7.65mm

The VZ61, or Skorpion, submachine-gun was designed by Miroslav Rybar. It was intended for use by security personnel and police. By incorporating a telescoping bolt, Rybar was able to produce a weapon that was short overall, so it was ideal for use in cramped spaces or for carrying beneath clothing. Its vertically folding stock further minimized its length.

▲ STECHKIN APS

Date 1960s

Origin USSR

Barrel 5in (12.7cm)

Caliber 9mm Makarov

The Stechkin was an unsuccessful attempt to produce a fully automatic pistol for use by security forces. Like the Makarov (see p.264), it was an unlocked recoil design based on the American Walther PP. In automatic mode, firing 750 rounds per minute, it was virtually uncontrollable.

SUBMACHINE-GUNS (1966–PRESENT)

In this period, some of the guns took on a futuristic look that almost masked their real purpose. The ability to conceal a gun became a prime factor in their construction. Consequently, many submachine-guns were little larger than pistols so that police SWAT and military personnel could carry them beneath civilian clothing. Heckler and Koch's MP5 (see p.257) is probably one of the most iconic submachine-guns produced at this time, and it has been employed in more than 40 countries. It gave way to the MP7 seen here.

▲ SKORPION VZ83

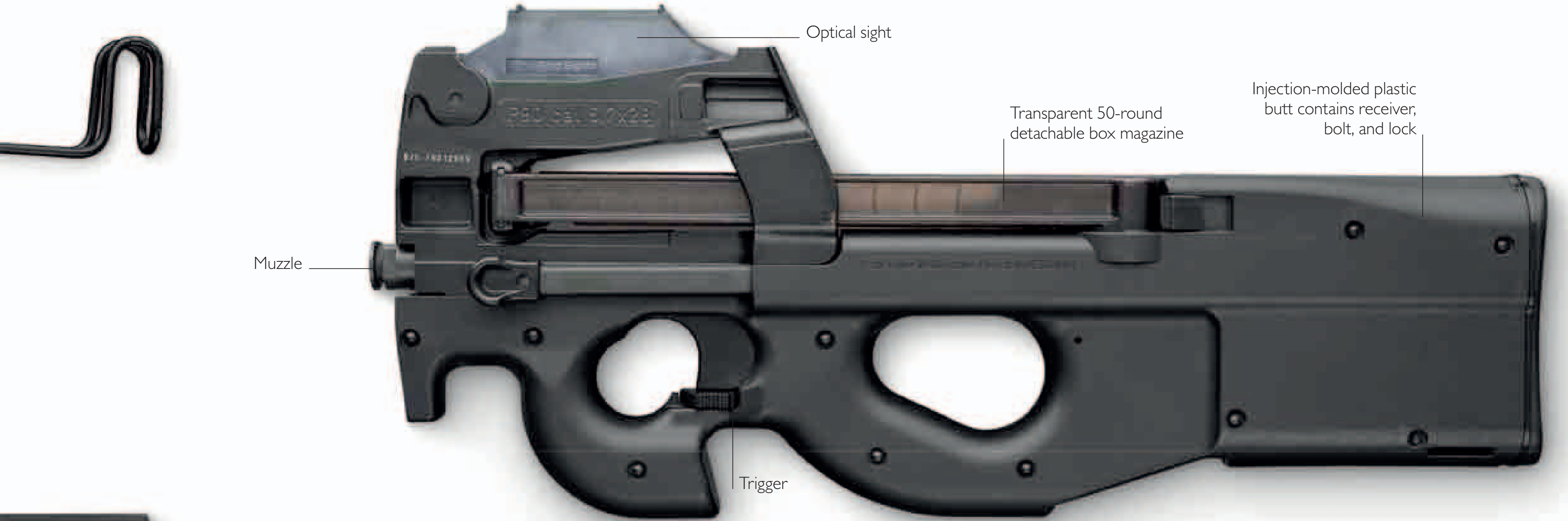
Date	1990s
Origin	Czechoslovakia
Barrel	4½in (11.5cm)
Caliber	9mm Kurz

The Skorpion VZ61 (see p.273) was modified following its introduction to accept larger cartridges, including 9mm Kurz and 9mm Parabellum, but did not go into production. In the 1990s, the rechambered versions were introduced officially. The version using the 9mm Kurz cartridge was called the VZ83.

▲ STEYR MPI 81

Date	1990s
Origin	Austria
Barrel	10¼in (26cm)
Caliber	9mm Parabellum

The MPi 81 has a conventional cocking handle that allows the bolt to be manually drawn rearward to cock the gun. This gun is a 9mm recoil-operated weapon with fire selection via trigger pressure—light pressure fires single shots while heavy pressure produces automatic fire, shooting 700 rounds per minute.



▲ FN P90

Date	1990
Origin	Belgium
Barrel	10¼in (26.3cm)
Caliber	5.7 × 28mm

A ground-breaking personal defense weapon (PDW), the FN P90's non-mechanical body components are all molded from plastic, and its unique horizontal ammunition feed allows the magazine to be incorporated within the receiver.

FULL VIEW

▲ HECKLER AND KOCH MP7

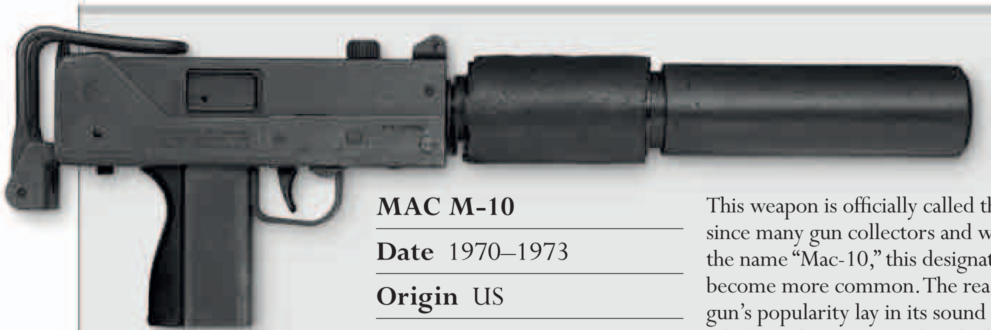
Date	2001
Origin	Germany
Barrel	7in (18cm)
Caliber	4.6 × 30mm

Similar in concept to the FN P90 (above), the MP7 is a "personal defense weapon" that fires one of the new-generation reduced caliber, high-velocity rounds, in this case the 4.6 x 30mm cartridge, which it can fire 950 times a minute. It has a fully ambidextrous design—having controls, such as the safety switch and decocking device, on both sides, accommodating both left-and right-handed operators.

SHOWCASE

MAC M-10

Manufactured by the Military Armaments Corporation, the M-10 submachine-gun was designed by Gordon Ingram in 1964. Although it was only in production from 1970 to 1973, its stamped steel components, compact design, and two-stage sound suppressor provided a successful blueprint for future arms design. This weapon was extensively used by military special forces because of its light weight and highly effective sound suppressor—features that made it a perfect fit for clandestine operations.



FULL VIEW (RIGHT SIDE)

MAC M-10	
Date	1970–1973
Origin	US
Barrel	2in (5cm)
Caliber	9mm Parabellum

This weapon is officially called the M-10, but since many gun collectors and writers used the name "Mac-10," this designation has become more common. The reason for the gun's popularity lay in its sound suppressor, which made it so quiet that the bolt could be heard functioning. The gun was widely used by US special forces and CIA agents during the Vietnam War (1955–75).

▸ UPPER RECEIVER AND BARREL ASSEMBLY
The upper receiver contains the cocking handle, bolt housing, and recoil spring. It also houses the ejection port along the right side, corresponding to the placement of the magazine beneath it. Mounted on the upper receiver is an unusual threaded barrel. The thread supports the sound suppressor, which can be easily screwed on to reduce the sound of firing without affecting the velocity of a bullet.

▸ SHOULDER STOCK FOLDED AND UNFOLDED
The M-10 is fitted with a hinged tubular steel shoulder stock that slides into the lower receiver assembly. The stock can be pulled out by pressing the release button at the bottom of the assembly, and it can be folded downward to act as a shoulder support, steadying the gun during firing.

1

2

◀ SOUND SUPPRESSOR
The sound suppressor is fitted onto the barrel and has a two-stage design. The first stage consists of a large cylinder that is fed into the second stage, which is a longer, slimmer cylinder. This two-stage design baffles the air from rushing into the barrel directly, which greatly reduces the sound emitted on firing a cartridge. The sound suppressor does not add much to the weight of the gun, allowing it to be fired single-handed.

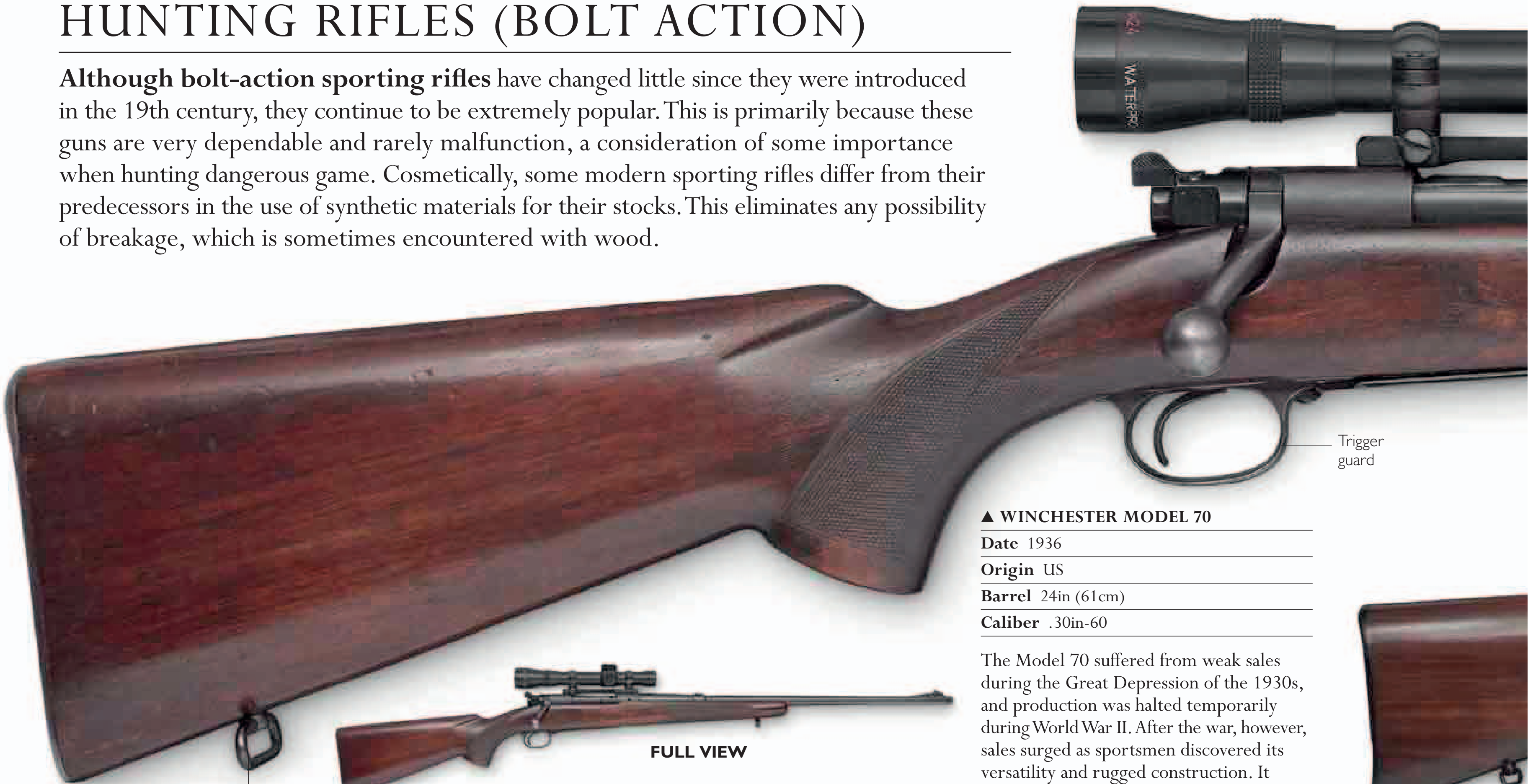
▶ COCKING HANDLE
The cocking handle is situated along the top of the receiver. A notch cut through the handle ensures an unobstructed line of sight between the user and his target. The user pulls the cocking handle backward to ready the gun for firing the first time. The handle can be turned through 90-degrees to lock the bolt when the weapon is not in use.

◀ BOLT AND RECOIL SPRING
This is an "open-bolt" recoil-action gun, in which the bolt is held at the rear when the gun is not firing. The bolt is driven to the rear by moving the cocking handle backward. On pulling the trigger, the recoil spring drives the bolt forward. As it advances, the bolt strips a cartridge, chambers it, and fires it, then flies back, ejecting the spent cartridge. This cycle is repeated automatically during fully automatic fire (when the trigger is kept pulled). When firing from an open bolt, the ejection port is left open to release gases during the firing process. This prevents the breech chamber from overheating. Open-bolt guns, however, are not as accurate as closed-bolt guns, in which the bolt is closed and chambered at rest. As in the case of most automatic guns, this weapon relies more on rate of fire (1,090 rounds per minute in this case) than accuracy. It was originally designed for covert operations, especially during the Vietnam War.

◀ LOWER RECEIVER ASSEMBLY
Made from steel stampings, the lower receiver assembly incorporates the magazine as part of the grip. A simple rear sight is attached to the uppermost rear part of the assembly.

HUNTING RIFLES (BOLT ACTION)

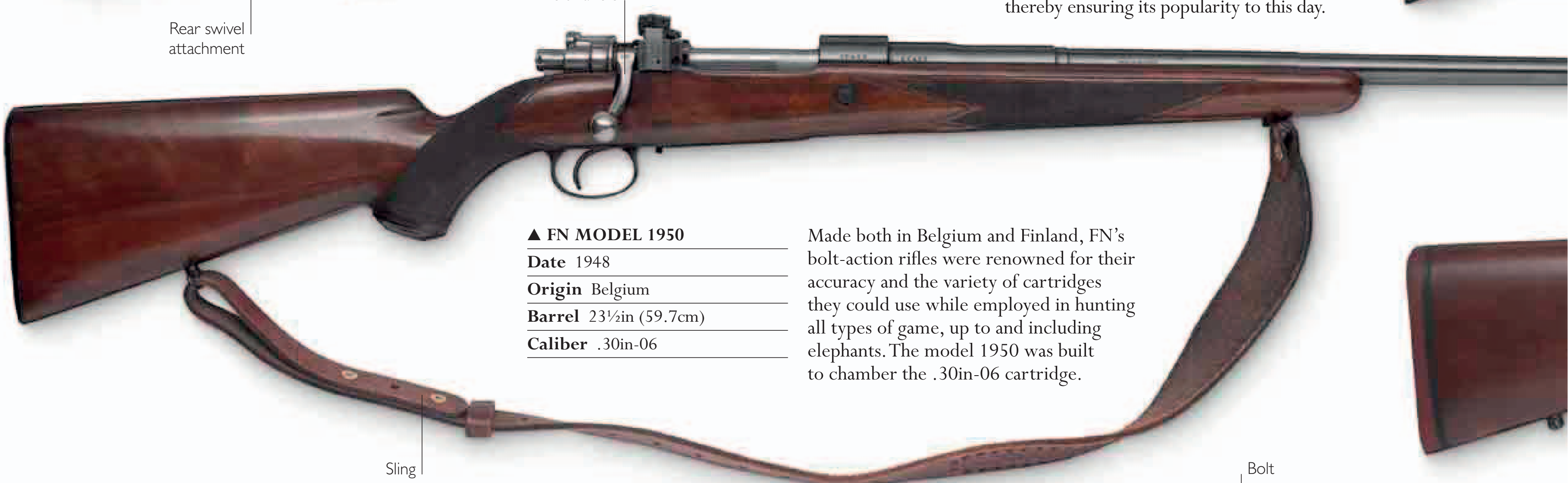
Although bolt-action sporting rifles have changed little since they were introduced in the 19th century, they continue to be extremely popular. This is primarily because these guns are very dependable and rarely malfunction, a consideration of some importance when hunting dangerous game. Cosmetically, some modern sporting rifles differ from their predecessors in the use of synthetic materials for their stocks. This eliminates any possibility of breakage, which is sometimes encountered with wood.



FULL VIEW

▲ WINCHESTER MODEL 70	
Date	1936
Origin	US
Barrel	24in (61cm)
Caliber	.30in-60

The Model 70 suffered from weak sales during the Great Depression of the 1930s, and production was halted temporarily during World War II. After the war, however, sales surged as sportsmen discovered its versatility and rugged construction. It earned the name "The Rifleman's Rifle," thereby ensuring its popularity to this day.



▲ FN MODEL 1950	
Date	1948
Origin	Belgium
Barrel	23½in (59.7cm)
Caliber	.30in-06

Made both in Belgium and Finland, FN's bolt-action rifles were renowned for their accuracy and the variety of cartridges they could use while employed in hunting all types of game, up to and including elephants. The model 1950 was built to chamber the .30in-06 cartridge.

▲ BRNO MODEL 465

Date	1949
Origin	Czechoslovakia
Barrel	23in (58.4cm)
Caliber	.22in Hornet

This bolt-action, Mauser-style rifle, which derives its action from the Mauser Model 1898 (see p.153), was designed for hunting light game or vermin with either open or telescopic sights. Its lightweight and attractive profile made it a favorite weapon among hunters. Featuring a detachable magazine, it could be loaded and fired with considerable speed. It had a double set trigger. This system increased accuracy by minimizing physical movement at the time of firing. Pulling the rear trigger held the sear, following which the slightest pressure on the forward trigger caused the sear to disengage, releasing the firing pin.

▲ RUGER 77

Date	1983
Origin	US
Barrel	22in (55.8cm)
Caliber	7 × 57mm

The Sturm, Ruger, and Company Model 77 is truly a product of modern technology. It is built using wax investment castings that require a minimum amount of machining. More importantly, the barrel is rifled using a proprietary process that makes the rifle very accurate.

▲ REMINGTON MODEL 700 ETRON-X

Date	2005
Origin	US
Barrel	26in (66cm)
Caliber	.243in Winchester

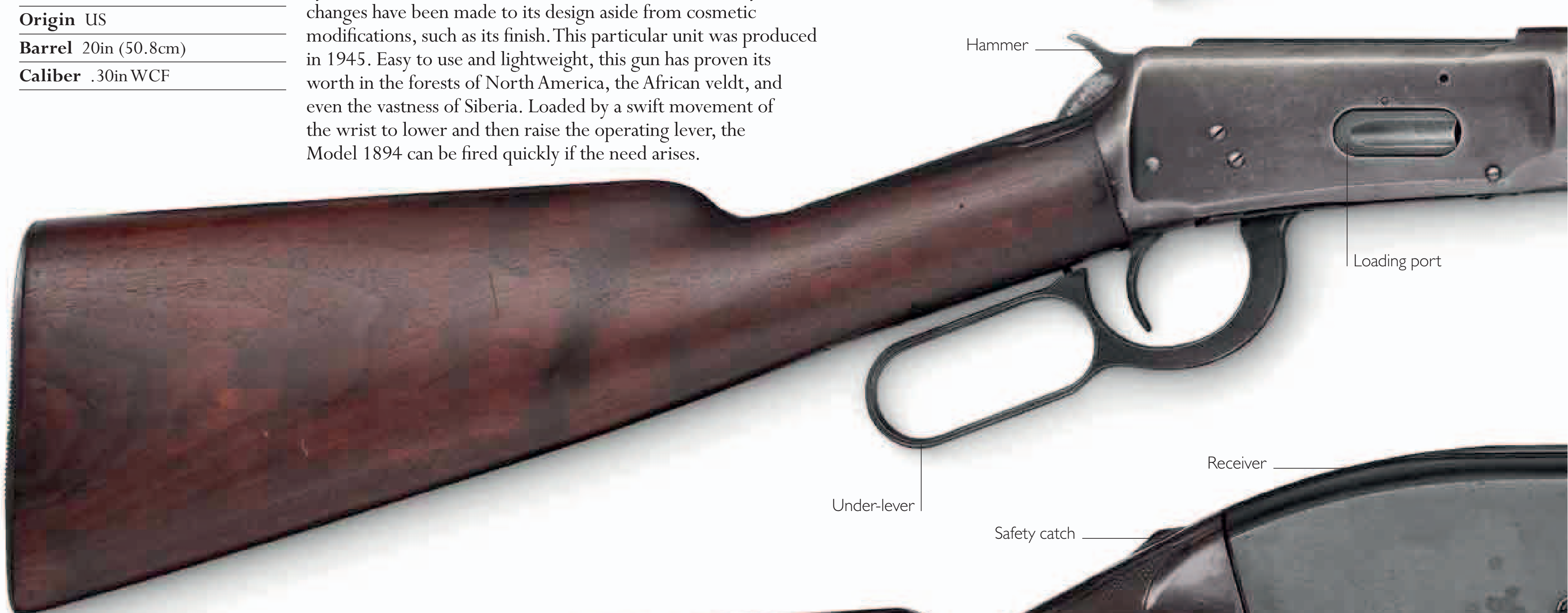
The Model 700 Etron-X features electric primer ignition. Pulling the trigger sends a pulse of electricity that ignites the cartridge's electric-sensitive primer. This essentially eliminates any movement during the firing process, significantly increasing the gun's accuracy as well as its lock time.

