

The Iron Guns of Willard Park



Naval Historical Center



Acknowledgments

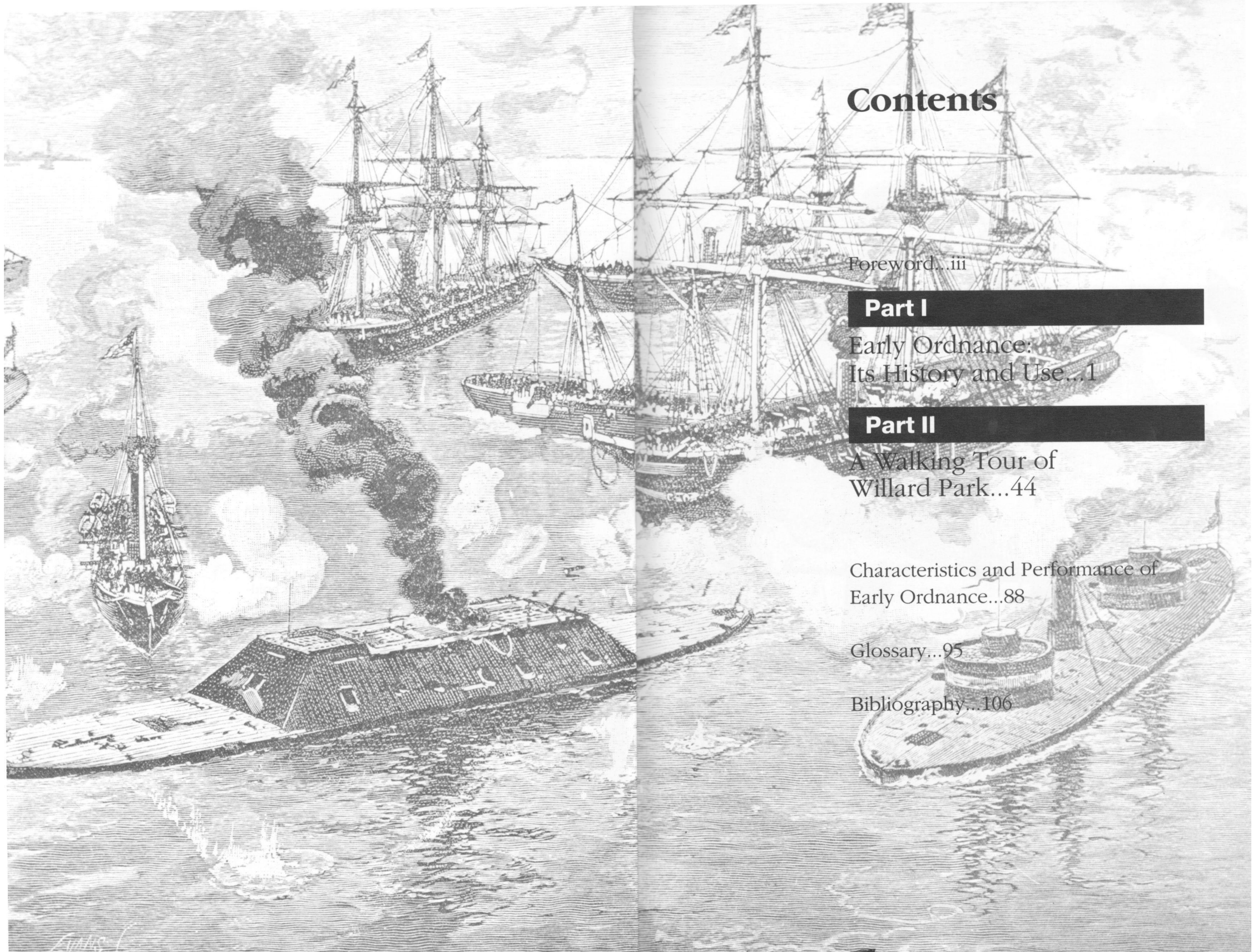
The descriptions of Willard Park ordnance contained in this publication have drawn heavily on the work of Mr. Edwin Olmstead, who has made a profound study of nineteenth-century weaponry. His generosity, in sharing the fruits of his labor with the Naval Historical Center, is as marked as is his scholarship. Dr. E. R. Lewis and Mr. John L. Morris, recognized authorities in their field, provided invaluable and sincerely appreciated advice and criticism. Errors, of course, are solely those of the author.

Foreword

It seems particularly fitting that the historical organization of the Navy should be housed in the Washington Navy Yard. The Yard is our oldest shore activity. It is located on a site approved by President George Washington and built under the direction of Benjamin Stoddert, the first Secretary of the Navy. At various times a shipyard; an operating base; a proving ground for guns, ammunition, and armor; an ordnance manufacturing plant; a school for gunners and fire controlmen; and, now, a center of administration, ceremony, and specialized services, the Washington Navy Yard has served our country well. The sailors, marines, and Navy civilians who have worked there through nearly two centuries have made numerous contributions to America's victory in war and to her safety in peace.

This work is part of the Naval Historical Center's continuing effort to make our Navy's history more accessible and understandable to the American people. An earlier work, *The Bronze Guns of Leutze Park*, described the Navy Yard's collection of early bronze ordnance; this publication discusses our holding of nineteenth-century iron artillery. A 1988 reprint of *The United States Naval Railway Batteries in France*, first published in 1922, describes the 14-inch naval railway gun manufactured for service during World War I and now on display near the Navy Museum. We hope that these works will bring new life and interest to the heritage of this historic place and to the accomplishments of the Navy's people over the years.