HUNTING RIFLES (OTHER TYPES)

Repeating rifles employing bolt action are commonly used by hunters. Other kinds of hunting rifles include repeaters operated by lever action (see pp.114–15), self-loading rifles (see pp.176–77), and even some that fire only single shots. Some rifles, such as the venerable Winchester Model 94, continue to be extremely popular despite having been in production for over a century. Others, the Sturm Ruger No. 1 being a prime example, incorporate designs that reflect new methods of construction and manufacture. Some recent rifles have been built using nylon components or operating systems developed in the late 1900s.

▼ WINCHESTER MODEL 1894	
Date	1945
Origin	US
Barrel	20in (50.8cm)
Caliber	.30in WCF

The durability of this deer-hunting rifle has been appreciated by hunters since its introduction in 1894. Since then, very few changes have been made to its design aside from cosmetic modifications, such as its finish. This particular unit was produced in 1945. Easy to use and lightweight, this gun has proven its worth in the forests of North America, the African veldt, and even the vastness of Siberia. Loaded by a swift movement of the wrist to lower and then raise the operating lever, the Model 1894 can be fired quickly if the need arises.



▲ WINCHESTER MODEL 100

Date	1961
Origin	US
Barrel	22in (55.8cm)
Caliber	.308in Winchester

Fed by a detachable box magazine, the Model 100 was one of the first successful self-loading sporting rifles. Chambered for the .308in Winchester cartridge, it has proved to be a very popular rifle for deer hunting in some parts of North America.

▼ REMINGTON NYLON 66

Date	1959
Origin	US
Barrel	19½in (49.5cm)
Caliber	.22in

In 1959, the Remington Arms Company broke with tradition and introduced a self-loading rifle with a stock made entirely from the Dupont Chemical Corporation's Zytel-101 nylon. Offered in three colors (Mohawk Brown, Apache Black, and Seneca Green), the new firearm weighed just 4lb (1.8kg). It ushered in a new era in gunmaking because of its light weight and use of new materials.

FULL VIEW

▲ STURM RUGER NO. 1

Date	c.1999
Origin	US
Barrel	24in (61cm)
Caliber	.375in Magnum

This gun was designed by William B. Ruger. Built using wax investment castings (see p.264), the No. 1 had improved lock-work and a safety meeting the more stringent requirements of today's regulations, such as the presence of two concurrent safety mechanisms—one preventing the hammer from moving and the second blocking trigger movement. This weapon incorporates blocks for the hammer and trigger. Older arms usually had one or the other.

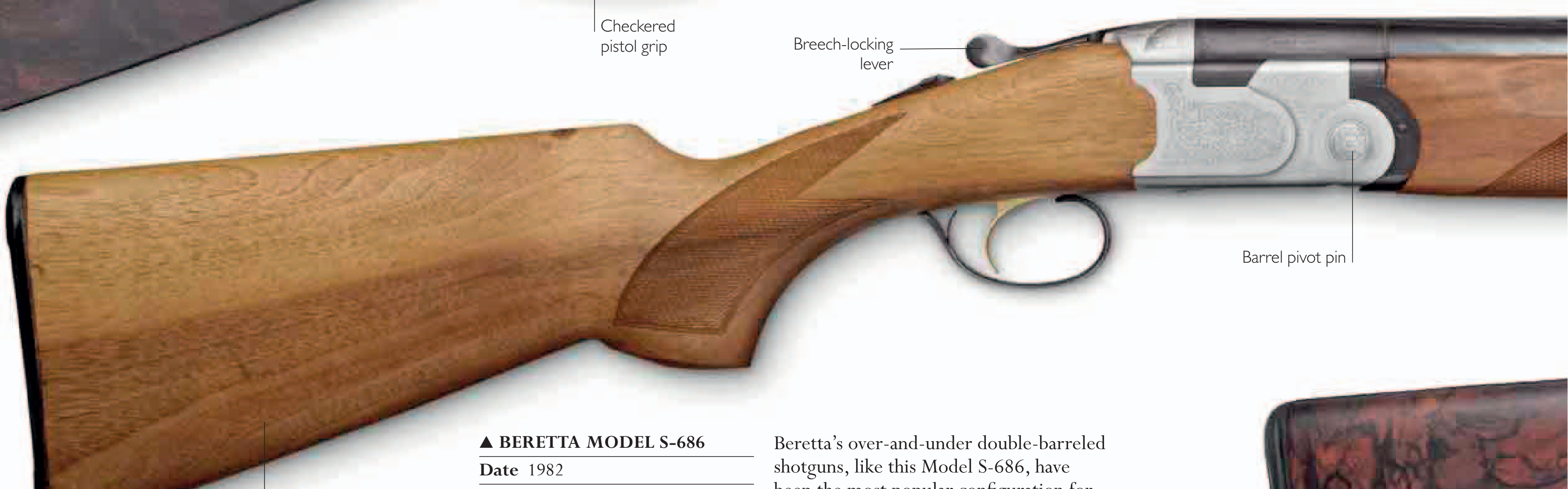
DOUBLE-BARRELED SHOTGUNS

Since the 18th century, double-barreled shotguns have been characterized by a pair of barrels placed horizontally next to each other. By aligning them carefully, the shot patterns created during firing can be made to converge at some specific point forward of the muzzle, such as 50 yards (46m). Recently, over-and-under guns (shotguns having their barrels set vertically one above the other) have gained popularity, especially among trapshooters and skeet shooters. The shot patterns of over-and-under guns can be made to converge as well, albeit vertically, thus allowing shooters used to rifles more opportunities of hitting a clay pigeon or a live bird.

▲ DARNE ROTARY-BREECH SHOTGUN

Date	1965
Origin	France
Barrel	25½in (65cm)
Caliber	16-gauge (.66in/16.76mm)

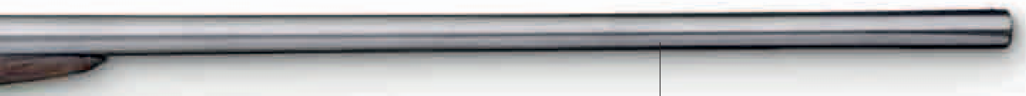
Made by Darne, this side-by-side shotgun has a patented breech action. Freed by means of the lever on top of the butt behind the breech, the entire lock rotates through a quarter turn to expose the chambers. Returning it to battery (the state of the gun's action when it is ready to fire) cocks the gun. The lever on the side of the breechblock is a cross-bolt safety.



▲ BERETTA MODEL S-686

Date	1982
Origin	Italy
Barrel	28in (71cm)
Caliber	12-gauge (.73in/18.54mm)

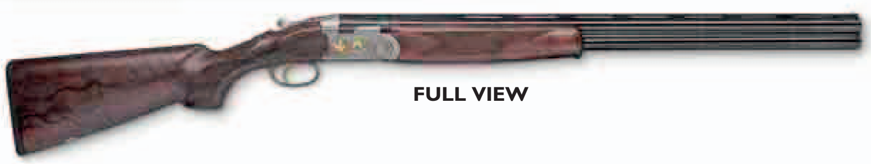
Beretta's over-and-under double-barreled shotguns, like this Model S-686, have been the most popular configuration for both hunting and trapshooting. Over-and-under guns have the advantage of a single sight line. Most are equipped with single-trigger locks.



▲ ANSCHUTZ-MIROKU OVER/UNDER SHOTGUN

Date	1998
Origin	Japan
Barrel	28in (71cm)
Caliber	12-gauge (.73in/18.54mm)

To reduce manufacturing costs, a number of Western arms companies partnered with the Miroku Corporation of Nankoku, Kochi Prefecture in Japan, to produce rifles and shotguns bearing their names. One such cooperative product is the Anschutz-Miroku shotgun. This moderately priced sporting arm is highly regarded because of its solid construction and ease of maintenance.

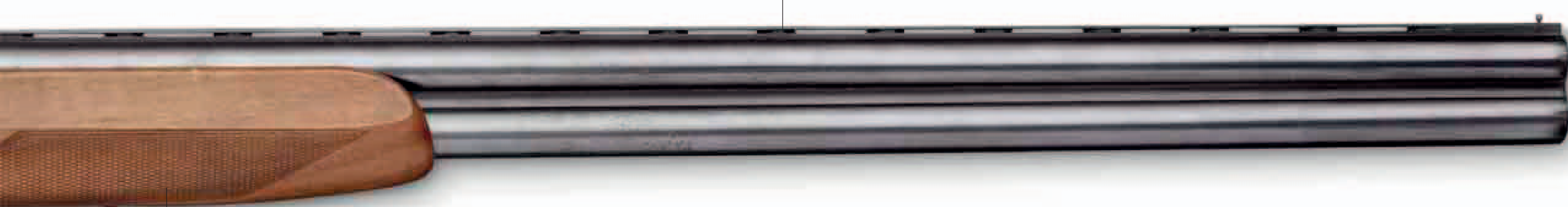


FULL VIEW

▲ BERETTA ULTRA LIGHT DELUXE

Date	1998
Origin	Italy
Barrel	28in (71cm)
Caliber	12-gauge (.73in/18.54mm)

This attractive gun was designed for shooting upland birds, such as pheasants and quail. It has an aluminum frame that makes the gun light enough for hunters to carry around all day. The strength of the action, however, is not compromised because the breech face and shoulders are made of titanium. To increase demand for the gun, it features machine-cut engraving and gold inlays.



▲ BERETTA 686 ONYX PRO

Date	2003
Origin	Italy
Barrel	26in (66cm)
Caliber	12-gauge (.73in/18.54mm)

This shotgun features laser-cut checkering on the pistol grip and forestock. Although designed for hunting, its barrels are equipped with screw-in chokes that modify the bore diameter to change shot patterns, which makes the gun fit for other purposes, too, such as trapshooting or skeet shooting.

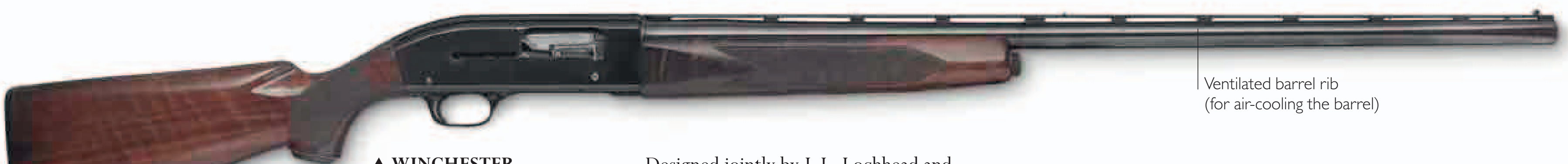
SHOTGUNS (REPEATING AND SELF-LOADING)

Repeating shotguns, usually equipped with tubular magazines carrying 3–11 cartridges, can fire several rounds in quick succession. The repeating action is commonly a slide, or a pump—a slide bar attached to the forestock which moves the breechblock back and forth. Some shotguns are self-loading, driving their autoloading cycle by gas or recoil operation. Repeating and self-loading shotguns have several applications. For sporting purposes, they allow a hunter to fire several rounds in quick succession at rising birds. This feature also makes them ideal for military or police use, when multiple attackers might be met at close quarters.

▲ REMINGTON WINGMASTER PUMP-ACTION SHOTGUN

Date	1951
Origin	US
Barrel	20in (51cm)
Caliber	13-gauge (.748in/19mm)

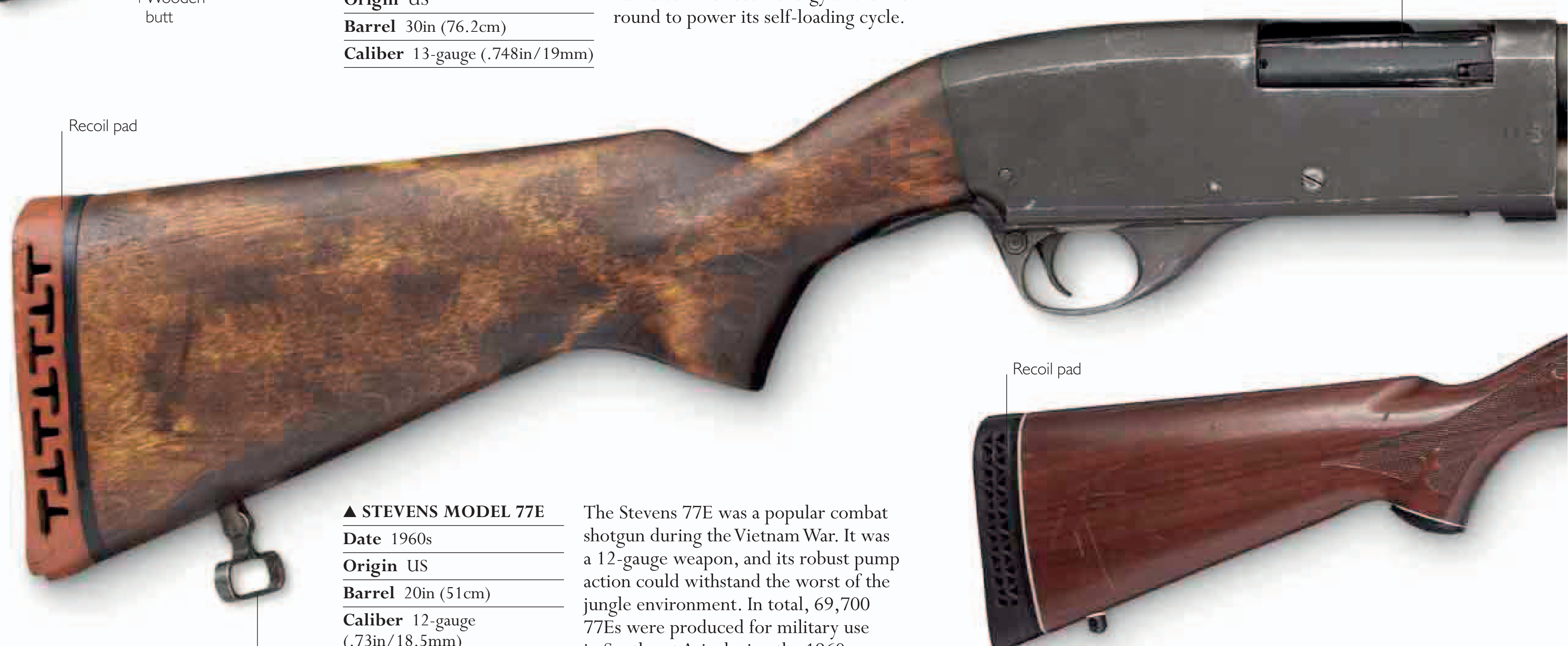
Fitted with a folding stock and rear pistol grip, this shotgun epitomizes the American police shotgun. Compact and easily stored, it can be quickly brought into service if needed. Its extended magazine also allows it to be loaded with about 4–5 more cartridges than similar sporting versions.



▲ WINCHESTER MODEL 50

Date	1954
Origin	US
Barrel	30in (76.2cm)
Caliber	13-gauge (.748in/19mm)

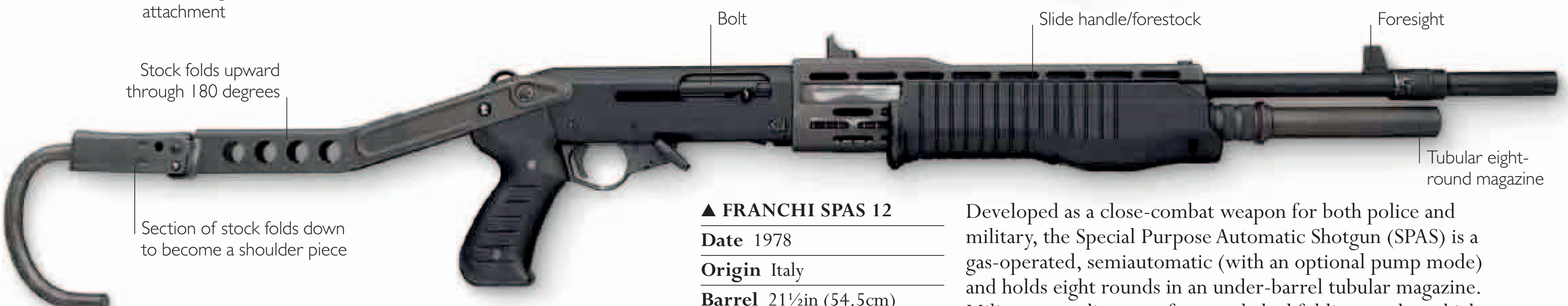
Designed jointly by J. L. Lochhead and David M. Williams, the Winchester Model 50 was a recoil-operated weapon. The gun harnessed the recoil energy of the fired round to power its self-loading cycle.



▲ STEVENS MODEL 77E

Date	1960s
Origin	US
Barrel	20in (51cm)
Caliber	12-gauge (.73in/18.5mm)

The Stevens 77E was a popular combat shotgun during the Vietnam War. It was a 12-gauge weapon, and its robust pump action could withstand the worst of the jungle environment. In total, 69,700 77Es were produced for military use in Southeast Asia during the 1960s.



▲ FRANCHI SPAS 12

Date	1978
Origin	Italy
Barrel	21½in (54.5cm)
Caliber	12-gauge (.73in/18.5mm)

Developed as a close-combat weapon for both police and military, the Special Purpose Automatic Shotgun (SPAS) is a gas-operated, semiautomatic (with an optional pump mode) and holds eight rounds in an under-barrel tubular magazine. Military or police guns frequently had folding stocks, which allowed the guns to be stored in confined spaces, such as armored vehicles or squad cars.