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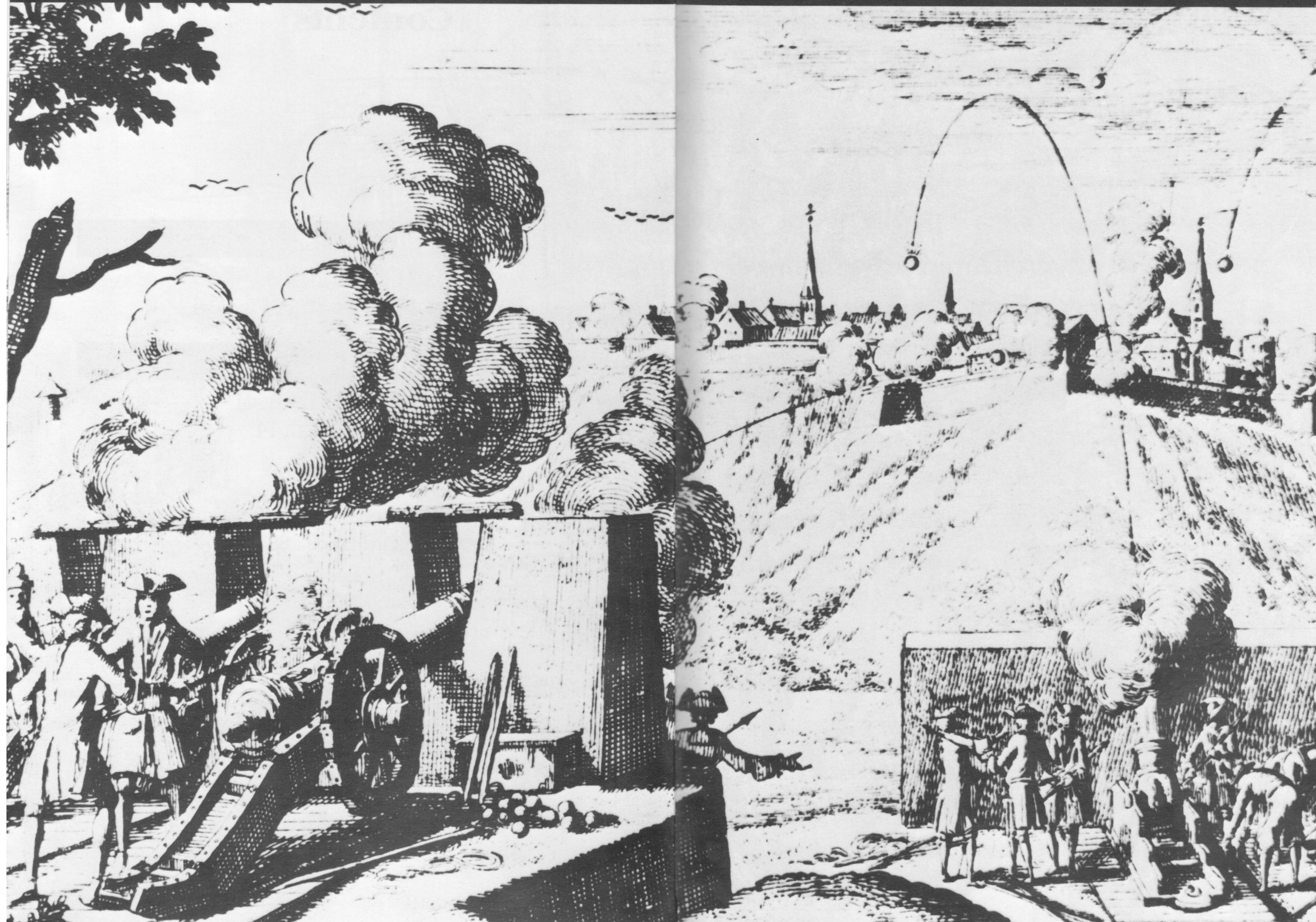
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Part I Early Ordnance: Its History and Use





An illumination of the late 15th century shows archers and a cross-bowman supporting an assault on a fortified wall as a gunner touches off a large siege bombard.

Origins

“... And he shall set engines of war against thy walls, and with his axes he shall break down thy towers.”

—Ezekiel XXVI: 9.

Artillery has been with us since the origin of gunpowder. Even today, after the development of supersonic aircraft and guided rocket weapons, artillery—guns, howitzers, and mortars—is still very much an essential part of the first line of every nation’s defenses, by sea as well as by land.

The earliest weapons of primitive man were crude hand-held implements. During the centuries that followed, hand weapons were supplemented by thrown stones and spears. Using such auxiliary devices as the sling, the throwing stick, and the bow, soldiers and sailors of early history attempted to hit their enemies at longer distances. Military catapults, some resembling large crossbows and others taking their power from twisted cords or from the release of heavy counterweights, were developed and widely used for siege work in classical antiquity. Field artillery was generally unknown, but light engines were taken to sea; Julius Caesar’s *Commentaries* describe his legions landing in Britain with the help of missile fire from catapults mounted in Roman warships.

The origin of gunpowder has long been disputed. Like so many other developments whose chronologies were never recorded with any precision, this may never be certain. Friar Roger Bacon (1214–92) is credited with the discovery of the explosive properties of a combination of seven parts saltpeter to five parts each of charcoal and sulphur. Bacon did not speculate on his formula’s possible use as a propellant, but it was not long before early forms of artillery began to make their appearance.

Introduction of Cannon

They had also . . . fired a bombard of a very great size . . . and shot stones of an immense weight. When they fired off this bombard . . . the report of it was so loud that it seemed as if all the devils in hell had broken loose.

—Sir John Froissart (1338-1410?)
Chronicles of England, France, and Spain, describing the siege of Oudenarde (1382).

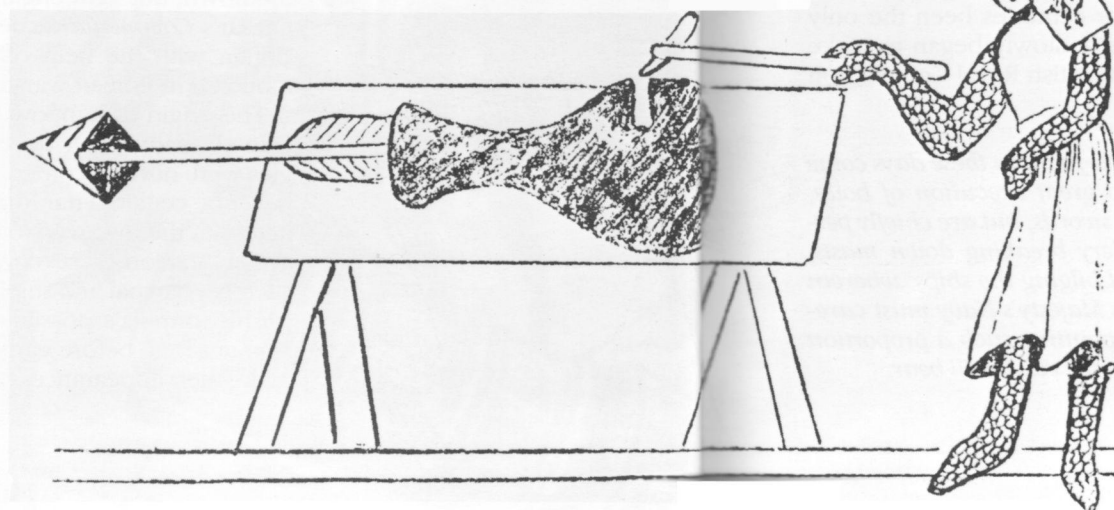
Definite references to cannon began to appear early in the second quarter of the fourteenth century. On 11 February 1326, the Council of Florence is recorded as dealing with the procurement of *pilas seu palloctas ferreas et canones de metallo* (iron balls and metal cannon) for the defense of the Italian city-state. The word “metal” here is interpreted as referring to brass or bronze.

The earliest known picture of a cannon appears in the illuminated manuscript of an address by Walter de Milimete, chaplain to King Edward III, on that monarch’s accession to the English throne in 1327.

Milimete’s address does not mention cannon, but is illustrated with a representation of a bottle-shaped gun being touched off to fire a large dartlike missile.

Edward III is described as taking “crakys of war” with him in his invasion of Scotland in 1327. Guns were used in the Hundred Years’ War (1339–1453) between England and France. Powerful and well-handled French siege artillery had a large share in the final outcome of that long struggle, and was used to devastating effect by Charles VIII in his campaigns in Italy (1494–96). Siege guns figured prominently in the final campaigns of the reconquest of Spain from the Moors by Ferdinand and Isabella, and in the Ottoman offensive against Byzantium which ended with the fall of Constantinople in 1453. From time to time artillery was used, to a limited extent, on early battlefields, but the guns involved were cumbersome. Not until the Thirty Years’ War (1618–48) did a true field artillery even begin to develop as Gustavus II Adolphus of Sweden equipped his army with mobile guns and used them to good effect. Other powers soon followed Gustavus’ lead and, during the first half of the eighteenth century, artillery became an essential element of every field army.

The earliest known representation of an artillery piece, from the Milimete manuscript of 1327.



Artillery Goes to Sea

The principal purpose of our large Naval establishment being to use cannon and small arms and torpedo explosives against public enemies, the question of ordnance is of the first importance.

—Secretary of the Navy William E. Chandler
Annual Report, 1882

The introduction of cannon had an effect on warfare at sea that was, perhaps, even more remarkable than its impact on land fighting. One of the biggest problems facing the early gunner was mobility. Ordnance had to be hauled along dirt roads and across country by horses or oxen, the only motive power available, using early gun carriages that were a long way from the developed models which made the mobile artillery of Napoleon's time possible. The more powerful the gun, the heavier it was and the harder to move. At sea, though, this was much less of a problem. Since the ship herself was a mobile gun platform, warships could carry heavy guns anywhere that enough water could be found. As shipboard ordnance improved, so did doctrine for its use. The ancient grapple-and-board tactic, which had for centuries been the only way to fight an action at sea, slowly began to make way for gunfire. By 1618, a British Royal Commission could remark that

Experience teacheth how sea-fights in these days come seldome to boarding or to great execution of bows, arrows, small shot and the swords, but are chiefly performed by the great artillery breaking down masts, yards, tearing, raking and bilging the ships, wherein the great advantage of His Majesty's Navy must carefully be maintained by appointing such a proportion of ordnance to each ship as the vessel will bear.

The employment of naval ordnance was much in advance of land artillery. Gun-armed warships became common during the sixteenth century, and before its end had reached a fair measure of power and effectiveness. Field artillery, on the other hand, had its crude beginnings only in the mid-1600s and did not attain its full development until late in the following century. Perhaps the most notable effect of the rise of naval artillery was in the area of geopolitics. For centuries, Europe had been on the strategic defensive. The coincidental development of effective ordnance and efficient seagoing sailing ships was ultimately to result in a global European ascendancy, and has been credited with bringing about what Carlo Cipolla (*Guns, Sails and Empires* (1965)) has called a "dramatic and sudden transition from a state of insecure defense to that of bold and aggressive expansion."

Artillery has continued to develop into our own time, the many changes which have occurred in it being more matters of refinement and improvement in material and techniques than of finding new uses for the arm. The principal exception to this, of course, has been the development of antiaircraft and anti-missile gunnery in this century.