▼ BENELLI M1

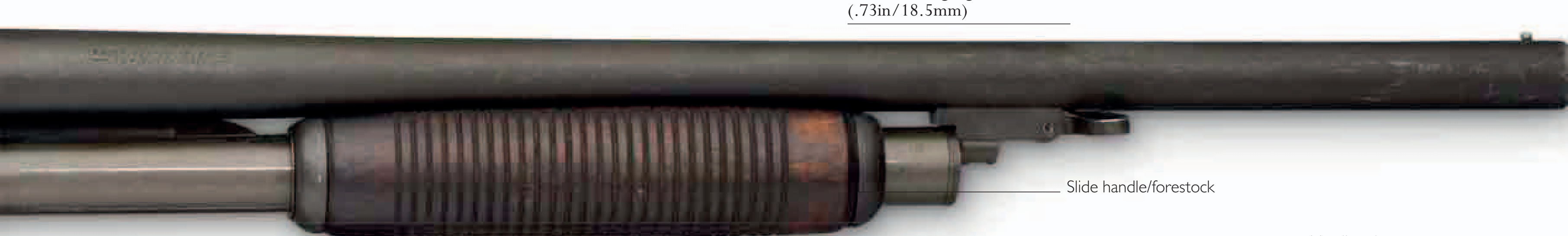
Date	1980s
Origin	Italy
Barrel	20in (51cm)
Caliber	12-gauge (.73in/18.5mm)

Benelli produces some of the world's finest semiautomatic shotguns, such as the early version of the M1 seen here. This self-loading shotgun utilizes recoil energy stored in a short, powerful spring to provide power for the reloading cycle.

▲ REMINGTON 1100 SEMIAUTOMATIC SHOTGUN

Date	1985
Origin	US
Barrel	28in (71cm)
Caliber	12-gauge (.73in/18.5mm)

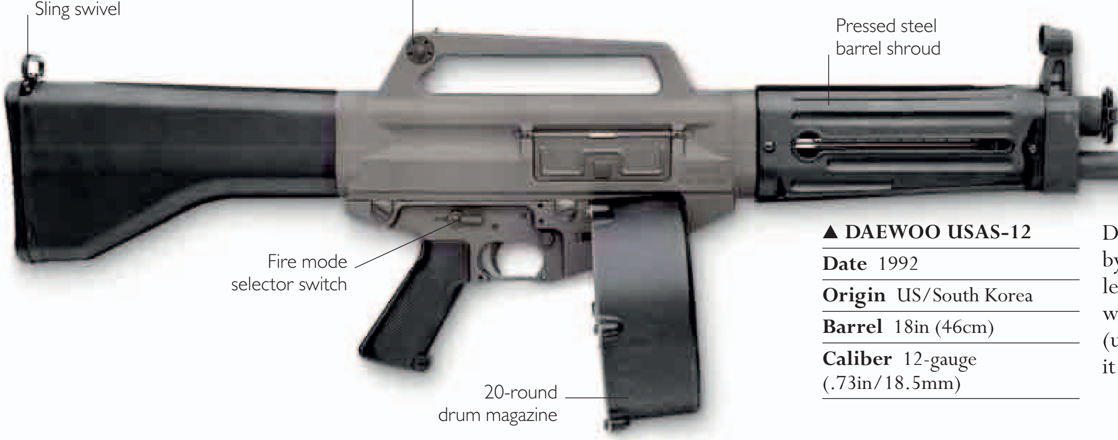
John Browning produced the first design for a gas-operated, self-loading shotgun while working for Winchester between 1902–04, but it was not put into production. This Remington 1100 is a modern example of a gas-operated shotgun, and was produced in a variety of barrel lengths and calibers.



▲ REMINGTON MODEL 870

Date	1985
Origin	US
Barrel	25½in (64.7cm)
Caliber	13-gauge (.748in/19mm)

One of the most popular slide-action shotguns in the US, the Remington Model 870 is made in a number of types designed for upland bird or waterfowl hunting. Differences between them involve various barrel lengths and types of choke (constrictions in the barrel near the muzzle for creating shot patterns). Over the years, the Model 870 has earned a well-deserved reputation for reliability in all weather conditions.



▲ DAEWOO USAS-12

Date	1992
Origin	US/South Korea
Barrel	18in (46cm)
Caliber	12-gauge (.73in/18.5mm)

Designed in the US and manufactured in South Korea by Daewoo, the gas-driven USAS-12 is unusual in at least two respects. First, it is a selective-fire weapon, with the option for single-shot or automatic operation (using a drum magazine for continuous fire); second, it can be set up for either right- or left-handed users.

MODERN SHOTGUNS
Established in 1835 in London, Holland and Holland produces some of the most coveted modern sporting rifles and shotguns. It is known for the restrained elegance of its arms, whether gold inlaid or engraved, as seen on this shotgun.

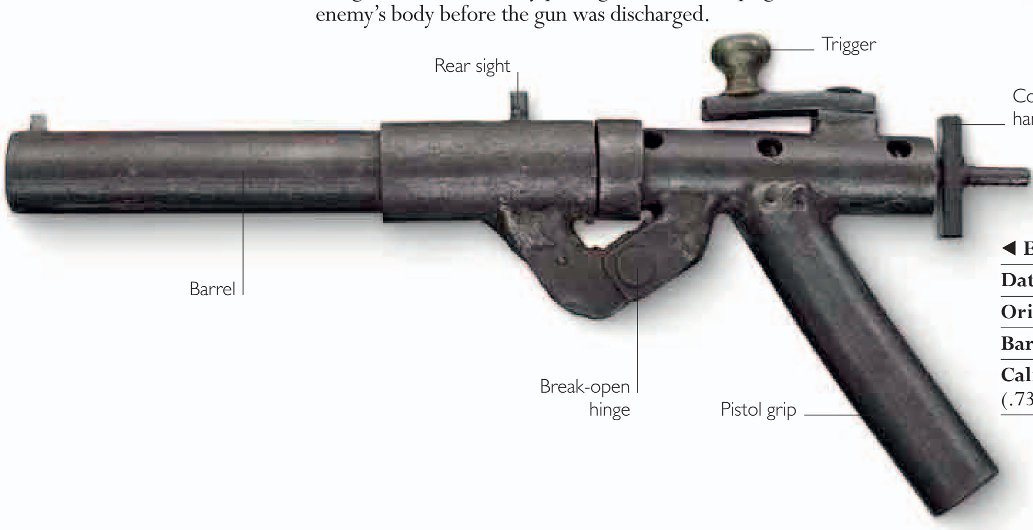
IMPROVISED ARMS

During insurgencies and revolutions, some combatants may not have production arms at their disposal. They may use handmade arms that have been produced based on necessity. These firearms vary enormously in their quality and performance—from crude guns made of metal pipes to sophisticated submachine-guns. These weapons are often poor in construction and are generally unable to withstand the pressure developed during the ignition of a cartridge. This makes them likely to blow up when in operation.

▶ **EOKA PISTOL**

Date	1950s
Origin	Cyprus
Barrel	4¼in (11cm)
Caliber	12-gauge (.73in/18.54mm)

The *Ethniki Organosis Kyprion Agoniston*, or National Organization of Cypriot Fighters (EOKA), fought a guerrilla campaign against British colonial rule on the Mediterranean island of Cyprus from 1955 to 1959. During that time, they created small numbers of crude guns. This pistol is so crudely fashioned that it barely qualifies for the name. The barrel is a spent 20mm caliber cartridge case, secured to a rough-hewn wooden frame. Since it had no rifling, the most effective way of firing would have been by putting the "muzzle" up against the enemy's body before the gun was discharged.



◀ **EOKA SHOTPISTOL**

Date	1950s
Origin	Cyprus
Barrel	4¼in (11cm)
Caliber	12-gauge (.73in/18.54mm)

Eoka built this weapon in the 1950s. Made from iron piping, it has a simple break-open action. It fires a shotgun cartridge by means of a spring-loaded plunger.

▲ MAU-MAU CARBINE

Date	1950s
Origin	Kenya
Barrel	20¼in (51.2cm)
Caliber	.303in

Somewhat more sophisticated than many of its type, this short-barreled, bolt-action, single-shot carbine was made in Kenya during the time of the Mau-Mau insurrection against British rule in the 1950s. Most of the improvised weapons made by the rebels, the majority of whom were from the Kikuyu people, exploded when they were fired.

▲ LOYALIST SUBMACHINE-GUN

Date	1970s
Origin	UK
Barrel	7¾in (20cm)
Caliber	9mm Parabellum

Modeled on the vintage Sten gun from World War II, this homemade machine-pistol was produced by a loyalist paramilitary group in Northern Ireland. The barrel shroud and receiver have been fashioned from square-framed tubing. This gun uses a magazine from an L2 Stirling submachine-gun.

◀ SOUTH AFRICAN PISTOL

Date	1980s
Origin	South Africa
Barrel	8¾in (22cm)
Caliber	Not known

This homemade pistol, recovered in South Africa, is rather more sophisticated than it appears at first sight. It has a simple, single-action lock linking trigger and hammer, perhaps derived from a child's toy pistol, and can be used single-handedly. It would have been so inaccurate as to render the rudimentary sights redundant.

FERDINAND RITTER VON MANNLICHER

GREAT GUNSMITHS

STEYR-MANNLICHER

Steyr-Mannlicher, a celebrated Austrian firearms manufacturer, began as a very traditional maker of weapons, but has also embraced innovation and change. The company's founder, Josef Werndl, came from a family of metalworkers, so he could draw on experience stretching back over many generations. However, his company made rapid progress in the 1860s, when Werndl began to collaborate with Austrian designer Ferdinand Ritter von Mannlicher, especially on innovative rifle designs.

The city of Steyr, near the confluence of the Enns and Steyr rivers in Upper Austria, has been a metalworking center since at least the 13th century. Weapons manufacture became a major industry in the area around the time of the Thirty Years' War (1618–48), when the region supplied muskets and pistols to the Hapsburg Army. During the 19th century, this tradition continued, and one Steyr metalworker, Leopold Werndl, sent his son Josef to the US to learn about the latest ideas in firearms production. By the late 1860s, Josef was in control of the family firm and was delivering thousands of breech-loading rifles to the Austro-Hungarian Army.

ROOTS IN TRADITION

Josef Werndl's company, the Österreichische Waffenfabriksgesellschaft (Austrian Weapons Manufacturing Company), prospered in the second half of the 19th century, combining modern production methods with a traditional use of craft skills. A turning point came in 1885, when the Austro-Hungarian Army adopted its new bolt-action rifle, which was the brainchild of Ferdinand Ritter von Mannlicher. Mannlicher, who also invented the en bloc clip for loading cartridges, eventually became the company's chief designer, and the firm's name changed to Steyr-Mannlicher. He was successful again with the Mannlicher Schönauer full-stock rifle, a hunting weapon that he designed with Otto Schönauer, the director of the company. By this time, the company had established a prime position in both sporting and military markets.

Mannlicher died in 1904, but the company continued to build on its tradition and introduced new models, notably pistols, including the self-loading M1912, and also built a new factory, much larger than its predecessor and with the latest machinery. This new plant enabled the company to turn out firearms in large numbers, and was in place just in time to fulfill the huge surge in demand triggered by World War I. The firm soon employed around 15,000 people and even branched out into products such as bicycles and aircraft engines. However, the postwar treaty signed by Austria severely diminished the country and imposed economic limitations on it. The size of its army and the production of weapons were restricted. As a result, Steyr-Mannlicher faced difficulties. It only staved off bankruptcy by concentrating on products other than weapons, particularly bicycles and cars, which it had begun to manufacture during the war.

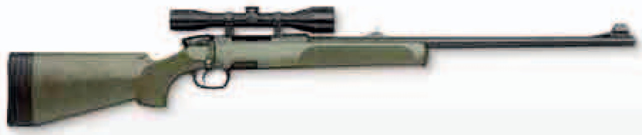
▲ **QUALITY CONTROL**
Careful quality control is at the heart of successful firearms production. Here a worker undertakes a manual check on a gun barrel at the Steyr-Mannlicher factory.

> "There is no figure in the history of **firearms** who can approach the great Austrian inventor, **Ferdinand Ritter von Mannlicher** …"
>
> *ATTRIBUTED TO* **W. H. B. SMITH, AUTHOR OF *"SMALL ARMS OF THE WORLD"***

THE MODERN COMPANY

Large-volume production of firearms began again at Steyr during World War II, but the factory suffered damage from Allied bombing. After the war, the production of weapons was

M1905



SSG-69, 1969

AUG, 1978

1864 Josef Werndl and his brother Franz found their first company (Österreichische Waffenfabriksgesellschaft), which later becomes Steyr-Mannlicher.
1867 The Austro-Hungarian Army begins to take delivery of Werndl's breech-loading rifles.
1885 Mannlicher's bolt-action rifle is accepted by the Austro-Hungarian Army.

1905 The M1905 (see p.168) is popular with Austro-Hungarian army officers, who buy the weapon privately and use it during World War I.
1914 On the eve of World War I, Steyr-Mannlicher completes its large new factory building.
1915 In a move toward diversification, Steyr begins to manufacture automobiles.

1969 The SSG-69 (see p.252) sniper rifle features a cold hammer-forged barrel and rotary five-round magazine.
1978 The Steyr AUG assault rifle (see p.250) is launched; it will spawn a huge number of variants and see very wide service.

curtailed, but in 1950, the company received the go-ahead for the manufacture of hunting rifles. Since then, it has built up an impressive range of weapons for hunters, together with a number of sporting rifles and pistols. When it reentered the field of military weapons, it produced a new assault rifle—a "bullpup" design making extensive use of synthetic materials. In Austria, this model became known as the StG 77, while in foreign markets it is the AUG (*Armee Universal Gewehr*) (see p.250). The company has produced this firearm in a range of models, along with sniper rifles such as the Steyr SSG-69 (see p.252); submachine-guns such as the Steyr MPI 81 (see p.274); and pistols such as the Steyr SPP (see p.271). To take full commercial advantage of these products, Steyr-Mannlicher adapted to the business conditions of the late-20th century by adopting an international approach—licensing production overseas (for example, to Australia and Malaysia) and exporting widely. As a result, the company continues to be a prominent player in the 21st-century firearms market.

▼ MILITARY USE
Some militaries in Southeast Asia use Steyr rifles. Women members of the Royal Malaysian Air Force can be seen marching with Steyr AUG assault rifles during the 48th Malaysian Independence Day celebrations in 2005.

SPECIALIZED AND MULTIPURPOSE ARMS

Multipurpose firearms have existed since the 17th century, when pistols and long arms were used for launching grenades for the first time. What has changed over the intervening centuries is the lethality of those projectiles and the need to launch them farther to protect the firer. Other specialized arms were built ruggedly for survival in the event of aircraft crashes, or other similar incidents where a virtually indestructible firearm might be needed. Precision target shooting also demands arms specifically designed for that purpose, and often they bear little resemblance to other firearms. One example of such a weapon is the Hammerli 162, which is fired by an electronic trigger.

▲ M59/66 WITH GRENADE-LAUNCHER

Date	1949
Origin	Soviet Union
Barrel	20in (50.8cm)
Caliber	7.62 × 39mm
Grenade range	330ft (100m)
Grenade type	Antitank

This was the Red Army's standard antitank grenade launcher during the 1950s. Mounted on the self-loading M59/66 assault rifle, it employed an overpowered blank cartridge to launch a grenade. While effective, it proved unpopular due to the disastrous effect of mistakenly chambering a regular live round while the grenade is still attached.

▲ AR7 EXPLORER ARMALITE SURVIVAL RIFLE

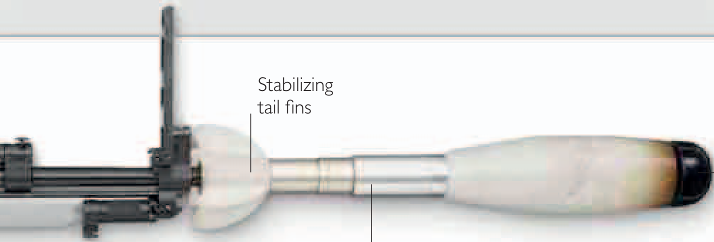
Date	1958
Origin	US
Barrel	16in (40cm)
Caliber	.22in

The AR7 was designed by Eugene Stoner in 1959 as a survival rifle for USAF aircrew. A semiautomatic .22in weapon, it ingeniously breaks down into four main parts—the barrel, action, magazine, and water-resistant stock (which can float in water).

◀ HECKLER AND KOCH MP5A5

Date	1966
Origin	Germany
Barrel	8¾in (22.5cm)
Caliber	9mm Parabellum
Grenade range	450ft (137m)
Grenade type	Antipersonnel

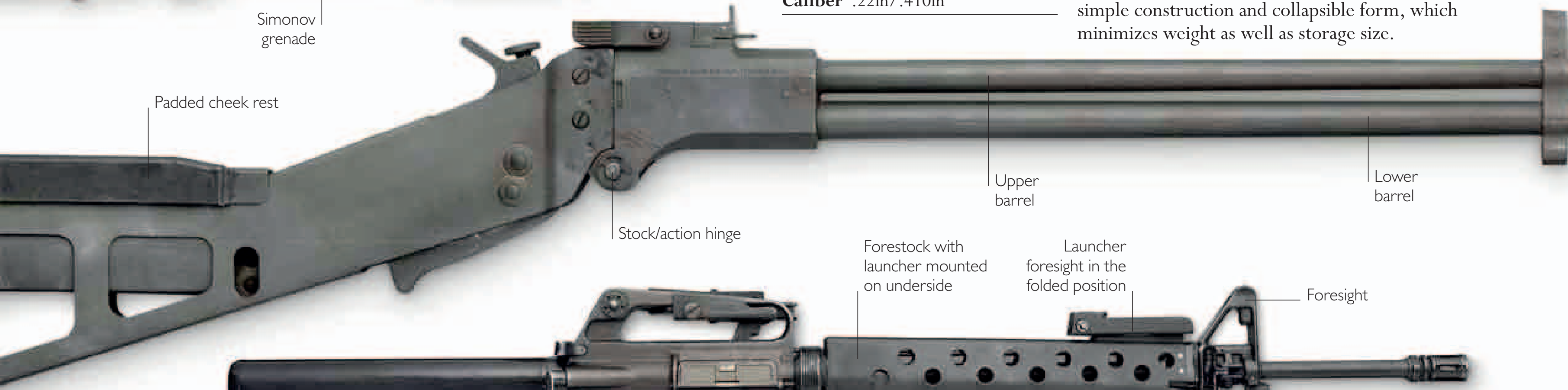
The MP5A5 is a plastic-stock version of the MP5 (see p.257). Here the multipurpose arm is featured in combination with a mounted grenade-launcher built by the British company ISTEC.



▼ ITHACA M6 SURVIVAL RIFLE

Date	1975
Origin	US
Barrel	14in (35.5cm)
Caliber	.22in/.410in

The Ithaca M6 survival rifle combines a rifled .22in upper barrel with a lower .410in shotgun barrel, the stock having storage capacity for 15 .22in cartridges and four shotgun shells. The gun originally had a folding design, while current models break down into two pieces. This rifle typifies survival arms in its extremely simple construction and collapsible form, which minimizes weight as well as storage size.



▲ M16A1 WITH M203A2 GRENADE-LAUNCHER

Date	1990s
Origin	US
Barrel	12in (30.5cm)
Caliber	5.56 × 45mm
Grenade range	500ft (150m)
Grenade type	Antipersonnel

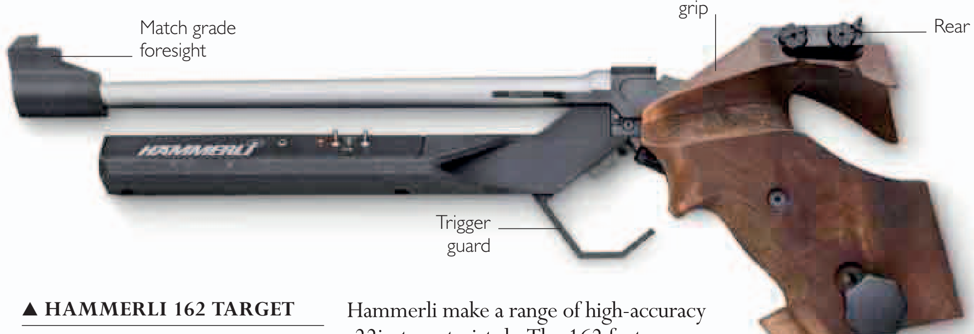
This version of the M16 (see pp.244–45) is equipped with an M203A2 grenade-launcher. By fitting a standard infantry rifle with a grenade-launcher, a two-fold purpose is served—providing direct fire (as a rifle) and allowing projectiles to be fired over long range (via the grenade-launcher).