Types of Ordnance

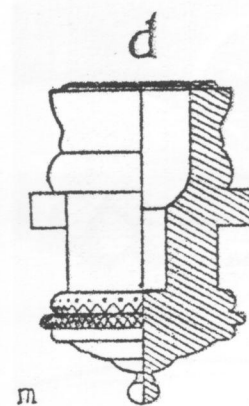
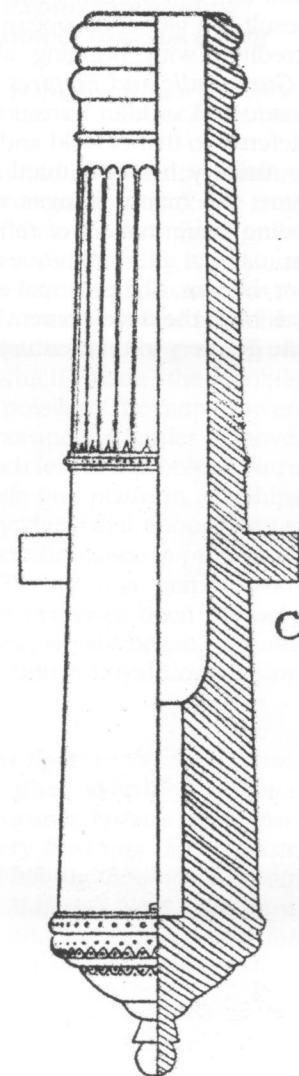
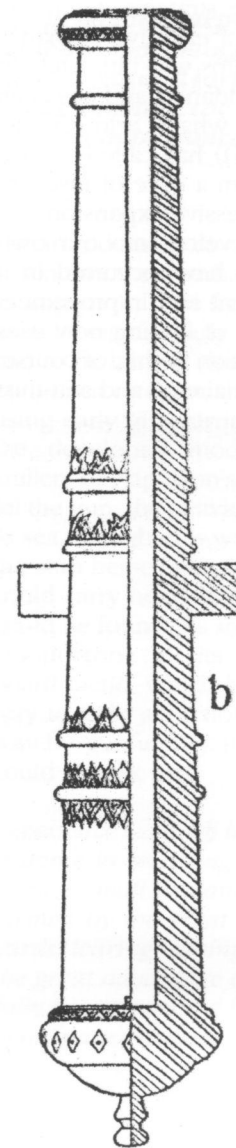
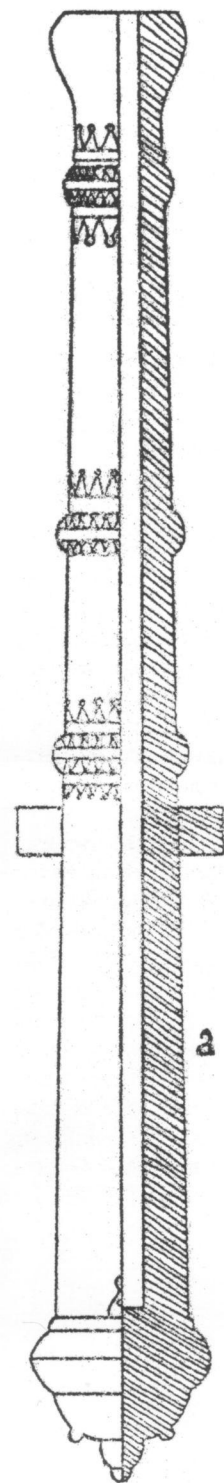
Two are the tasks of artillery: One is to hurt the enemy in the field and the other is to destroy the walls of those places that one wants to conquer. One has therefore to use different types of artillery. . . .

—A. Chincerini, *Lo Scolare Bombardiere Ammaestrato* (Venice, 1641).

Culverin (a); cannon (b); pedrero, or perrier (c); mortar (d). Drawing by Albert Manucy in his *Artillery Through the Ages*, adapted from Luis Collado's *Platica Manual de la Artilleria* (1592).

Most of the guns seen at the Navy Yard represent the period of muzzleloading artillery and date from the late 17th to the 19th centuries. Artillery is classified by type (e.g., gun; howitzer; mortar) and size (expressed in terms of bore diameter or of the weight of the solid shot fired). It can also be categorized by purpose (field; siege; garrison, or fortress; naval, or "sea-service"). The pieces seen here represent most of these categories.

The earliest guns were small antipersonnel weapons, used as much for psychological effect as for anything else. They were, at first, rather ineffective, but improvements followed. The first gunpowder small arms were inferior, both in accuracy and in power, to the existing longbow and crossbow so efforts turned to the design of heavy ordnance for the attack and defense of fortifications. Big guns quickly became common, some of them almost grotesquely large. Some of the larger guns of the 14th and 15th centuries were built in two sections in an attempt to make them more transportable, one section screwing into the other.



0 1 2 FEET 3



The interior of the arsenal established at Innsbruck, Austria, by the Emperor Maximilian I, circa 1507. Note the heavy trail carriages of the heavy, short-barreled battering pieces in the foreground and the longer, smaller-caliber culverin in the rear. The round shot on the ground are of stone.

Iron and Bronze

The best gun and the best vessel should certainly be chosen, but the victory three times out of four depends upon those who fight them. . . .

—Rear Admiral David G. Farragut (1864).

Wrought iron was, at first, the most common material for guns. Bars of iron were welded together around a cylindrical mandrel, and heated hoops of the same metal were shrunk around the welded bars to compress them. The result was a tube, open at both ends, so early iron guns were, perforce, breechloaders. Powder was loaded into a cylinder, which was joined to the after end of the gun barrel and held tightly in place with wedges. This was reasonably serviceable as long as guns were small and early gunpowders generated low pressures, although the escape of burning gases on firing was hazardous to the gunner and did nothing to improve performance.

The problem with these early breechloaders was obturation, the ordnance term for the sealing off of a firearm's breech to direct all the force of the propellant powder down the barrel and to keep hot gases from escaping in any other direction. Gas-tight systems for doing this were not successfully produced until the latter part of the 19th century, and earlier guns not only leaked gases but often could not withstand firing pressures.

By about the end of the 14th century, bronze founders began to cast muzzleloading ordnance. This was a logical development of the art of bell casting, practiced in Europe since the 11th century; by the late 1300s, references to guns of "brass" or "latten" began to be seen. Wrought-iron guns continued to be made in smaller calibers, but bronze soon became the metal of choice for heavy weapons. Iron melts at a higher temperature than copper, zinc, and tin—the principal ingredients of bronze and brass—and practical techniques for heavy iron casting were not to exist until the 16th century. The earliest heavy artillery was thus

cast from bronze, and guns made of this metal did not pass from use until late in the 19th century.

Bronze had two principal disadvantages as a gun metal. Its specific gravity was ten percent greater than that of iron, and it was considerably more expensive. Muller, in his *Treatise of Artillery* (London, 1780), spoke of it as costing nine to 10 times as much as an equivalent quantity of iron. If cast guns with a solid breech were desired, though—as they were for reasons of power and safety—bronze was the only practical choice during artillery's earlier years. Even after the art of casting iron guns developed in Sussex, England, and in Sweden during the 16th century, the quality of iron ordnance was dubious, and bronze was still preferred by most gunners. Early cast iron was brittle and prone to fracture; many iron guns failed their proof tests, and service guns had a tendency to blow up without warning. Iron was, at first, considerably less resistant to pressure than bronze, and iron gun tubes had to be thicker than corresponding bronze guns of the same caliber. Early cast-iron guns were thus heavier than their bronze equivalents, nullifying the advantage of iron's lighter specific weight. Metallurgy and casting technique improved and, during the 17th century, iron foundries began to turn out guns of adequate strength that were lighter than bronze ones.

This was a period of incessant warfare and colonial rivalry; expanding demand made the cost differential between iron and bronze increasingly attractive. Cast-iron guns began to move toward a position of predominance by the late 1600s though, for various technical and economic reasons, this varied from one nation to another. Some advocated a general replacement of bronze ordnance by iron; others took the opposite view. By the 18th century, iron artillery was in general use on land and sea, though most light field pieces continued to be made of bronze, and the older metal was still liked for shipboard use because of its resistance to rust. Bronze artillery continued to be manufactured well into the 19th century—the historic collections at the Washington Navy Yard and the Naval Academy contain examples of this—and not until the late 1800s did bronze guns pass entirely out of service use as the steel breechloader became the universal artillery weapon.

There is some uncertainty about the metal used in early guns. What we now call bronze guns were often called "brass" in period texts, and the words "brass"

and "bronze" were indiscriminately applied to copper alloys into the early 1800s; the word bronze is, in fact, seldom seen until the 19th century. "Gun metal," as it was often called, is described as usually being the alloy of copper and tin which we now know as bronze rather than the copper-zinc combination properly called brass. An English author of 1628 described bell bronze as 20 to 23 parts tin to 100 of copper; gun-metal, on the other hand, contained only 12 parts of tin, the higher proportion of tin in bell metal making it too brittle for use in guns without adding more copper. French ordnance regulations fixed the proportion of tin to copper at 11:100 until 1764, when it was revised to 1:10. Louis de Tousard, in his *American Artillerist's Companion* (Philadelphia, 1809), describes "bronze or brass" as composed of 188 parts copper, 50 parts brass, and 12 parts tin.

Suitable gun bronze was considered so valuable that the master gunners of an army were entitled to claim some or all of the bells in a place won by siege. Medieval French gunners could claim not only the bells, but any cannon and even utensils of copper or brass in a captured town. This practice survived nearly as long as bronze artillery itself. A British letter of 1807 refers to the "invariable custom in our service whenever a place capitulates to allow the officer commanding the Royal Artillery a claim of the bells in the town and its dependencies."