GP25 GRENADE

▲ AK74 WITH GP25 GRENADE-LAUNCHER

Date	1978
Origin	Soviet Union
Barrel	16¼in (41.5cm)
Caliber	5.45 × 39mm
Grenade range	500ft (150m)
Grenade type	Antipersonnel

The AK74 (see p.246) is an improved version of the AK47, rechambered for the high-velocity intermediate 5.45 × 39mm cartridge. The example shown here has been equipped with a GP25 grenade-launcher. Aside from being an infantry arm, the AK74 with the GP25 is a multipurpose weapon designed for defensive and offensive actions.



▲ HAMMERLI 162 TARGET

Date	1992
Origin	Switzerland
Barrel	11in (28cm)
Caliber	.22in

Hammerli make a range of high-accuracy .22in target pistols. The 162 features an electronic trigger system with a hair-trigger adjustment, and is powered by batteries that hold enough power for around 10,000 discharges.

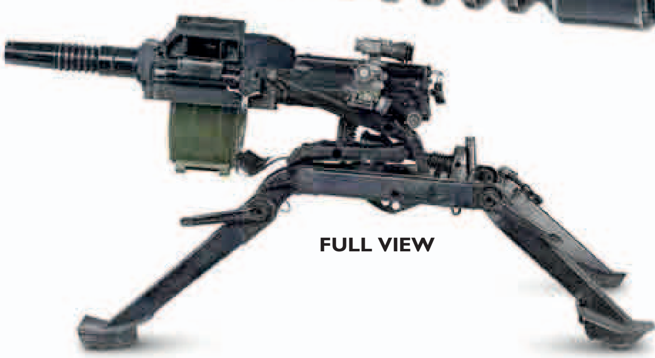
GRENADE-LAUNCHERS

The highly fluid character of modern warfare has necessitated mortars that are portable or even handheld infantry weapons. More often termed grenade-launchers, these mortars are designed to provide immediate support fire. The simplest are the American M79 and the South African Mechem. In contrast, the Russian AGS-17 almost enters the artillery class with its heavy fixed mount. The Rocket Propelled Grenade (RPG) launcher is now the most common launcher due to its simplicity and effectiveness. Its shaped-charge projectiles allow a single combatant to disable or destroy armored vehicles and fixed positions such as buildings.

M79 40MM GRENADE

▲ M79 "BLOOPER"	
Date	1961
Origin	US
Barrel	12in (30.5cm)
Caliber	40mm
Grenade range	328 yards (300m)

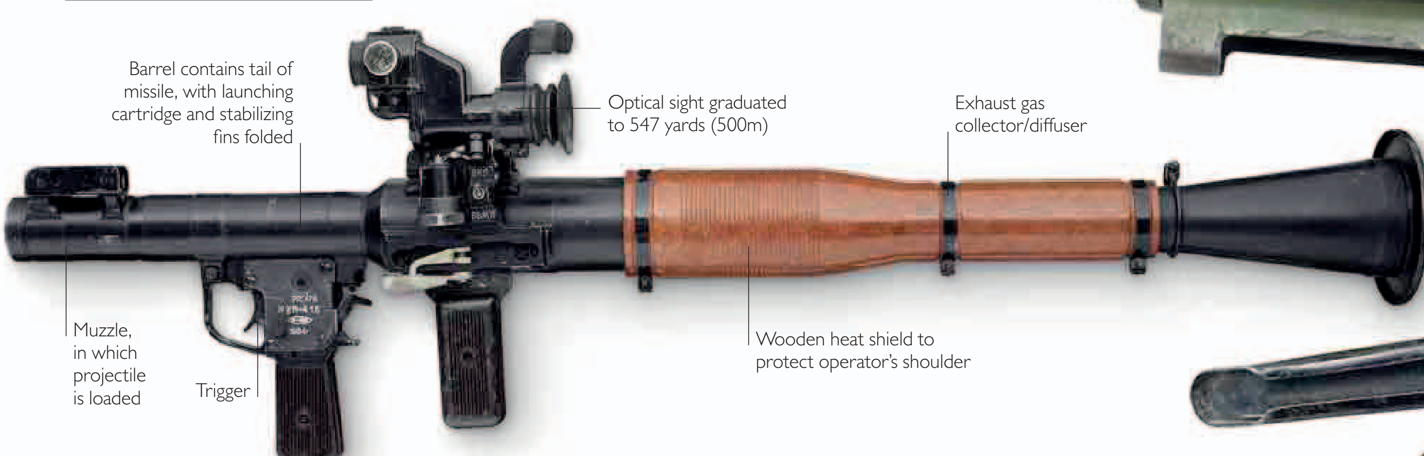
Nicknamed the "Blooper" because of the distinctive sound it makes when fired, the M79 grenade-launcher bridged the gap between short-range hand grenades and the long-range mortar. In addition to firing high-explosive grenades, the M79 could fire antipersonnel, smoke, and illuminating rounds. During the Vietnam War, two M79s were issued to each US infantry squad consisting of nine men.

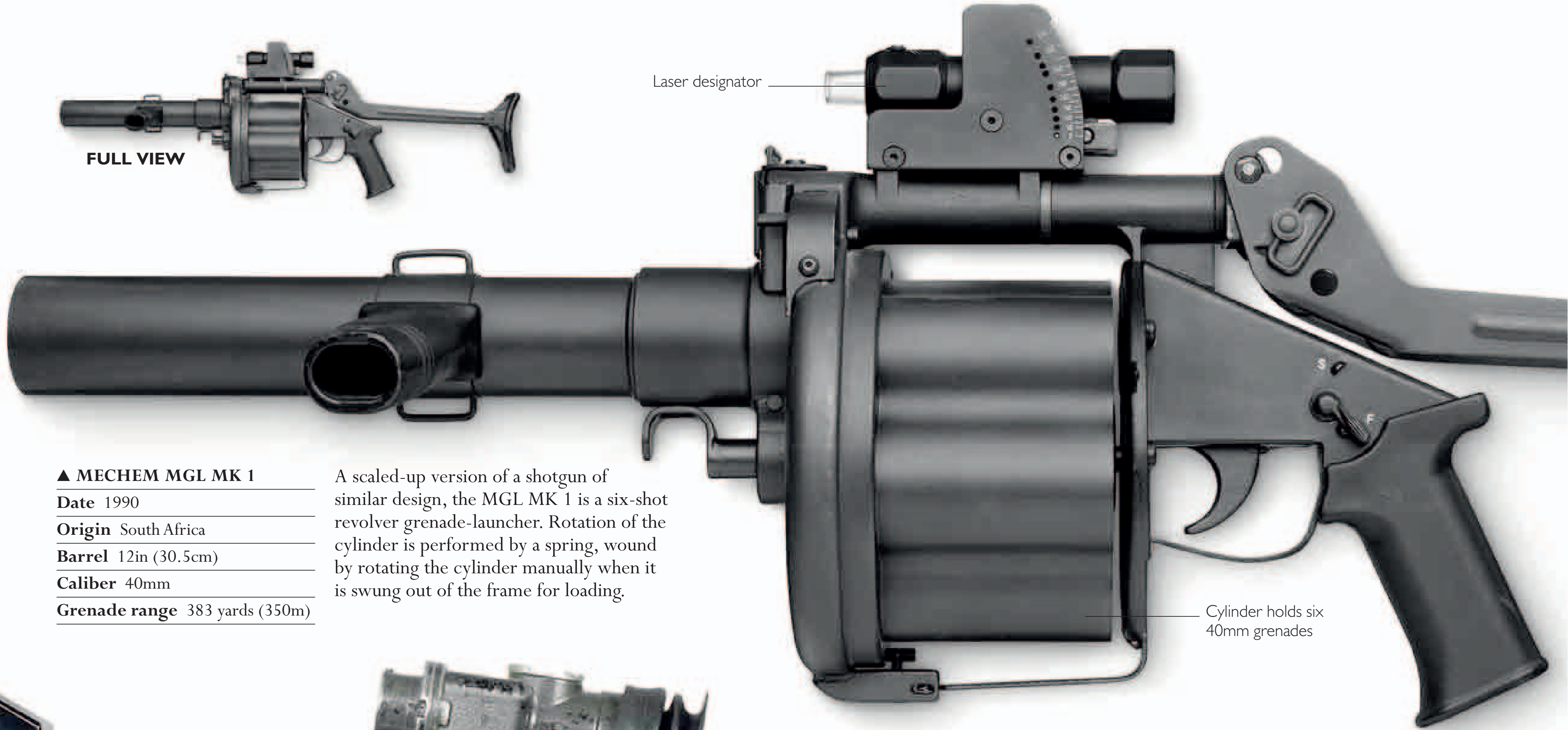


FULL VIEW

▼ RPG-7V	
Date	1961
Origin	Soviet Union
Barrel	37½in (95cm)
Caliber	40mm
Grenade range	547 yards (500m)

The RPG-7V can be used with a variety of grenades, including antipersonnel, fuel-air explosive, and high-explosive antitank ones. Regardless of the grenade type, the projectiles have two propelling charges, one for launching and the other for flight.

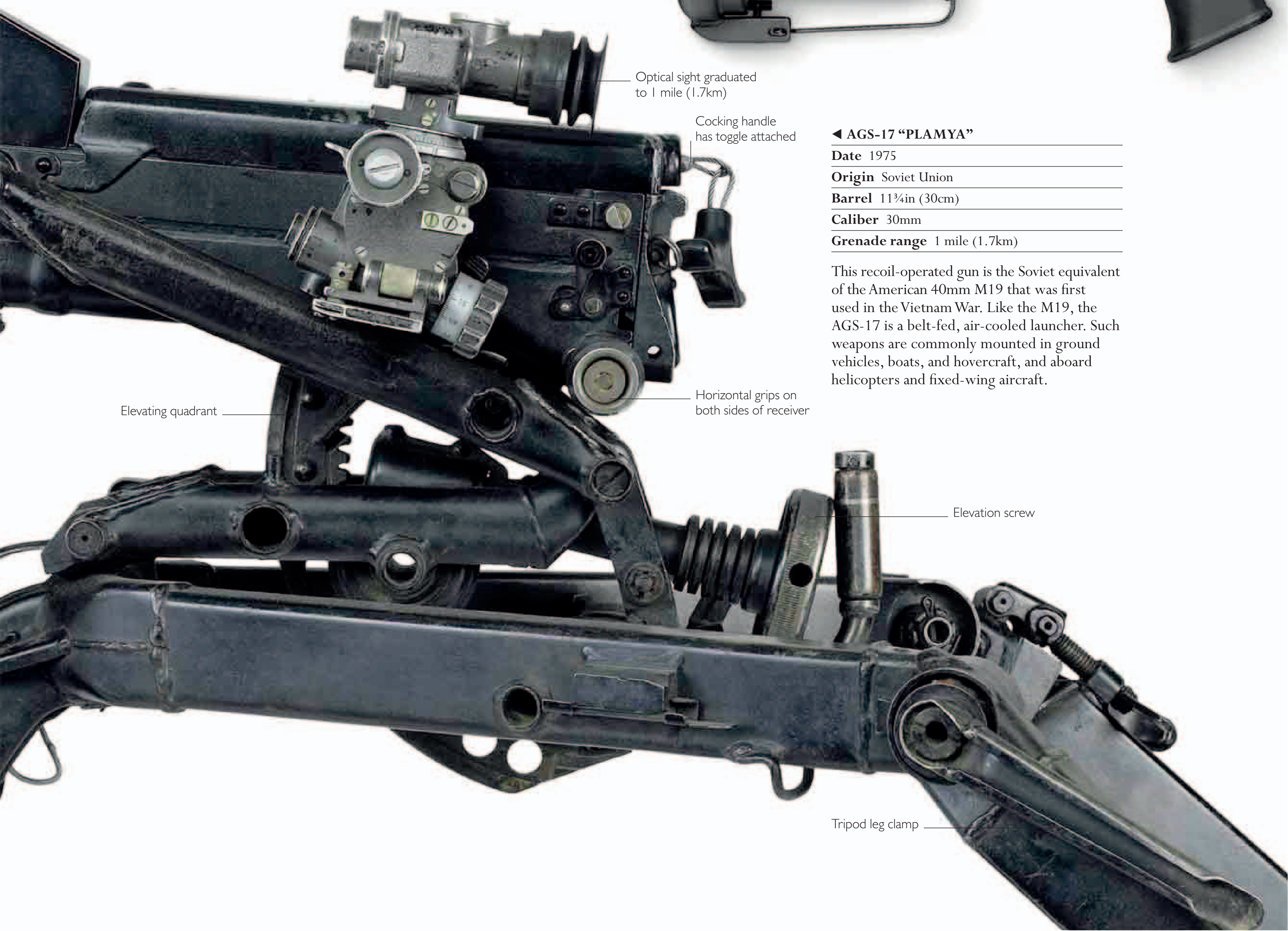




▲ MECHEM MGL MK 1

Date 1990
Origin South Africa
Barrel 12in (30.5cm)
Caliber 40mm
Grenade range 383 yards (350m)

A scaled-up version of a shotgun of similar design, the MGL MK 1 is a six-shot revolver grenade-launcher. Rotation of the cylinder is performed by a spring, wound by rotating the cylinder manually when it is swung out of the frame for loading.



◀ AGS-17 "PLAMYA"

Date 1975
Origin Soviet Union
Barrel 11¾in (30cm)
Caliber 30mm
Grenade range 1 mile (1.7km)

This recoil-operated gun is the Soviet equivalent of the American 40mm M19 that was first used in the Vietnam War. Like the M19, the AGS-17 is a belt-fed, air-cooled launcher. Such weapons are commonly mounted in ground vehicles, boats, and hovercraft, and aboard helicopters and fixed-wing aircraft.

RECOIL-LESS ANTITANK WEAPONS

Antitank weapons have diversified since the World Wars. Developed in the 1930s, the recoil-less rifle has evolved into the towed and handheld types seen today. It is a lightweight artillery weapon that diverts the exhaust gases of the propellant backward to counteract the recoil of a gun. Gun carriages for it were designed to face forward, toward the barrel. The next major development after the recoil-less rifle has been the creation of portable guided missile systems in the latter half of the 20th century. These can be launched by a single operator, often firing from mounts in helicopters.

▼ MILAN ANTITANK MISSILE LAUNCHER

Date	1972
Origin	France, West Germany
Length	4ft (1.2m)
Caliber	125mm
Range	1¼ miles (1.95km)

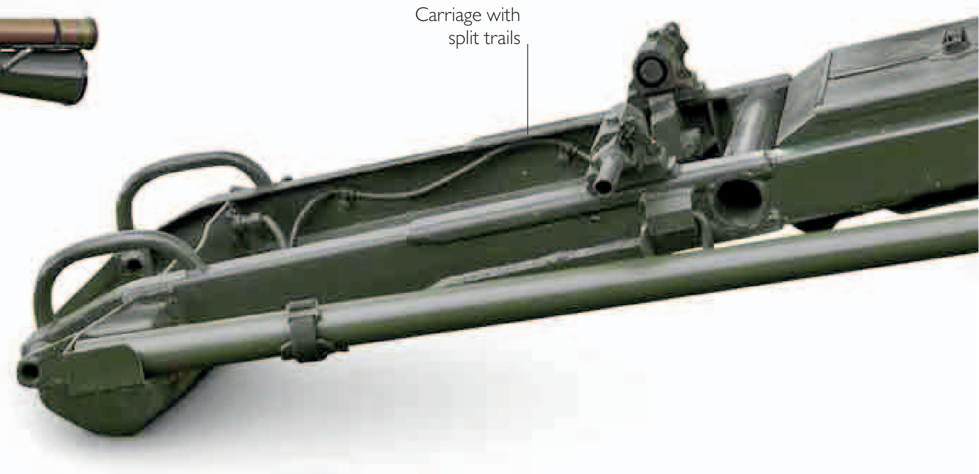
The *Missile d'Infanterie Léger Antichar*, or MILAN, is an antitank guided missile that is directed to its target via signals sent along wires that reel out behind it as it flies. Seen here is its launcher. Although many MILANs are vehicle-mounted, they can be deployed by a two-man infantry crew.

▲ L4 MOBAT

Date	1950s
Origin	UK
Length	8¾ft (2.7m)
Caliber	120mm
Range	½ mile (800m)

The 1950s saw the creation of the WOMBAT (Weapon of Magnesium Battalion, AntiTank), a British recoil-less rifle operated by a crew of three. The L6 WOMBAT's shield was removed to produce the L4 MOBAT (Mobile Battalion, AntiTank). This weapon was much lighter, and it was designed to be towed by a specially adapted Land Rover.

FULL VIEW



▶ CARL GUSTAV RECOIL-LESS RIFLE

Date	1946
Origin	Sweden
Length	3½ft (1.1m)
Caliber	84mm
Range	½ mile (700m)

The Carl Gustav is a man-portable multirole recoil-less rifle produced in Sweden by Saab Bofors Dynamics. It was first tested in 1946, and different versions have been adopted by armies all over the world. It is usually operated by a two-man crew, one for carrying the weapon and another for carrying high-explosive (HE) rounds.

HESH (HIGH-EXPLOSIVE SQUASH HEAD) ROUND

MODERN ARTILLERY (1946–PRESENT)

Since World War II, artillery in fixed positions has died out due to the threat of being destroyed from the air. Modern artillery is mobile—either towed, self-propelled, or even air-portable by helicopter, as in the case of the lightweight M777. Conventional artillery (that firing shells rather than rockets) includes howitzers and field guns. Towed artillery is generally 4.13–6.10in (105–155mm) in caliber and has become ever more precise in its targeting, using indirect fire—where the target cannot be seen—and benefitting from technologies such as the Global Positioning System (GPS). This is especially useful for longer guns, which can now achieve ranges of up to 30 miles (50km). Despite these advances, most artillery weapons used in conflicts today are designs that originated in the Soviet Union. Examples such as the D20 are simple, robust, and reliable.

▼ D20

Date 1950s

Origin Soviet Union

Length 28½ft (8.7m)

Caliber 152mm

Range 15 miles (24km) with rocket-assisted projectile

Soviet-made artillery is commonly used in conflicts around the world. The rugged D20 is a manually loaded towed howitzer. The gun's barrel is mounted on a cradle, which houses a recoil system. This includes a recuperator, which enables the gun's barrel to return to its firing position after recoil.

▼ M109 HOWITZER

Date 1963

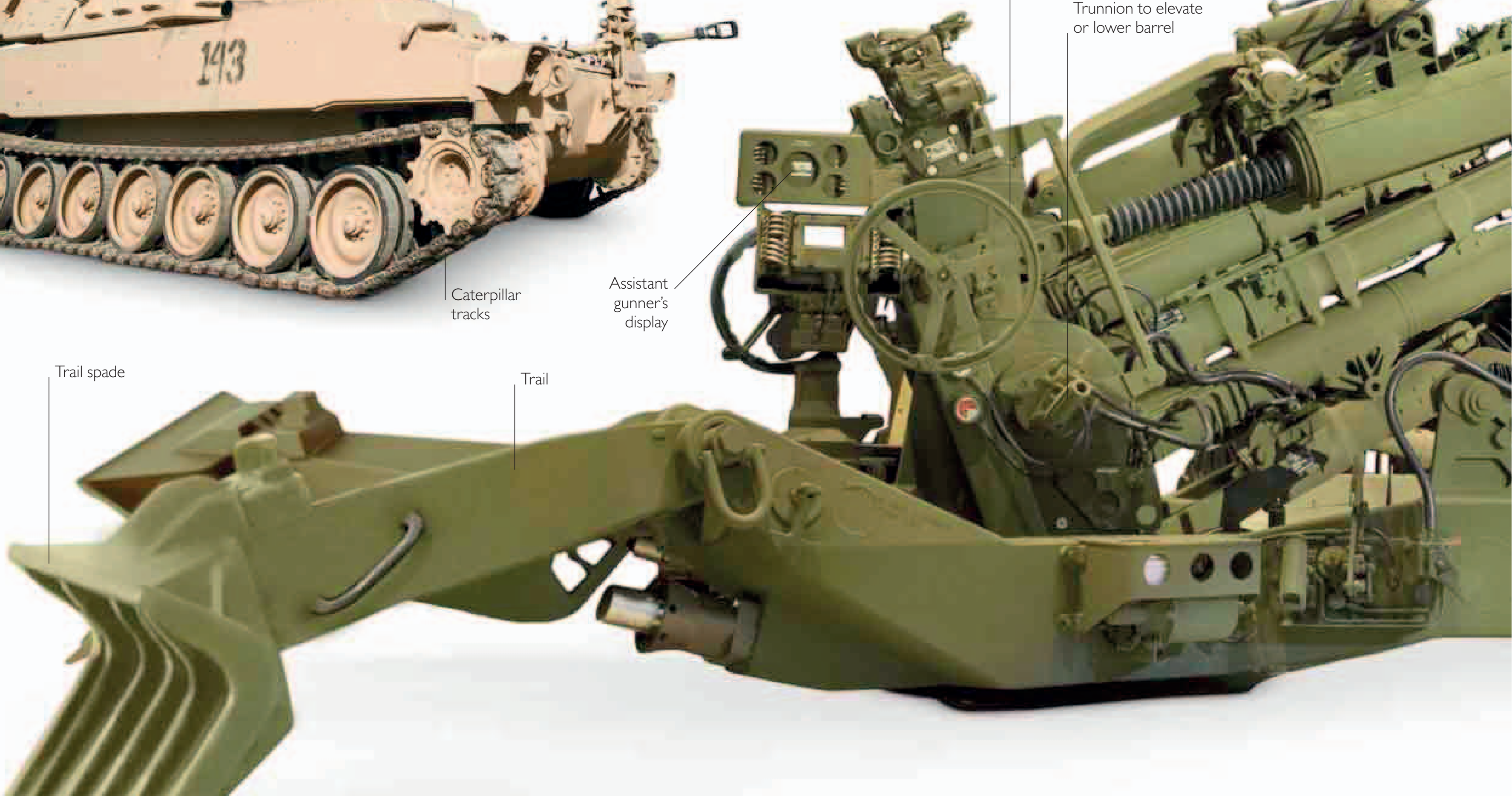
Origin US

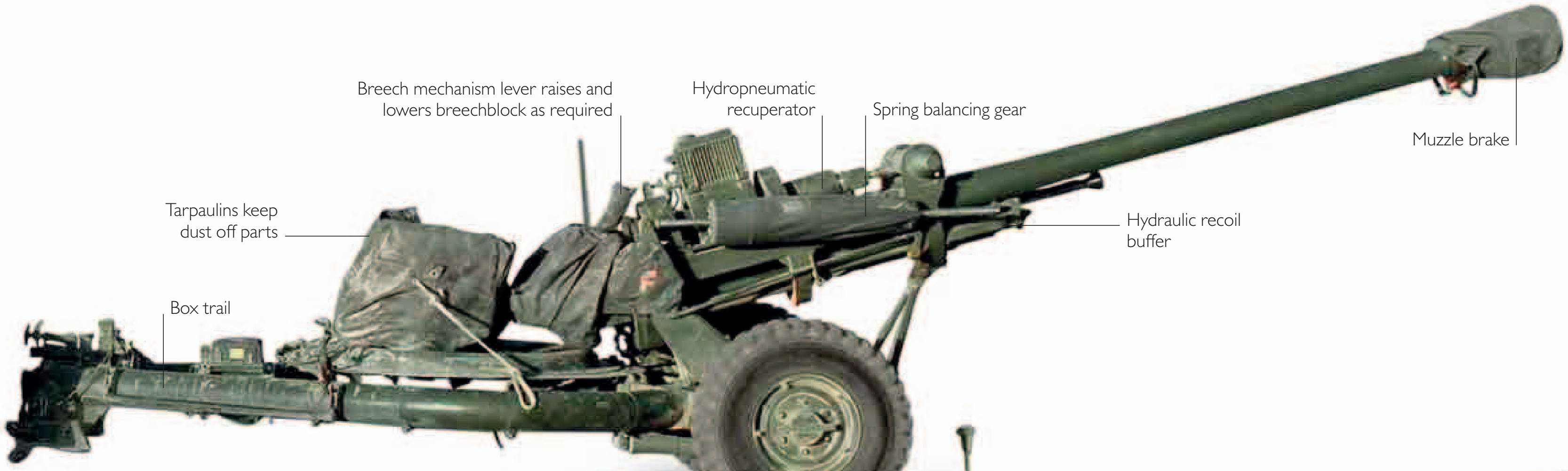
Length 29¾ft (9.1m)

Caliber 155mm

Range 18½ miles (30km) with rocket-assisted projectile

The term howiter is now used for a range of different artillery weapons. The M109 Howitzer is the main self-propelled howitzer of the US Army and is in use in many other countries. Self-propelled artillery can be activated more quickly in battle than towed artillery.

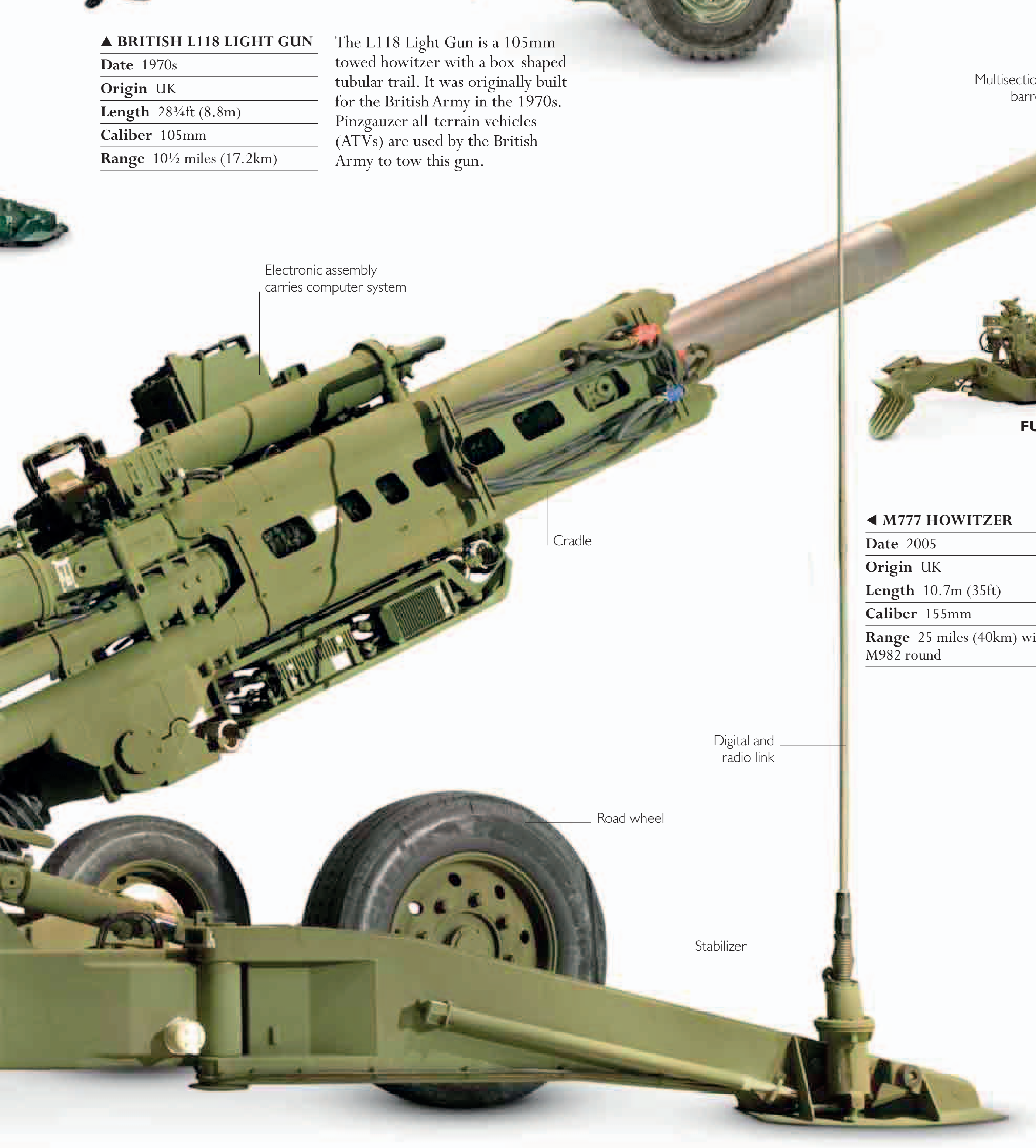




▲ BRITISH L118 LIGHT GUN

Date	1970s
Origin	UK
Length	28¾ft (8.8m)
Caliber	105mm
Range	10½ miles (17.2km)

The L118 Light Gun is a 105mm towed howitzer with a box-shaped tubular trail. It was originally built for the British Army in the 1970s. Pinzgauzer all-terrain vehicles (ATVs) are used by the British Army to tow this gun.




FULL VIEW

◄ M777 HOWITZER

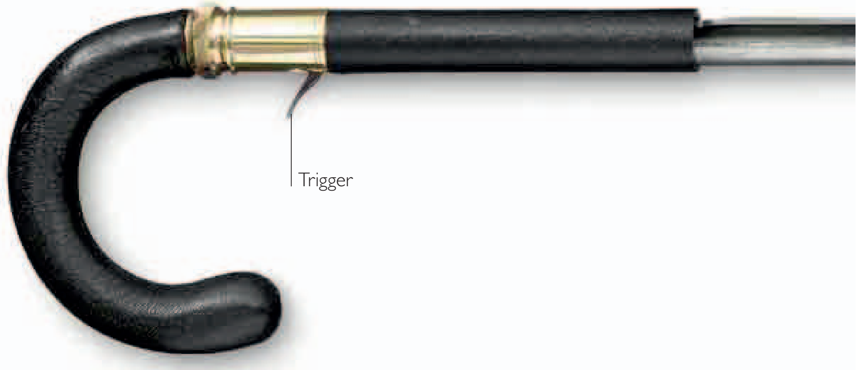
Date	2005
Origin	UK
Length	10.7m (35ft)
Caliber	155mm
Range	25 miles (40km) with M982 round

Developed by BAE Systems, the M777 Howitzer is a British gun that is used mainly by the US marine corps. It is the world's lightest 155mm howitzer and uses titanium parts. It is almost solely controlled by computers, which makes the gun extremely accurate due to its sophisticated aiming and positioning system.


PROJECTILE USED BY M777 HOWITZER

DISGUISED FIREARMS

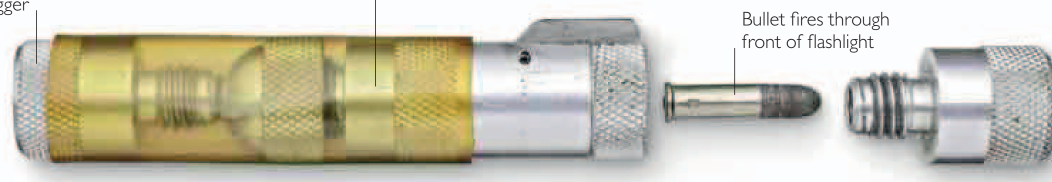
Since the 16th century, attempts have been made to disguise firearms as other objects (see pp. 222–23). Although early ignition systems (wheel-lock and flintlock) prevented any degree of effective disguise, the introduction of the self-contained metallic cartridge made it possible. As a result, from the mid-19th century onward, firearms have been made in the form of canes, umbrellas, pens, and so forth. These arms are effective only at close range, and civilian use of them is frowned upon by authorities because the weapons could be utilized for nefarious purposes, such as assassinations.



◄ CIGARETTE LIGHTER PISTOL

Date 1970s
Origin Not known
Barrel 1½in (4cm)
Caliber .22in

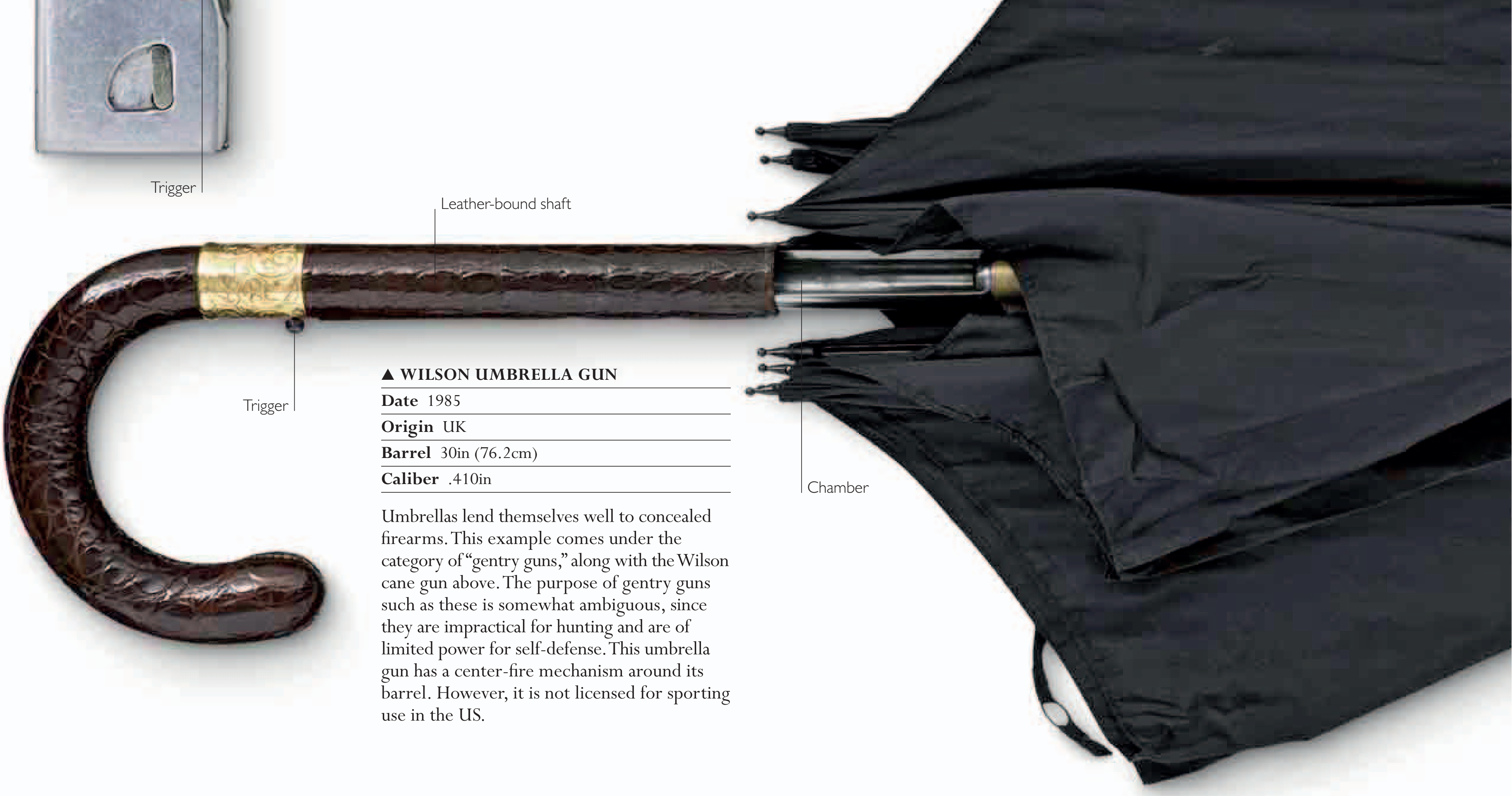
What appears to be a cigarette lighter actually contains a single-shot pistol. The trigger is of a clasp type and runs up the side of the "gun" body. It is not known which country produced this firearm, but it was made in the 1970s.



▲ FLASHLIGHT STINGER

Date 1980s
Origin US
Barrel 2in (5cm)
Caliber .22in

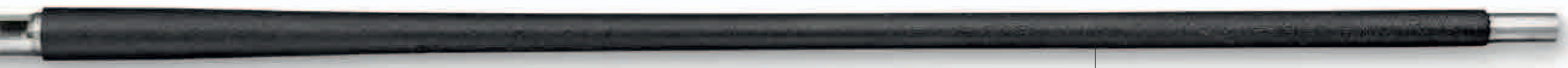
This covert weapon is disguised as a flashlight and actually contains a .22in single-shot firearm. The bullet is loaded behind the flashlight's bulb section and is fired by depressing the light switch.



▲ WILSON UMBRELLA GUN

Date 1985
Origin UK
Barrel 30in (76.2cm)
Caliber .410in

Umbrellas lend themselves well to concealed firearms. This example comes under the category of "gentry guns," along with the Wilson cane gun above. The purpose of gentry guns such as these is somewhat ambiguous, since they are impractical for hunting and are of limited power for self-defense. This umbrella gun has a center-fire mechanism around its barrel. However, it is not licensed for sporting use in the US.



▲ WILSON CANE GUN

Date 1984
Origin UK
Barrel Not known
Caliber .410in

This cane gun is a "gentry gun" produced by the same gunmaker who made the Wilson umbrella gun (below). With a caliber of .410in and a range of up to 25 yards (23m), it would have been suitable for poaching.

▲ PEN PISTOL

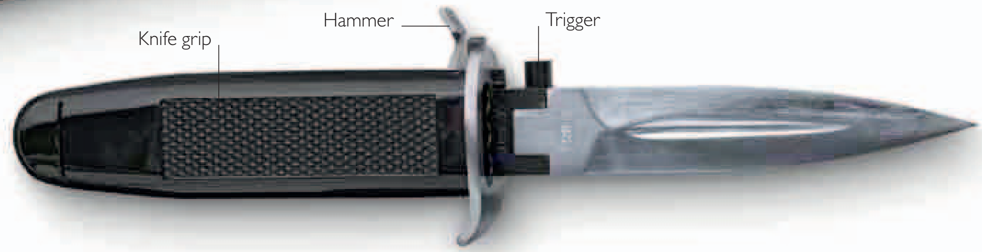
Date 1990s
Origin Lebanon
Barrel 2in (5cm)
Caliber .22in

This pen pistol is of extremely lightweight—2½oz (70g)—hence it uses the .22in cartridge. However, it would require careful handling if the pistol was not to endanger the user as well as the target.

◀ RING PISTOL

Date 1990s
Origin Switzerland
Barrel 1in (2.5cm)
Caliber .22in

This is possibly the ultimate concealed weapon. It has an overall length of only 1¾in (4.3cm) and the barrel is scarcely longer than the .22in cartridge that it fires. Penetration from such a gun would be a matter of an inch or two, so the firing range would need to be point-blank.



▲ KNIFE PISTOL

Date 2000s
Origin China
Barrel 1in (2.5cm)
Caliber .22in

This modern weapon originated in China in the 2000s, and would be intended for criminal or covert use. It features a folding knife integrated with a three-shot pistol firing .22in ammunition. The .22in round is ideal for small weapons such as this firearm, since it produces negligible recoil.