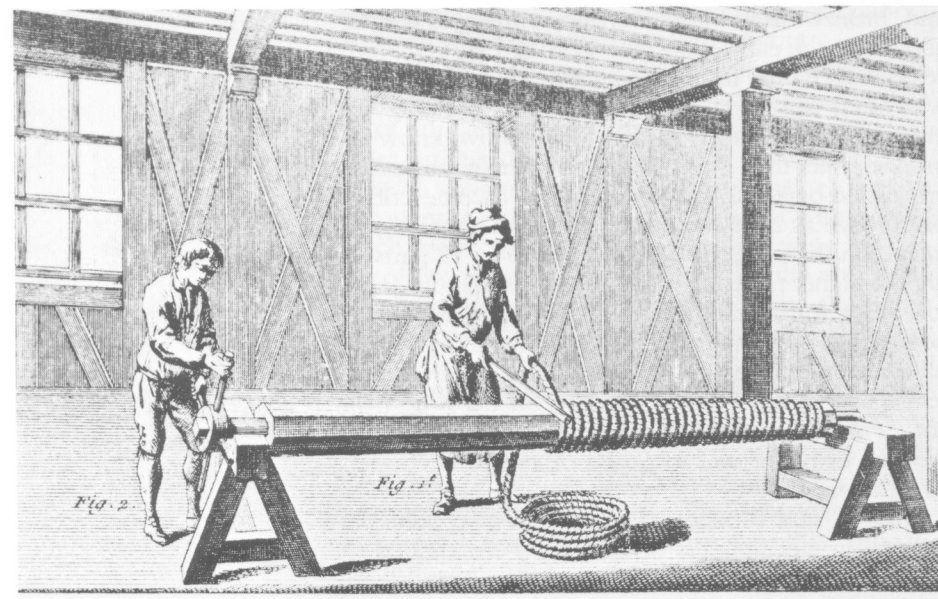


Fig. 2

Fig. 3

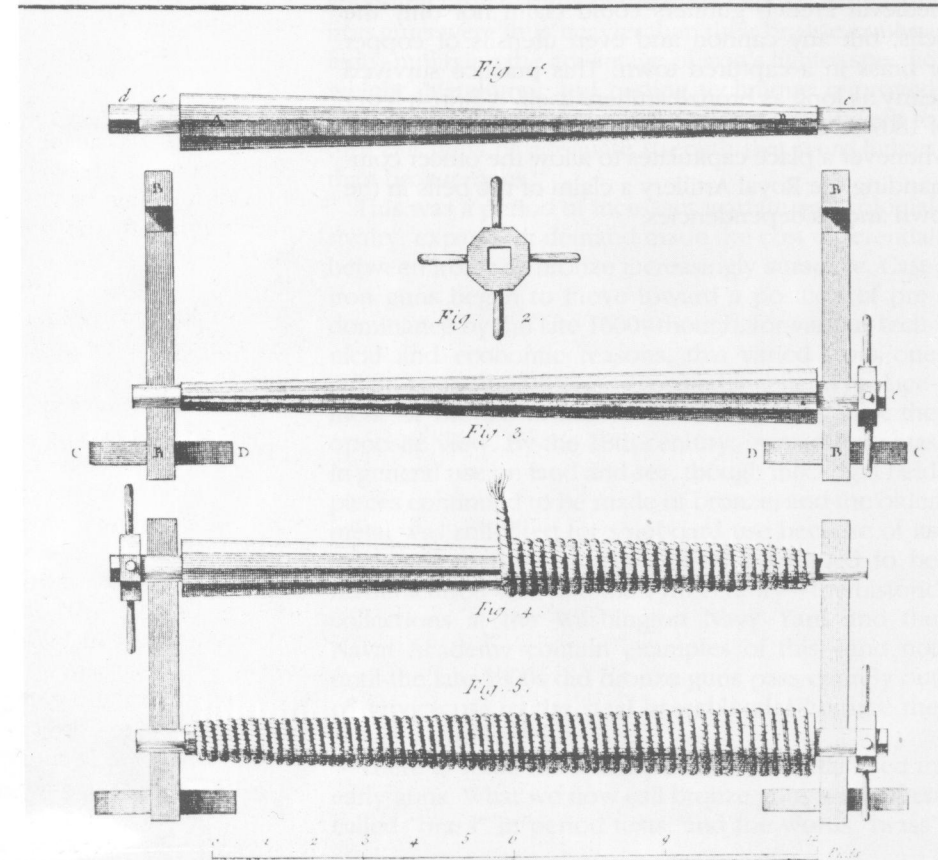


Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Casting Ordnance

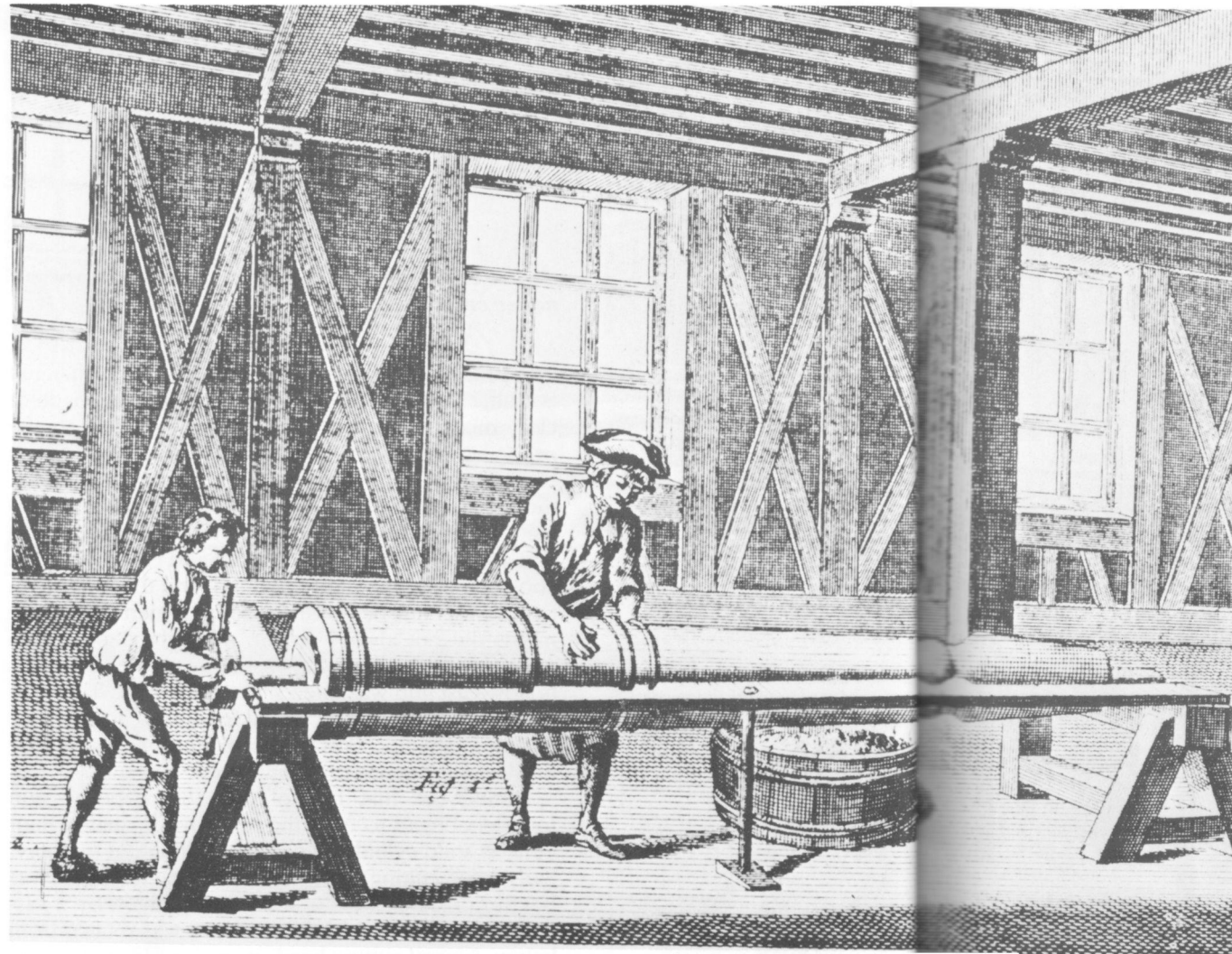
There can never be too many guns; there are never enough of them.

—Marshal Ferdinand Foch (1919).

Steps in the manufacture of bronze ordnance, as illustrated in Diderot's Encyclopédie of 1751–1772. Rope is first wrapped tightly around a wooden core and layers of a savory mixture of clay, hair, and horse dung are successively added until the desired size is attained.

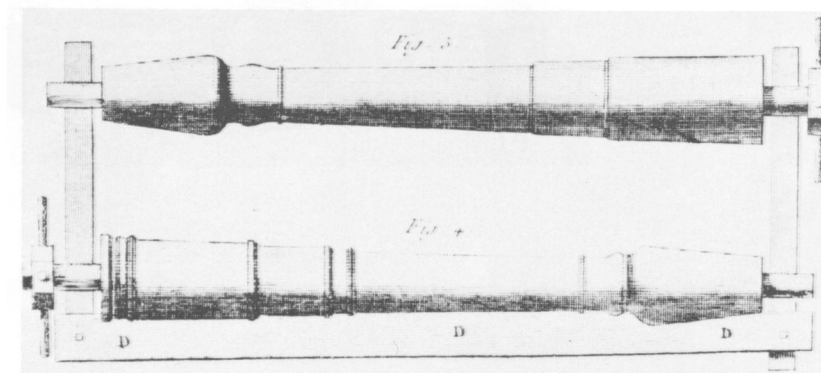
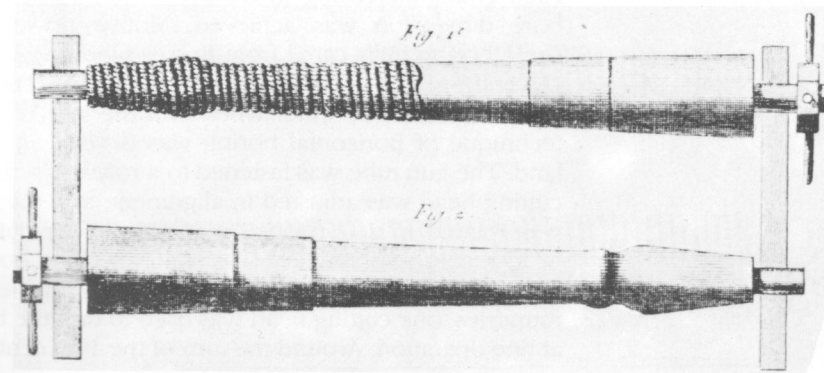
The process of casting guns seems to have changed but little through the centuries. A mold was made of clay, mixed with bits of fiber and kneaded to the proper consistency. Another cylindrical mold was formed around an iron bar in the shape of the bore, then inserted within the exterior mold. Metal was melted in a furnace, poured into the assembled mold, and allowed to harden. The mold and core were then cooled with water and broken up, and the rough gun casting was finished to the desired dimensions. Core molds did not always remain properly aligned with the exterior mold during casting, and the bore of a hollow-cast gun was often slightly eccentric. These internal molds were also blamed for obstructing the free flow and solidification of the molten metal, and the finished castings were often flawed.

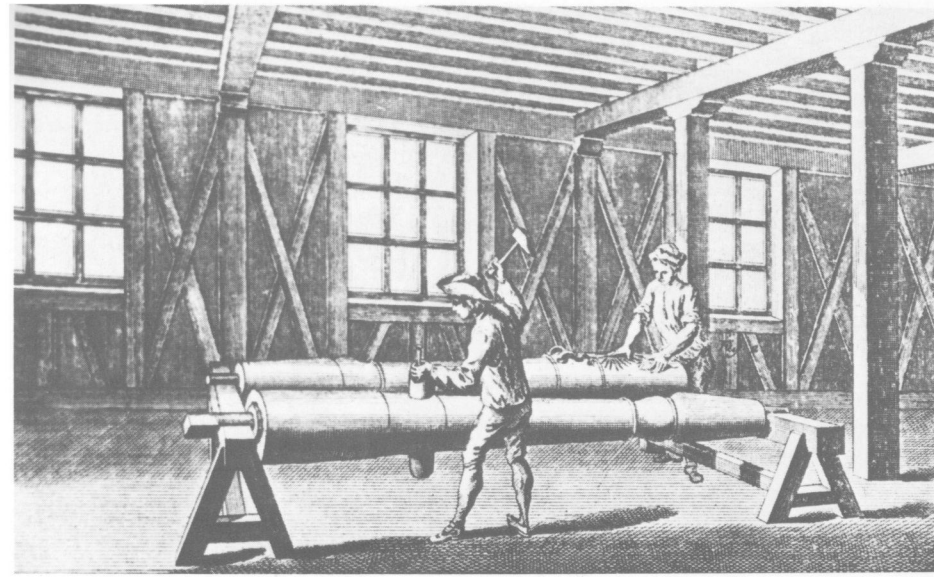
During the first half of the 18th century, gun founders began to omit the bore mold, casting their guns as solid cylinders and then drilling out the bore. Early bore cutting plants were vertical; the gun was held in position and adjusted in alignment by a system of tackle while the cutting head was rotated from below. Several cutting heads were used in succession, each cutter increasing in diameter until the correct bore dimension was achieved. Motive power for some boring mills came from horses plodding in circles at the end of poles attached to the drill shaft; others were connected to water wheels. In the late 1700s a technique of horizontal boring was devised in Holland. The gun tube was fastened to a rotating bed, the cutting head was adjusted in alignment, and the gun was rotated in a horizontal plane while the cutting head remained stationary. This simplified the boring process and reduced the chance of error. In newer foundries, one cutting head was used to drill the bore at one operation. Around the turn of the 19th century,