HOW GUNS WORK

BEFORE THE 19TH CENTURY

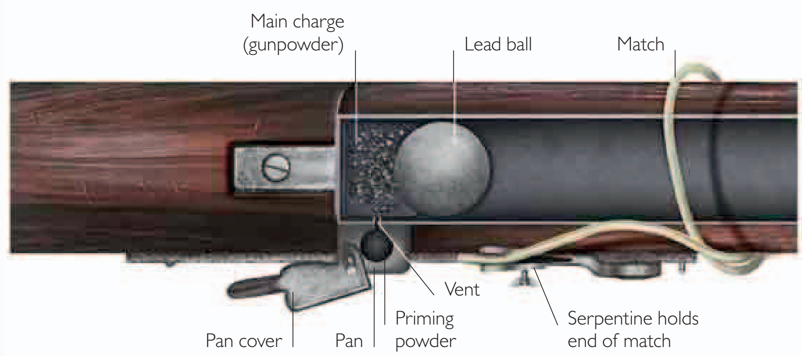
Early guns were tubes of bronze or iron, loaded at the muzzle with a propellant (main charge of gunpowder) and a projectile (ball of lead or stone). The barrel had a small hole—a vent, or touchhole—at the breech, into which a user placed priming powder (a small amount of gunpowder). Igniting this priming powder, usually with smoldering match-cord, caused flames to pass down the vent and fire the propellant in the barrel. The vents of later hand-cannon were on the right of the breech, with a shelf, or pan, for the priming powder. Next came devices that ignited the priming powder mechanically. These mechanisms were called locks, because their workings resembled the lock mechanism on a door or chest. The first was the matchlock.

▲ **FIRING ARTILLERY**
Until the 19th century almost all artillery was fired by match-cord, usually held at the end of a rod (linstock) to allow the gunner to stand away from the recoiling gun. In the late 19th century, gunners were able to fire instantly using "friction tube" primers—copper tubes containing fine gunpowder placed directly into the vent. It was operated by a lanyard, as seen here, which was a length of cord with a hook.

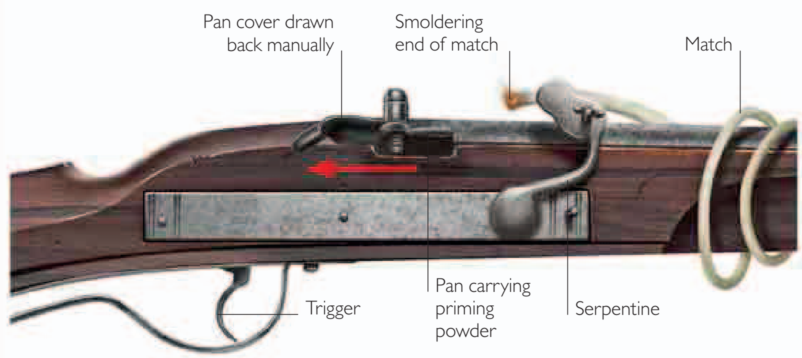
▲ **HAND-CANNON**
Hand-cannon were the earliest guns small enough to be carried and fired by one user. They had no mechanical firing mechanism—the user touched a smoldering match-cord on the vent manually.

Matchlock

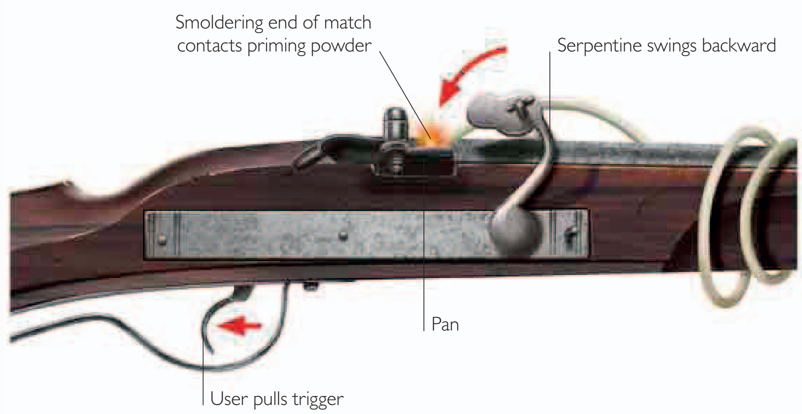
A user loaded a charge of gunpowder and a lead ball at the muzzle, then poured a small amount of finer-grained gunpowder into the priming pan, before closing the pan cover. He would then place a piece of match-cord, its end already smoldering, in the jaws of a snake-shaped match-holder called a serpentine. The user might test the position of the end of the match by gently squeezing the trigger to lower the serpentine, to make sure the match was positioned over the center of the closed pan.



OVERHEAD VIEW OF MATCHLOCK MECHANISM



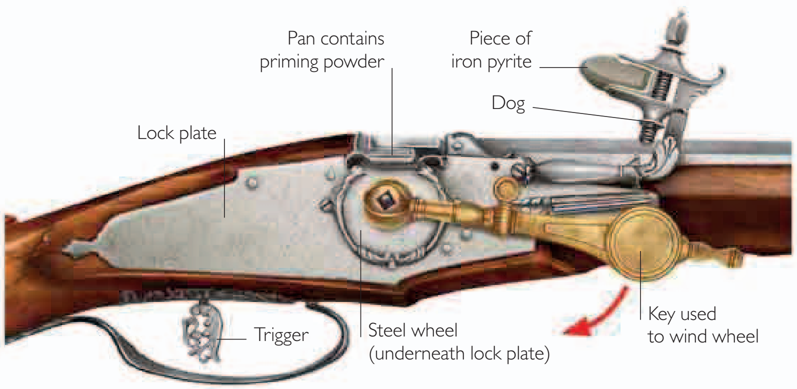
1 Before firing, the user readies the gun by blowing on the already-smoldering match to enliven it, and by moving the pan cover aside.



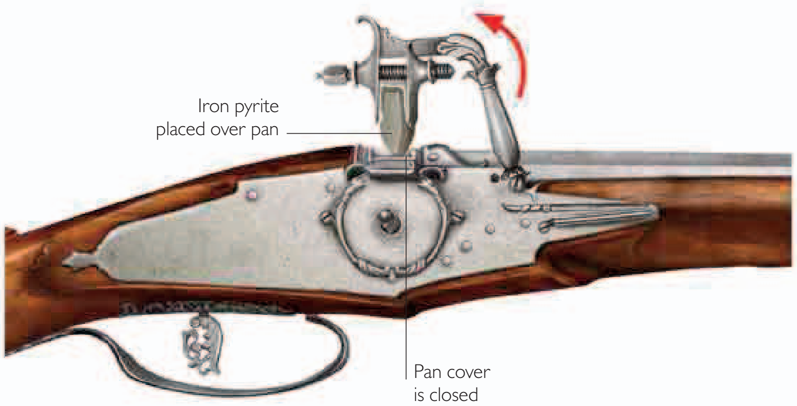
2 Pulling the trigger rotates the serpentine, plunging the burning match into the pan with the priming powder. This produces a flash that ignites the main charge via a vent in the side of the barrel.

Wheel-lock

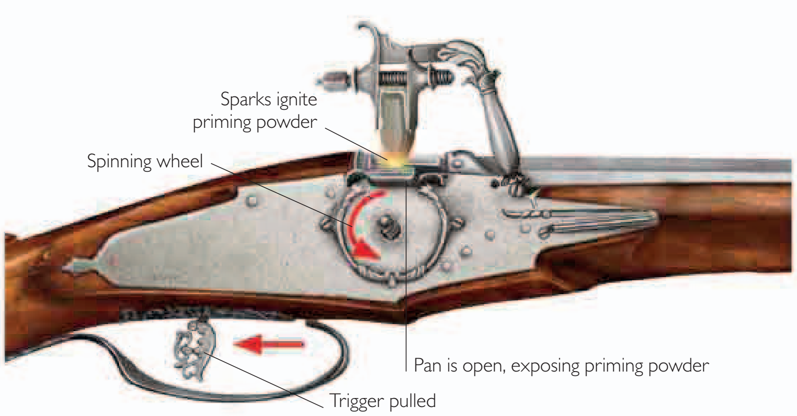
The wheel-lock used a rotating steel wheel to strike sparks from a piece of iron pyrite. After loading the barrel, the user rotated the wheel with a key about three-quarters of a turn, until it was held by the trigger mechanism. Then he placed the priming powder in the pan. The top of the wheel passed up through a slot in the bottom of the priming pan, so that sparks produced when the iron pyrite contacted the wheel fell into the priming powder.



1 A spring-loaded arm called a dog, retained in position by the dog spring, holds a piece of iron pyrite in its jaws. The user spans the lock—winding the steel wheel using a key, which compresses the mainspring (underneath lock plate).



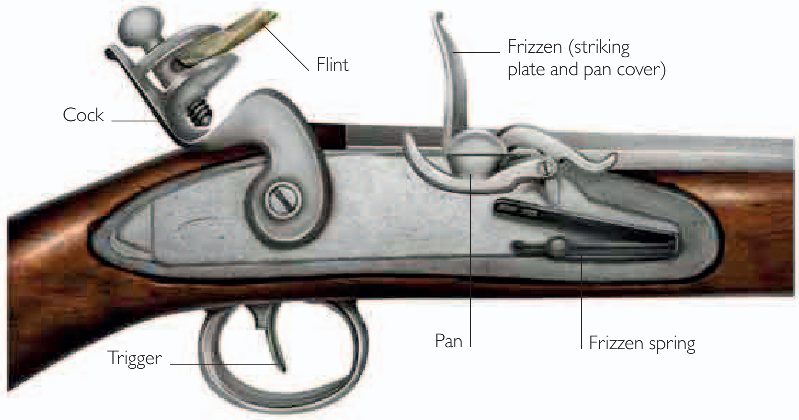
2 Before firing, the user moves the dog manually, placing it onto the pan cover, which is shut.



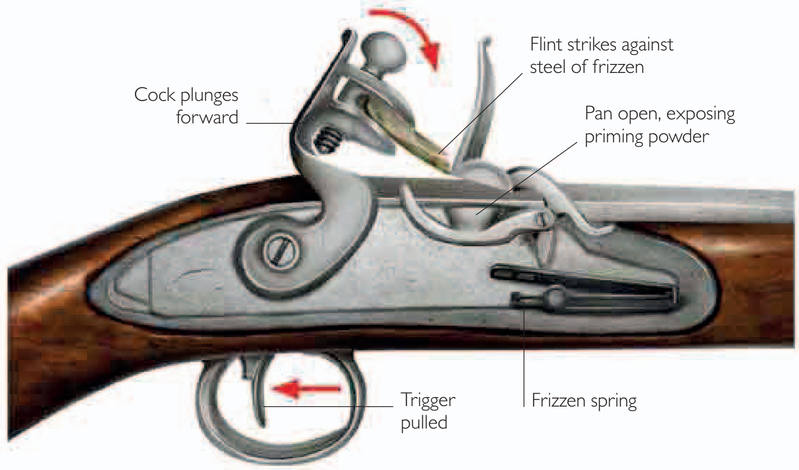
3 Pulling the trigger releases the wheel, which starts spinning. The pan cover opens automatically, bringing the iron pyrite into contact with the wheel. The friction creates sparks, which ignite the priming powder, causing a flash that ignites the main charge in the barrel.

Flintlock

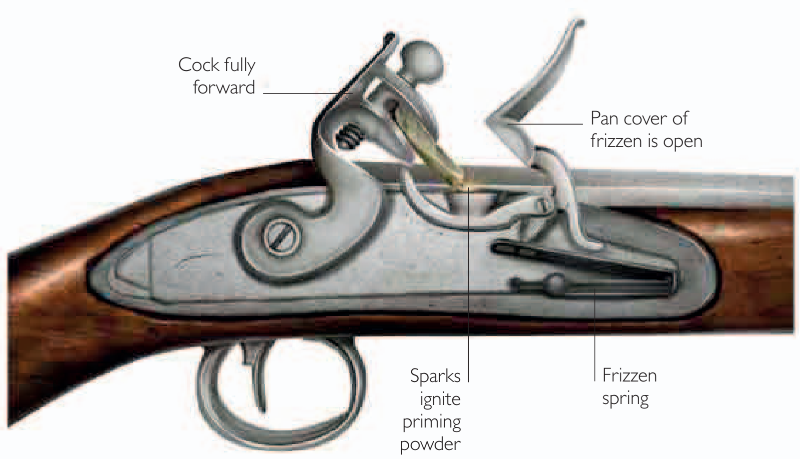
The flintlock had a simpler design than the wheel-lock. It used the impact of natural flint on hardened steel to strike sparks. The cock held a flint, which was propelled forward by a spring to strike a steel part called the frizzen, which was a combined striking plate and pan cover. The impact forced the steel back, opening the pan cover. Sparks fell into the priming powder to ignite it.



1 Before firing, the cock is held by a hooked part called a sear (inside the gun). A frizzen spring holds the frizzen closed over the pan.



2 Pulling the trigger retracts the sear, allowing the cock to spring forward to scrape the face of the steel. This impact forces the steel back, opening the attached pan cover and exposing the priming powder.



3 Sparks caused by the flint striking the steel fall into the pan to ignite the priming powder. This produces a flash that ignites the main charge in the barrel via a vent in the side of the barrel.

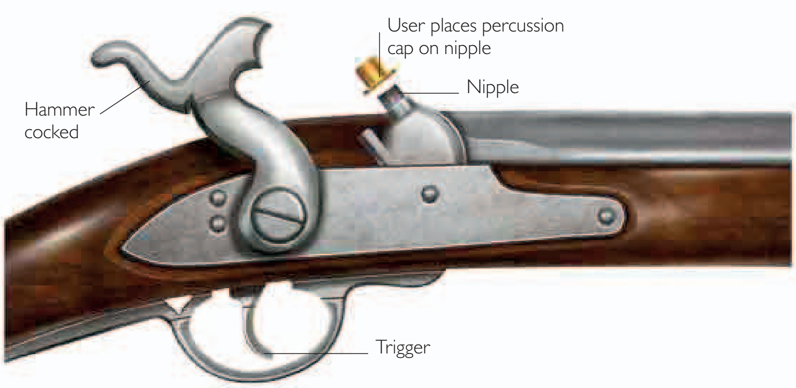
HOW GUNS WORK

FROM THE 19TH CENTURY

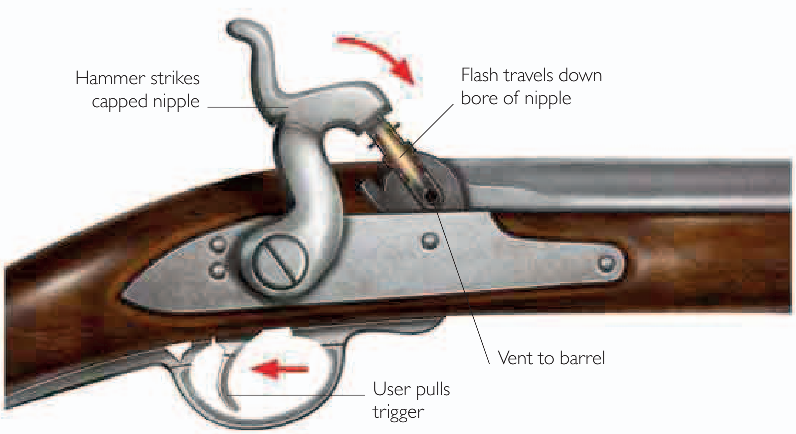
The invention of percussion caps provided firearms with an instantaneous method for the chemical ignition of the propellant (gunpowder). By the 1870s, these caps were contained within fully integrated metallic cartridges. These cartridges carried a projectile, propellant, and a primer in one compact package. Cartridges could be loaded quickly at the breech of the gun—with the cartridges being fed into the chamber by bolt action. Soon, cartridges were being fed repeatedly from magazines. The automation of this loading process, from magazines or belts, using a recoil-operated or a gas-operated action, led to semi-automatic (self-loading) and fully automatic weapons.

Percussion cap

A percussion cap is formed of two layers of copper foil with a mixture of fulminate of mercury, potassium chlorate, and sulfur or antimony between them. The composition catches fire when the hammer strikes it.



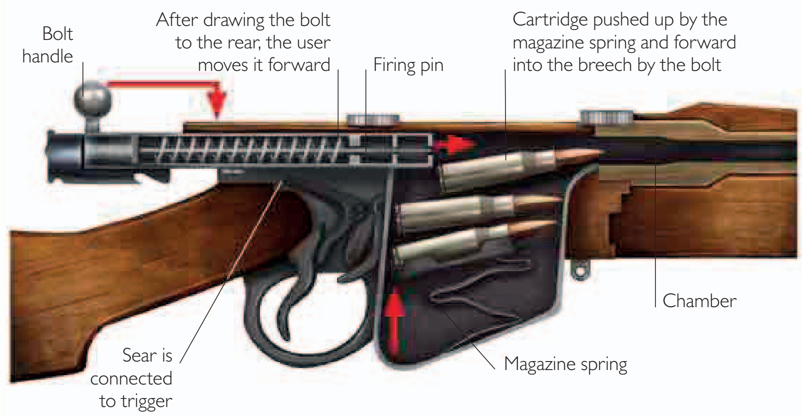
1 A sear (a hooklike part inside the gun) holds the hammer in the cocked position. The sear connects to the trigger. The user places the percussion cap on the nipple, the bore of which leads to the propellant in the barrel.



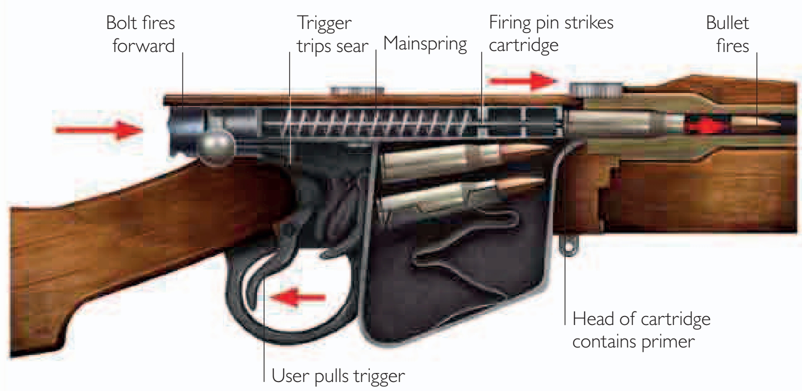
2 Pulling the trigger trips the sear, releasing the hammer and driving it onto the nipple. The primer in the cap ignites. The flame passes down the bore in the nipple and through a vent into the main charge in the barrel, igniting it.

Bolt action

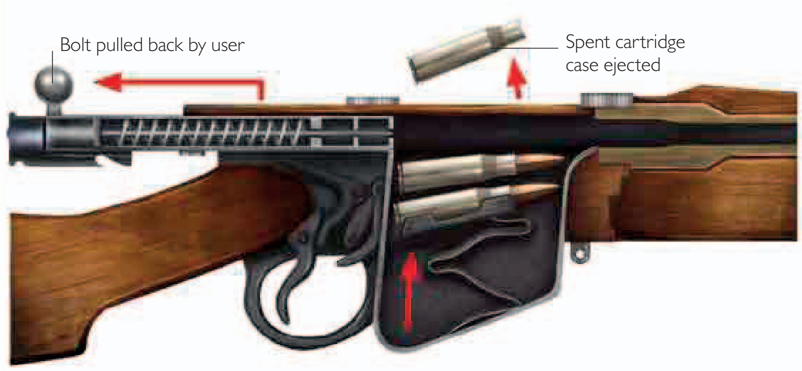
Bolt action, essentially based on the device that holds a garden gate closed, is a sure and effective design of breech-loading firearm. The mechanism was used with the first repeater rifles, which were the first guns with magazines. The magazines contained cartridges ready to be loaded and fired.



1 The user lifts the bolt handle, rotating the body of the bolt and freeing its locking lugs, and draws it fully to the rear. This opens the breech of the gun. As the user moves the bolt forward, it picks up a cartridge from the magazine and chambers it.



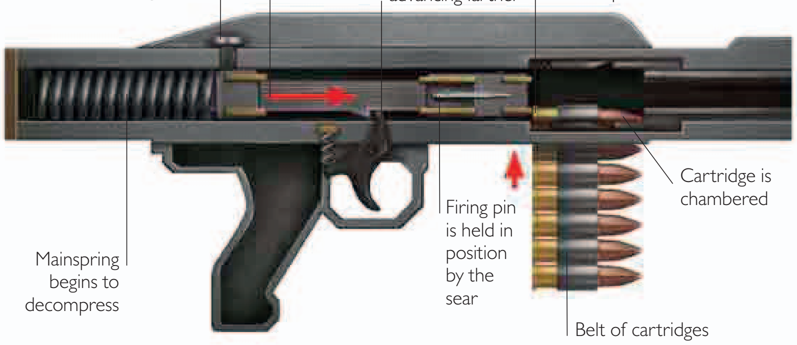
2 As the user returns the bolt handle to the closed position, seating the locking lugs and sealing the breech, the mainspring and firing pin are held back by the sear, which keeps the bolt cocked. Pulling the trigger trips the sear and releases the firing pin. As the mainspring decompresses, the pin flies forward and impacts the primer at the head of the cartridge, detonating it and firing the bullet.



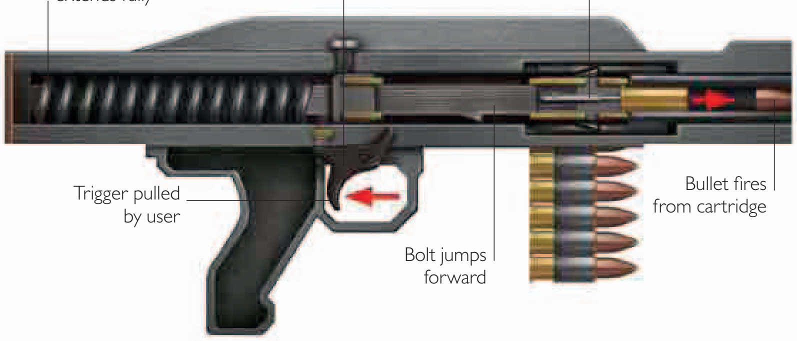
3 As the user withdraws the bolt, it extracts the spent cartridge case by means of a hook on the bolt head, which engages with the rim of the case. The recoil force generated pushes the bolt backward, compressing the mainspring, which then springs forward once more. The movement pushes up the next cartridge.

Recoil reloading

Every action, Isaac Newton's Third Law of Motion tells us, has an equal and opposite reaction. The action—ignition of the propellant—in a firearm—propels the bullet down the barrel and on toward its target. The reaction, known as the recoil, drives the gun into the shoulder or hand of the user. Recoil-operated action drives the auto-loading action of many semiautomatic pistols and automatic guns, such as machine-guns.



1 First, the user draws the cocking handle back against the mainspring, compressing it. As the mainspring rebounds, it pushes the bolt forward, stripping a cartridge from the magazine and chambering it. The sear is connected to the trigger and now holds the bolt and the firing pin in position.

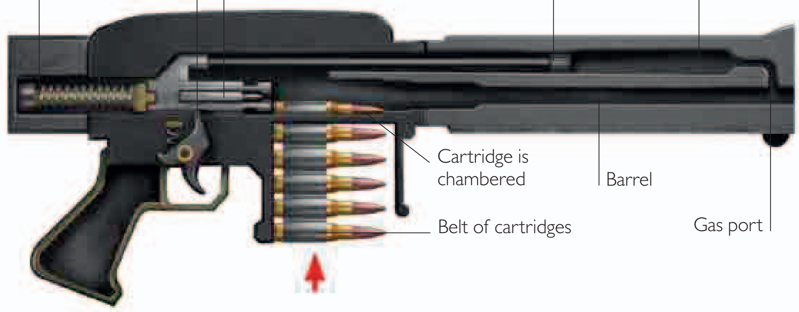


2 Pulling the trigger releases the sear. The mainspring extends fully, pushing the bolt fully forward and sending the firing pin flying toward the cartridge. The pin impacts the primer in the head of the cartridge and detonates it, igniting the propellant and firing the bullet.

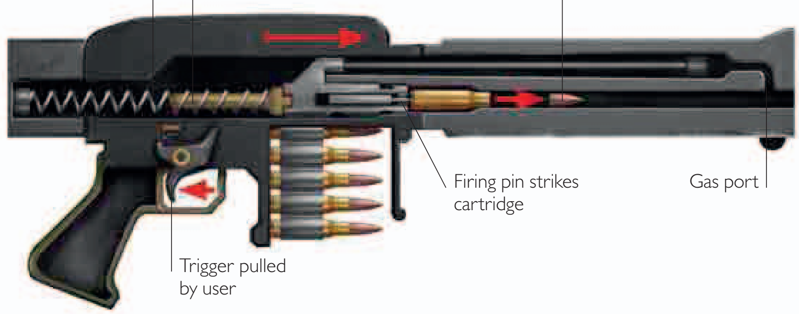
3 The recoil from firing the cartridge sends the bolt backwards, ejecting the empty cartridge case and allowing a new cartridge to enter the chamber. If the trigger remains depressed, the cycle continues.

Gas reloading

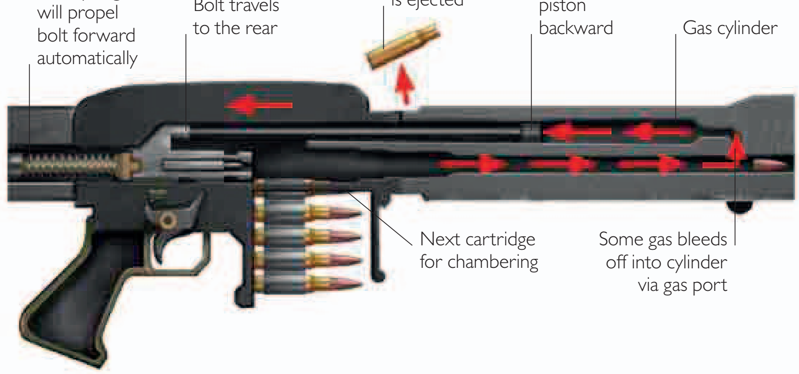
As an alternative to harnessing the force of the gun's recoil, it is possible to use some of the energy of the violently expanding gases that propel the bullet down the barrel. Some of that gas can be tapped off after the bullet has passed and employed to reload the gun by driving the breechblock or bolt to the rear. In automatic weapons, this action is cycled to produce continuous fire.



1 First, the user draws back the bolt against the mainspring. The mainspring pushes it forward again and as the bolt begins to advance, it strips a cartridge from the magazine and chambers it. The bolt is attached to a piston in a cylinder running parallel to the barrel. At the head of the cylinder is a gas port.



2 Pulling the trigger releases the sear. The mainspring extends, pushing the bolt forward. The firing pin impacts with the primer in the head of the cartridge, detonating it, igniting the propellant and firing the bullet.



3 As the bullet passes the gas port, some of the gas produced by burning the propellant bleeds through the port, forcing the piston backward. As the bolt travels to the rear, it ejects the spent cartridge case. The mainspring then extends, pushing the bolt ahead and chambering a new cartridge. If the trigger remains depressed, the cycle continues.

AMMUNITION BEFORE 1900

Smoothbore guns and rifles were loaded at the muzzle with lead balls and a separate propellant (gunpowder), ignited by fine gunpowder acting as primer. Guns became easier to load with the advent of the cartridge, a package carrying the lead ball and propellant. While early paper cartridges had to be torn open, later ones could be loaded whole. It was the unitary metallic cartridge (see pp.112–13), a combination of cartridge and primer in one case, that made breech-loading quick and simple.

The powder-and-ball era

To achieve any sort of accuracy, the ball fired from a smoothbore gun had to be spherical and of an exact size. Rifling improved matters, but made the weapon slow to load; the problem was solved by the expanding bullet (see pp.98–99).

MUSKET/RIFLE BALLS
The size of the ball was expressed in "bore," being the number of balls of that size that could be cast from 1lb (0.45kg) of lead.

BELTED BALL
Some balls, such as the Brunswick ball (see p.98), were belted to slide into the grooves in a gun's rifled barrel.

MINIÉ BULLETS
These bullets had a hollow base. The force of the propellant detonating caused the bullets' skirts to expand and grip the rifling.

GROOVED MINIÉ BULLET
Greased grooves in the bullet lubricated the barrel as the bullet gripped the rifling.

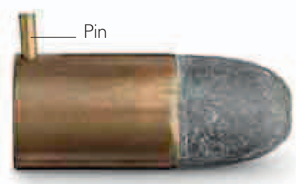
PERCUSSION CAPS
The percussion cap (see pp.80–81) provided an easier way to ignite the propellant by using a chemical primer. It was a thin, copper cap shaped to fit over a hollow plug attached to the breech of the gun. The chemical in it exploded when struck by the gun's hammer. Percussion caps could be used with powder and ball, as well as the earliest cartridges.

Early cartridges

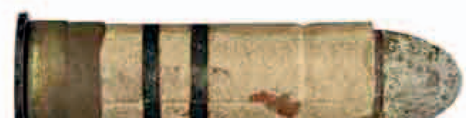
Early 19th-century cartridges carried a measured quantity of gunpowder and a bullet. Wrapped in paper, skin, or fabric, these cartridges posed a problem for breech-loading guns, whose breeches had to be sealed to prevent leakage of gases produced by the ignited propellant. To propel the bullet efficiently, a gas-tight seal was needed at the breech. The solution lay in the metallic cartridge, which was able to seal the breech perfectly. At the same time, metallic cartridges became "unitary" cartridges by integrating the primer, along with the propellant and projectile, within their metal shell. Metallic cartridges for rifled arms have longer ranges than those of handguns. They are usually longer than pistol cartridges, contain more propellant, and are designed for longer barrels, which allow bullets to be fully accelerated. This provides more velocity and energy to the bullet, increasing its range and penetration power.

PAPER CARTRIDGES
The first cartridges were nothing more than paper packages containing a measured charge of powder and a ball. They were used with both flintlock and percussion systems.

WESTLEY RICHARDS "MONKEY TAIL" CARTRIDGE
This paper-wrapped cartridge had a greased felt wad at the rear, which remained in the breech until pushed forward for removal before a new round was loaded. Doing so cleaned the bore and reduced fouling.



PIN-FIRE CARTRIDGE
Invented in the 1830s, the pin-fire was an early version of the unitary metallic cartridge. When the trigger was pulled, the gun's hammer fell on a pin projecting from the base of the cartridge. The force of impact drove the pin into the primer contained within the cartridge's base, igniting the primer and firing the gun.



SNIDER-ENFIELD BOXER CARTRIDGE
This was an early experiment at producing a center-fire cartridge, in the 1860s, with the primer at the center of the base. This cartridge for the Snider-Enfield rifle had a perforated iron base and walls built up from coiled brass foils.

.56IN-50 SPENCER (1860)
The rim-fire was another early type of metallic cartridge. This rim-fire round was fired by the first effective repeater rifle—the Spencer carbine—from the Civil War-era.

11MM CHASSEPOT (1871)
After the Franco-Prussian War (1870–71), the cartridge developed for the Mauser M71 rifle was adapted for the Chassepot rifle, which was converted to take it.

.30IN-30 WINCHESTER (1895)
This cartridge was the first "civilian" round to be charged with smokeless powder (see pp.142–43), a new propellant. It contained 30 grains (1.94g) of it.

.303IN MK V (1899)
The British Army's Lee-Metfords and Lee-Enfields were chambered for this blunt-nosed rifle bullet from 1899.

CARTRIDGE BOX FOR REPEATING RIFLES (1871)
Manufacturers of firearms preferred owners to use their own brand of ammunition. This pack of Winchester rifle cartridges is typical of the late 1800s.

BULLET BOX FOR MATCH RIFLES (1872)
To maintain consistent shooting, competitors in long-range "match" rifle-shooting contests demanded great precision in the manufacture of ammunition components. Swaged, or pressure-formed, bullets were individually weighed.

TOOLS

CASTING BULLETS
Until the sale of loose bullets became common, firearms were supplied with molds, with cavities into which molten lead was poured via channels. The metal solidified in the molds, producing ammunition of the correct size. Excess metal that solidified in the channels was termed sprue. Seen here are two molds. The upper mold has an automatic sprue cutter, which simply sliced off the sprue as the mold was opened. The lower mold has a more usual pivoting sprue cutter, which would cut off the sprue when knocked to one side.

RELOADING PRIMERS
This tool was used to remove fired primers—a special form of percussion cap—and install fresh ones in the heads of metallic center-fire cartridges.

Pistol cartridges

Pistols fire over a shorter range than rifles, and they use shorter cartridges that contain less powder and are less powerful. Shorter barrels mean a lower bullet velocity and lower penetrating power. Like rifle cartridges, they developed from rim-fire to the better center-fire design in the 1860s.

.44IN HENRY (1860)
This rim-fire round had primer arranged around the base of its case. It was soon superseded by the center-fire cartridge.

.44IN ALLEN AND WHEELOCK (1860s)
Allen and Wheelock revolvers were chambered for "lip-fire" cartridges (similar to rim-fire), chiefly in small calibers.

.45IN COLT (BÉNÉT 1865)
Colonel S V Bénét's 1865 version of the center-fire cartridge formed the basis for Berdan's popular center-fire metallic cartridge.

.45IN COLT (THUER 1868)
Alexander Thuer developed a method of converting Colt "cap-and-ball" revolvers to fire this tapering brass cartridge.

.44IN SMITH AND WESSON RUSSIAN (1870)
This center-fire cartridge was supplied to the Russian Army for Smith and Wesson revolvers.

.577IN WEBLEY (1880s)
Many small-caliber cartridges lacked the explosive power to stop a man. Webley addressed this with a .577in cartridge.

.476IN WEBLEY (1881)
The .577in revolver was unwieldy and a replacement in .476in caliber was adopted instead. It, too, was short-lived.

10.4MM BODEO (1889)
This revolver cartridge, used by the Italian Army from 1891, produced a muzzle velocity of 837ft (255m) per second—higher than most cartridges of the time.

.455IN WEBLEY (1891)
Webley's first smokeless-powder cartridge was more powerful than earlier types. As a lighter bullet with a more powerful charge, it could travel faster and inflict more damage.

7.63MM BERGMANN (1896)
The first cartridges made for the Bergmann No 3 pistol in 1896 were rimless and grooveless, with a sharp nose.

Shotgun cartridges

Only the very largest shotgun cartridges were made entirely of brass. Others had cardboard bodies.

10-BORE PIN-FIRE
Production of most pin-fire cartridges ceased in the 1860s. However those for shotguns, continued until the 1920s.

WILDFOWL CARTRIDGE
Large cartridges such as this were loaded with up to ¾oz (20g) of gunpowder and 3½oz (100g) of shot.

AMMUNITION AFTER 1900

Following the development of the unitary brass cartridge, which combined all three essential elements (primer, propellant, and projectile) in one package, it only remained for the nature of those elements to be improved. Primers became more effective and bullets became more aerodynamic and capable of accuracy at long ranges. However, the most important developments were in propellant. In the final decade of the 19th century, propellants evolved, with the advent of smokeless powder and later of a nitroglycerine-based mixture generally known as cordite. This replaced gunpowder entirely.

Rifle cartridges

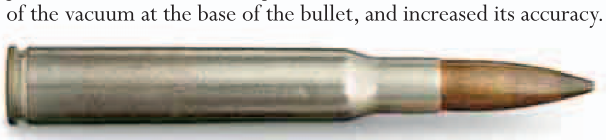
In the late 19th century, rifle bullets acquired a sharply pointed nose and a taper toward the tail. The shape minimized air resistance in flight, which almost doubled their effective range and improved their accuracy. In these examples, both velocity and energy are measured at the muzzle. The heavier the bullet and the higher its velocity, the greater is its energy.

8 × 58MM KRAG (1889)
This option for the Krag-Jørgensen rifle was adopted by the Danish Army. This 195-grain (12.7-g) bullet had a muzzle velocity of 2,525ft (770m) per second.

7.7 × 56MM JAPANESE (1889)
This fully rimmed cartridge—in which the rim was significantly wider than than the base of the cartridge—was used by the Arisaka rifle. It had a 175-grain (11.35g) bullet and a muzzle velocity of 2,350ft (716.3m) per second.

7.62 × 54MM RUSSIAN (1891)
This "3-line" cartridge was loaded with a 150-grain (9.65-g) bullet that left the muzzle at 2,855ft (870m) per second. The "line" is a caliber measure approximating one-tenth of an inch.

7.92 × 57MM MAUSER (1905)
Also called the SmK cartridge, this was loaded with a steel-jacketed 177-grain (11.5-g) bullet that left the muzzle at 2,745 ft (836.6m) per second. The boat-tail (tapered end) of the bullet reduced the size of the vacuum at the base of the bullet, and increased its accuracy.



.30IN-06 SPRINGFIELD (1906)
The .30in-06 remained in US service from 1906 until 1954. Its 152-grain (9.85-g) bullet left the muzzle at 2,910ft (887m) per second, with 2,820ft-lb (3,823J) of energy.

.470IN NITRO EXPRESS (1907)
"Nitro" refers to the propellant, while "Express" refers to the bullet, which was first produced in 1907. The bullet is hollow at the tip—on hitting the target, the bullet expands, reducing its penetration but increasing the tissue damage. Muzzle velocity of the bullet is 2,150ft (655.3m) per second, with 5,130ft-lb (6,955J) of energy.

7.7 × 56MM ITALIAN (1910)
The Italian 7.7mm cartridge had a 173-grain (11.25-g) bullet and a small charge with a muzzle velocity of 2,035ft (620.3m) per second.

.303IN MKVII (1910)
This version of the Lee-Enfield cartridge, with a 180-grain (11.66-g) bullet, had a muzzle velocity of 2,460ft (804.6m) per second and 2,420ft-lb (3,281J) of energy.

.50IN BROWNING /12.7MM M2 (1916/17)
Developed for the M2 machine-gun and adopted as a rifle round, this cartridge has a 710-grain (46-g) bullet and a muzzle velocity of 2,800ft (853.4m) per second.

.22IN HORNET (1920s)
One of very few high-velocity miniature rounds, the .22in Hornet was developed in the 1920s. Its 45-grain (2.9-g) bullet leaves the muzzle at 2,690ft (820m) per second.

7.92 × 33MM KURTZ (1938)
This was the first effective intermediate cartridge—less powerful than a typical battle rifle cartridge, such as the 7.62 × 54mm Russian, but significantly more powerful than pistol cartridges. It was developed in Nazi Germany and was copied by the Soviet Union in slightly smaller dimensions. It had a range of around 1,950ft (595m).

.257IN WEATHERBY MAGNUM (1944)
This is loaded with an 87-grain (5.31-g) "varmint" bullet—for rifles used to shoot small mammals, such as rodents. The cartridge achieves a muzzle velocity of 3,825ft (1165.8m) per second and delivers 2,826ft-lb (3,832J) of energy.

.30IN M1 CARBINE (1940)
This intermediate round developed for the American World War II-vintage M1 Carbine is loaded with a 110-grain (7.13-g) blunt-nosed bullet, effective at up to 600ft (180m).

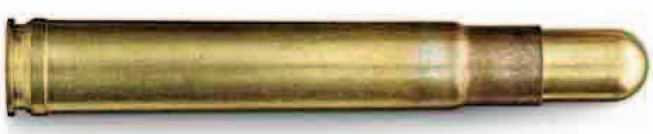
7.62 × 51MM NATO (1954)
When NATO chose a new rifle and machine-gun cartridge in the early 1950s, it opted for one based on the .30in-06.

.458IN WINCHESTER MAGNUM (1956)
Developed in 1956 as a "big game" round, with a 500-grain (32.4-g) bullet, it has a muzzle velocity of 2,040ft (621.8m) per second and 4,620ft-lb (6,264J) of energy.

.338IN WINCHESTER MAGNUM (1958)
First produced in 1958, this cartridge was developed for large North American game. It can be loaded with a variety of bullets, from 175 to 300 grains (11.34g to 19.44g) in weight.

SS109 5.56MM (1962)
The NATO-standard SS109 5.56mm round has a steel-tipped projectile, which allows it to penetrate steel effectively. The cartridge weighs 61.7 grains (4g) and achieves a muzzle velocity of 3,085ft (940.3m) per second.

7MM REMINGTON MAGNUM (1962)
Loaded with 62 grains (4,02g) of propellant and a 150-grain (9.72-g) spitzer bullet, this produces a muzzle velocity of 3,100ft (944.8m) per second and 3,220ft-lb (4,365J) of energy.



.416IN REMINGTON MAGNUM (1988)
A development of a cartridge produced by John Rigby and Company in 1911, the .416in Remington produces a muzzle velocity of 2,400ft (731.5m) per second and 5,115ft-lb (6,935J) of energy.

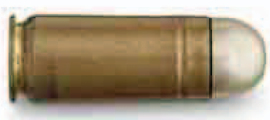
.243IN WINCHESTER MAGNUM (2003)
This short-case round delivers less power than a normal cartridge: a 100-grain (6.48-g) bullet leaves the muzzle at 2,960ft (902.2m) per second with 1,945ft-lb (2,637J) of energy.

Pistol cartridges

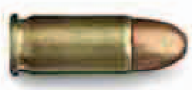
The only significant change in the character of pistol ammunition after 1900 was the introduction of the high-performance Magnum load.

.38IN S&W (1877)
This is the least powerful .38in cartridge. It gives the 145-grain (9.4-g) bullet a muzzle velocity of 685ft (208.7m) per second and 150ft-lb (203J) of energy.

.32IN LONG (1896)
Though a popular caliber for revolvers, the original .32in cartridge was low on power. A longer version was produced in 1896.



.45IN MARS (1899)
This was the most powerful pistol ammunition in the world prior to the arrival of the .44in Magnum. The bullet had a muzzle velocity of 1,200ft (370m) per second and 700ft-lb (950J) of energy.



.32IN AUTO (1899)
A popular caliber for small self-loading pistols, the .32in has a 60-grain (3.89-g) bullet and produces 125ft-lb (169J) of energy.

9MM MARS (1899)
Severely bottlenecked cartridges (with necks narrower than the rest of the case) are unusual in pistols, but the designer insisted on a heavy propellant load for the 9mm Mars.

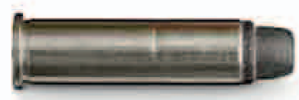
.380IN ENFIELD/WEBLEY (1900)
Made for the Enfield Mk 1 revolver, the 200-grain (12.96-g) bullet was almost as powerful as the .455in it replaced.

9MM PARABELLUM (1901)
Also known as 9mm Luger, this is the most common cartridge in the world. Countless firearms have been chambered for it.

8MM NAMBU (1902)
The Japanese officer's pistols issued from 1909 onward were the only weapons ever made for this powerful round.

.45IN ACP (1904)
An iconic pistol cartridge, the .45in Automatic Colt Pistol round was developed for the John Browning-designed Colt M1911.

9MM STEYR (1911)
There are many varieties of 9mm revolver cartridge. This one was developed for a pistol designed by Mannlicher.



.357IN MAGNUM (1935)
Developed by Smith and Wesson and Winchester, this cartridge has been produced in many varieties. Average muzzle velocity is around 1,300ft (396.2m) per second.

.44IN MAGNUM (1954)
This round was originally developed for revolvers, but later adopted for rifles and carbines as well. A 240-grain (15.55-g) bullet leaves the muzzle at 1,500ft (457.2m) per second with 1,200ft-lb (1,627J) of energy.

.50IN ACTION EXPRESS (1988)
Developed for the Desert Eagle pistol, its 325-grain (21-g) bullet leaves the muzzle with 1,415ft-lb (1,918J) of energy.

GLOSSARY

Action
The mechanism of a gun involving the loading and firing of a cartridge and the ejection of the spent cartridge.

Artillery
Guns that are too big and heavy to be fired by hand, including cannon, and also smaller weapons, such as swivel guns.

Assault rifle
A short-barreled, easily portable rifle capable of selective fire—semiautomatic or automatic fire—and utilizing a high-capacity magazine with medium- and small-caliber cartridges with short cases.

Automatic
Describes a firearm that will load and fire continually while the trigger is kept pulled.

Barrel shroud
A covering attached to the barrel of a firearm that insulates the user's hands from the hot barrel.

Battery
A group of artillery weapons—usually four to eight.

Bayonet
A blade designed to fit into, over, under, or around the muzzle end of a firearm, enabling it to be used as a close-combat weapon.

Blowback
A type of firearm operation in which the loading cycle is driven by the motion of the spent cartridge case as it is pushed backward by the exploding gases, which are produced by the ignition of the propellant.

Blunderbuss
A muzzle-loading firearm with a short barrel and a flared muzzle.

Bolt
In bolt-action weapons, the rod-shaped part that closes and seals the breech. It loads and extracts cartridges and carries the firing pin. It is also present in recoil- and gas-operated self-loading weapons.

Bolt action
A mechanism for loading a firearm at its breech. In guns featuring this action, the bolt is manually moved using a small handle. The breech opens, and the spent cartridge case is ejected while a fresh round is chambered.

Bore
The internal diameter of a gun's barrel.

Box-lock
A variant of the flintlock mechanism in which the cock was placed centrally inside the pistol. In later firearms, the term is used to describe a firing mechanism enclosed within a box-shaped housing in the breech.

Break-open
An action in which the barrel hinges downward before the trigger guard for loading at the breech of the firearm.

Breech
The rear part of the bore of a firearm or artillery piece.

Breechblock
An iron or steel component that slides or hinges to expose the breech of a barrel to allow reloading, and against which the cartridge rests while being fired.

Breech-loader
A firearm in which the propellant and projectile are loaded at the breech of the barrel.

Bridle
A piece of metal projecting from the pan of a flintlock to support the head of the frizzen's pivot screw; also, a bridging piece inside a gunlock to stabilize the inner end of the axle of the tumbler (part of the sear mechanism).

Bullpup
A type of rifle configuration in which the firing mechanism is set in the butt, allowing for a normal-length barrel in a relatively short weapon. It also allows the magazine to be housed behind the trigger.

Butt
The part of a long gun held to the shoulder or the part of a pistol held in the hand.

Caliber
The internal diameter of a weapon's barrel; also used to describe specific cartridge types.

Carbine
A short-barreled rifle or musket. Among muzzle-loading firearms, a carbine was often of lighter caliber than a long musket.

Cartridge
A wrapping of paper containing a measured charge of gunpowder and a ball or bullet (in muzzle-loading firearms); a tube, usually metallic, containing propellant, primer, and projectile (in breech-loading guns).

Center-fire
Describes a self-contained cartridge carrying the chemical primer in the center of its head. It is the most modern form of metallic cartridge.

Chamber
The part of a firearm from which the projectile is fired.

Cleaning rod
A metal device used to clean residue in the barrel.

Cock
The clamp that holds the flint in a flintlock gun; the act of pulling back a hammer, bolt, or cocking handle to ready a gun for firing.

Cycle
The series of operations necessary to fire a round and return the gun to its firing position.

Cyclic rate
An estimated rate of fire of an automatic weapon.

Cylinder
The part of a revolver that holds cartridges in separate chambers usually placed parallel to a central axis.

Discharger cup
A cup fixed to the end of a musket or rifle to accept grenades or missiles for firing.

Dog
The spring-loaded arm that holds the iron pyrite in a wheel-lock gun.

Double-action
An action type, typical of a revolver, in which the hammer can be cocked either automatically by pulling the trigger, or manually.

Extractor
The moving part of a firearm that removes spent cartridge cases from the chamber after firing.

Field gun
A portable artillery piece that was towed alongside infantry and cavalry on the battlefield. In the 18th and 19th centuries, it fired solid shot, explosive shells, and canister shot (shot made of smaller balls). Modern field guns fire shells.

Firing pin
A thin rod that strikes the primer of a center-fire cartridge when the trigger is pulled. It can be moved by an external hammer on the gun or, in firearms with bolts, positioned at the end of the bolt.

Flash hider
A device that conceals the flash of burning gases exiting the muzzle on firing a gun.

Flint
A piece of stone with a sharp edge that is capable of producing sparks when that edge is struck against hardened steel.

Flintlock
A firing mechanism in which a flint strikes a hardened steel surface, creating sparks that ignite the priming powder.

Forestock
The part of the stock of a firearm under the barrel and forward of the trigger guard.

Frizzen
In the flintlock mechanism, a curved metal plate, formed by the union of the pan cover and striking steel that is usually hinged and struck by a flint.

Fulminate
A detonating chemical used as a primer to ignite the main powder charge in the case of percussion locks and all subsequent types of firing mechanism.

Gas operation
A type of autoloading action in which the loading cycle is driven by the gases produced by igniting the propellant.

General-purpose machine-gun (GPMG)
A multipurpose machine-gun that works either as a light or a medium machine-gun and is mounted on a bipod or tripod.

Grenade
A small bomb that can be fired by grenade-launchers and also by some rifles. In the case of rifles, the grenade is mounted on the muzzle and propelled by firing a blank cartridge down the barrel.

Gunlock
The firing mechanism on a small arm.

Gunpowder
A mixture of saltpetre, charcoal, and sulfur. Until the 1880s, the sole propellant used in small arms and artillery.

Halberd
A weapon with a short, wide, axlike blade, a spearpoint, and a back pike for penetrating armor.

Hammer
An externally-mounted spring-driven part that is cocked by hand. When released by the trigger, it struck the cap on the nipple of a percussion firearm, or the cartridges of revolvers and earlier kinds of breech-loading sporting guns and rifles.

Hand-cannon
A small, crude, cannonlike firearm dating from the early 15th century. It was equipped with a wooden tiller to direct it.

Harquebus
A man-portable firearm that evolved from the hand-cannon. It was equipped with a wooden stock to rest it against the user's shoulder, arm, or chest, and was originally fired by a handheld match-cord.

Heavy machine-gun
A machine-gun chambered for a round of larger-than-rifle caliber, usually 12.7mm. It was usually fired from a fixed mount.

Hinged frame
A pistol in which the barrel can be hinged down to expose the chamber.

Hold-open device
A catch that holds back a long gun's bolt if there is no cartridge to be chambered; it also holds the slide of a self-loading pistol back so that the weapon may be dismantled.

Howitzer
A high-angle, long-range artillery piece, fitted with a shorter barrel than a field gun, used for destroying fortifications and trench systems. After World War I, howitzers come to include longer-barreled weapons.

Hydropneumatic recoil
A type of recuperator mechanism for artillery. Metal tubes below the barrel were partially filled with liquid. As the barrel recoiled on firing, the liquid was forced back in the tubes, compressing the air, which acted as a natural spring to return the barrel to its rest position.

Iron pyrite
A natural mineral that was used to produce sparks for igniting the priming powder in the wheel-lock mechanism.

Lanyard ring
A ring on the butt of a pistol or revolver by which the user can attach the weapon to his body using a cord or strap.

Lever action
A mechanism for loading a gun at its breech. The lever is used to open the breech chamber.

Light machine-gun (LMG)
A machine-gun chambered for rifle-caliber ammunition, but not capable of sustained fire.

Lock plate
An iron or steel plate around which a gun's lock mechanism is built; the main part of many forms of gunlock.

Machine-gun
A fully automatic weapon intended for sustained fire from an ammunition belt or magazine.

Mainspring
The principal spring of a gunlock mechanism. In early gunlocks, it powered the wheel or cock, and in later mechanisms, the hammer, striker, or firing pin.

Magazine
A storage device, detachable or integral, in a gun for holding and feeding the ammunition. Forms include box, drum, or tube.

Magnum
A long version of a standard cartridge. Its increased length helps to accommodate more powder for higher velocity, power, and range.

Matchlock
A firing mechanism incorporating a match-cord (or "slow-match") that ignites the priming powder when the trigger is pulled.

Match-cord
A hemp cord which was used to ignite gunpowder in early firearms.

Medium machine-gun
A machine-gun chambered for rifle-caliber ammunition and capable of sustained fire.

Metallic cartridge
A cartridge with a metallic case. Most are self-contained—propellant, projectile (bullet), and chemical primer are held within the case.

Miquelet
A type of flintlock mechanism—prevalent in the Mediterranean between the late-16th and mid-19th centuries—in which the mainspring is on the outside of the gun.

Mortar
A short-barreled, muzzle-loading artillery piece that fires projectiles at high angles. Mortars have evolved from weapons firing solid projectiles of stone to those firing special self-propelled explosive projectiles.

Musket
A smoothbore, muzzle-loading long arm that fires a spherical lead ball; the standard military weapon carried by infantry from the 16th to the mid-19th century.

Muzzle brake
A device that reduces the muzzle's tendency to lift or swing. Also known as a compensator.

Muzzle-loader
A firearm in which the propellant and projectile are loaded from the gun's muzzle.

Nipple
A small tube screwed into the breech of a percussion firearm's barrel. It was hollow and allowed the burning gases from the primer to reach the breech.

Open frame
A revolver design in which the cylinder is not contained by a top-strap of metal and can be removed easily for cleaning.

Pan
The receptacle for holding the priming powder of either a matchlock, wheel-lock, or flintlock gun.

Parabellum
The 9 × 19mm cartridge developed by Georg Luger for his self-loading pistol.

Patchbox
A compartment in the stock of a firearm; used for storing tools and patches of greased cloth, in which the ball of a muzzle-loading rifle was wrapped before it was loaded in order to grip, clean, and lubricate the bore.

Pepperbox
A popular name for a type of revolver, usually percussion, which had no separate barrel. Instead the chambers of the cylinder were extended to form a group of barrels.

Percussion-cap mechanism
A firing mechanism featuring a small cap containing fulminate that serves as a primer.

Pin-fire
Describes a self-contained cartridge that includes a metal pin, which strikes and ignites the primer within the cartridge when hit by the weapon's hammer.

Pistol
A nonrepeating, repeating, or semiautomatic small arm designed to be fired from one hand.

Prawl
A bump or a knob on the frame of a small arm to prevent the user's hand from slipping.

Pricker
A pointed metal tool used to clean out residual gunpowder from a gun's touchhole.

Primer
A substance lit by a firing mechanism to ignite the main charge in the barrel. Priming powder (gunpowder) and a detonating chemical, such as fulminate, are both examples of a primer.

Priming powder
The small amount of fine gunpowder lit by a firing mechanism to ignite the main charge in the barrel.

Projectile
A bullet, ball, grenade, or shot (group of small lead balls), fired by a firearm.

Propellant
The chemical substance, such as gunpowder, which imparts movement to the projectile in a firearm. Also called the main or powder charge.

Ramrod
A wooden or metal rod employed in charging the weapon by ramming the wad and bullet or shot down the barrel against the powder charge.

Recoil
The rearward movement of the barrel (or weapon) in reaction to the forward motion of the bullet.

Recoil operation
A type of firearm action in which the loading cycle is driven by the recoil of the barrel or breechblock after the firing of a cartridge.

Recoil spring
A coil spring attached to the slide or other type of breech component of a self-loading or automatic firearm. It initially absorbs the recoil, then returns the slide or breech mechanism to the closed position, readying the gun for firing.

Recuperator
A device that enables an artillery piece's barrel to return to its firing position after recoil.

Repeating rifle
A rifle that can discharge multiple consecutive shots using cartridges loaded from a magazine.

Revolver
A gun that carries ammunition in a rotating cylinder.

Rifle
A long-barreled firearm with spiral grooves in the barrel.

Rifling
The spiral grooves cut into the barrel that induce spin on the bullet.

Rifled musket
A musket which has been rifled by adding grooves in its barrel to impart a spin to the bullet.

Rim-fire
Describes a self-contained cartridge that carries the primer in its rim. The primer is ignited when the firing pin strikes and crushes the rim when hit by the weapon's hammer.

Safety catch
A mechanism which helps prevent the accidental discharge from a firearm, ensuring safe handling.

Sear
An often hooklike part of the firing mechanism that connects the trigger to the cock, hammer, or striker.

Selective fire
The system in some firearms for switching between semiautomatic and automatic firing mode. The preferred mode can be activated by means of a selector.

Self-loading
Describes a weapon that employs recoil force or the force of exploding propellant gases to eject a spent cartridge and chamber a new one. Also known as auto-loading.

Semiautomatic
Describes weapons that go through one cycle of firing and self-loading on each pull of the trigger, but do not perform continuous fire. Also known as self-loading. See also *Automatic*.

Serpentine
An S-shaped piece of metal with a central pivot attached to the side of a matchlock gun. It held a slow match that was lowered onto the priming pan on pulling the trigger.

Shot
A measured quantity of small lead pellets.

Shrapnel
Fragments or debris thrown out by an exploding shell, grenade, or bomb.

Single-action
An action type, typical of a revolver, in which the hammer must be cocked manually prior to each shot.

Silencer
A device that reduces, but rarely silences, the sound, flash, and recoil of a fired round.

Single-shot rifle
A rifle that has to be manually reloaded after every shot.

Slide action
A firearm mechanism in which the rearward and forward motion of a sliding sleeve ejects the spent cartridge case, loads a new cartridge, and cocks the gun. Also known as pump action.

Smokeless powder
A smokeless propellant, used almost universally now, that is composed of a mixture of nitrocellulose and other chemicals and is shaped into thin flakes before being loaded into a cartridge. Unlike black powder (gunpowder), it does not give away a concealed shooter's position.

Smoothbore
Describes a gun barrel lacking a rifled interior.

Snaphance
An early flintlock mechanism featuring a separate pivoting striking surface made of steel, and a sliding pan-cover. Sometimes spelled "snaphaunce."

Solid frame
A revolver design in which the cylinder is held in a rectangular frame made by the top and bottom straps, the standing breech end, and the part of the frame forming the rear of the barrel.

Stock
The portion of a firearm that is held by the person firing it.

Submachine-gun
A handheld, fully automatic weapon firing pistol-caliber rounds; it is shorter than a rifle.

Suppressor
Another word for silencer.

Toradar
An Indian matchlock gun on which the barrel and the stock are fastened together by coils of rawhide or wire.

Touchhole
A hole in the breech of early cannon and small arms through which the main charge was ignited. Also known as the vent.

Trigger guard
A frame protecting the trigger from damage and unintentional pressure that could accidentally discharge the weapon.

Trunnion
A cylindrical protrusion on each side of the barrel of an artillery piece on which it pivots to lower or elevate its barrel.

Under-lever
A lever, placed under the barrel near the trigger guard, that is used to open the breech in most lever-action guns.

Wad
A piece of paper, cardboard, or felt, used to retain the charge in the cartridge or barrel.

Wheel-lock
A firing mechanism that provided a means for self-igniting a firearm for the first time. It featured a wheel that created sparks on rubbing against a piece of iron pyrite. The sparks then lit the priming powder.

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ACKNOWLEDGMENTS

Dorling Kindersley would like to thank the following for their help with making the book:

The Smithsonian Institution
David D. Miller III
Associate Curator in the Armed Forces History division at the National Museum of American History, Kenneth E. Behring Center, Smithsonian

Springfield Armory National Historic Site
Alex MacKenzie
Acting Chief of Resource Management

Richard Colton
Park Ranger/Interpreter, Historian, Historic Weapons Safety Officer

Down East Antiques
joesalter.com

Joe Salter
Joe Salter Jr.
Peter Shirley
Jim Emo

The publisher would also like to thank: Rohan Sinha, Martyn Page, Ishani Nandi, Saloni Singh, Esha Banerjee, and Priyaneet Singh for editorial assistance; Jaypal Singh Chauhan for DTP assistance; Debra Wolter for proofreading; and Helen Peters for indexing.

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Information on caliber (firearms)
Throughout this book, measurements are provided in US measurements and metric, except in the case of caliber.

In the muzzle-loading era, the gauge diameters, or calibers, of guns were often not standardized, so calibers are provided in both US and metric measurements for each weapon from this period. With the advent of the metallic cartridge, manufacturers provided specifications for caliber, which is expressed in either inches or millimeters only.

Calibers of shotgun are given by "gauge," since this type of firearm is still identified using a form of measurement created in the 17th century, based on the number of balls which could be cast from a single pound of lead.

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