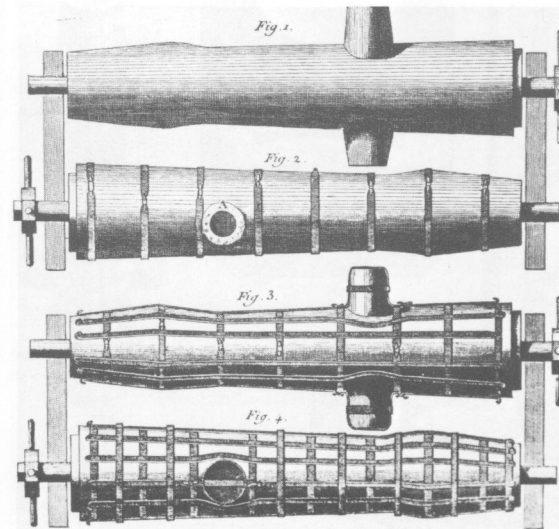
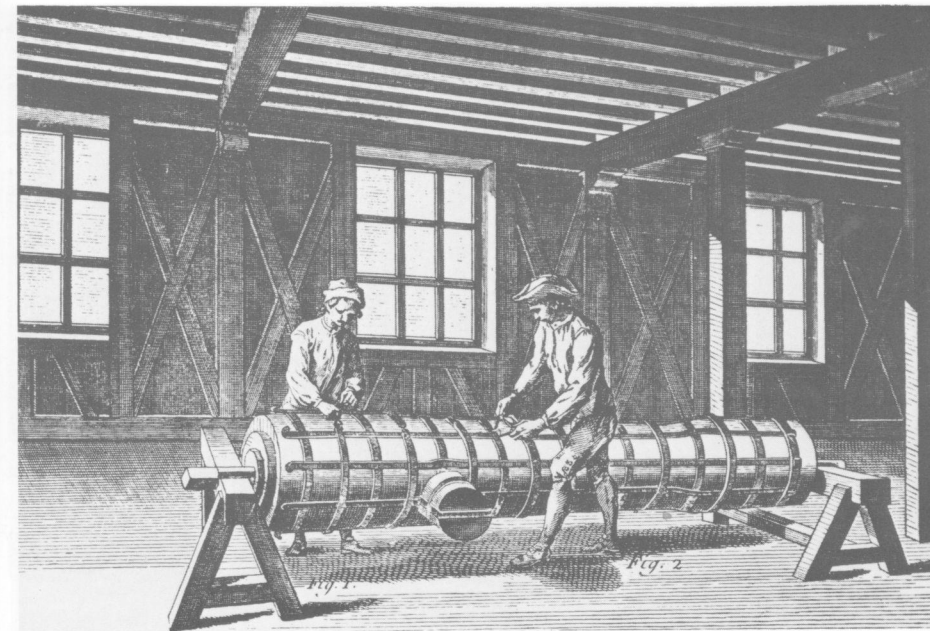
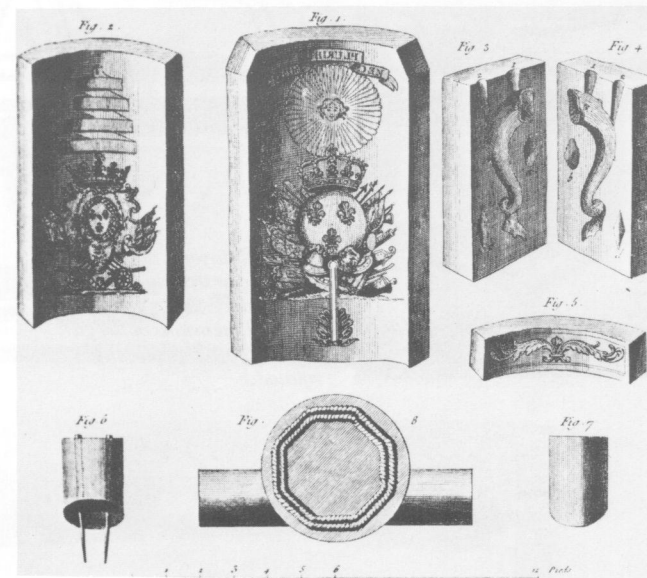
what Tousard described as "probably the best boring machine in Europe" was set up in England at Woolwich; this device not only drilled a gun's bore, but simultaneously turned and polished its exterior as well. Another new machine, installed in France in the early 1800s, was driven by a steam engine.

As the last layer is added a template, or strickle, is used to smooth the exterior to the proper dimensions of the gun tube while the spindle is rotated.

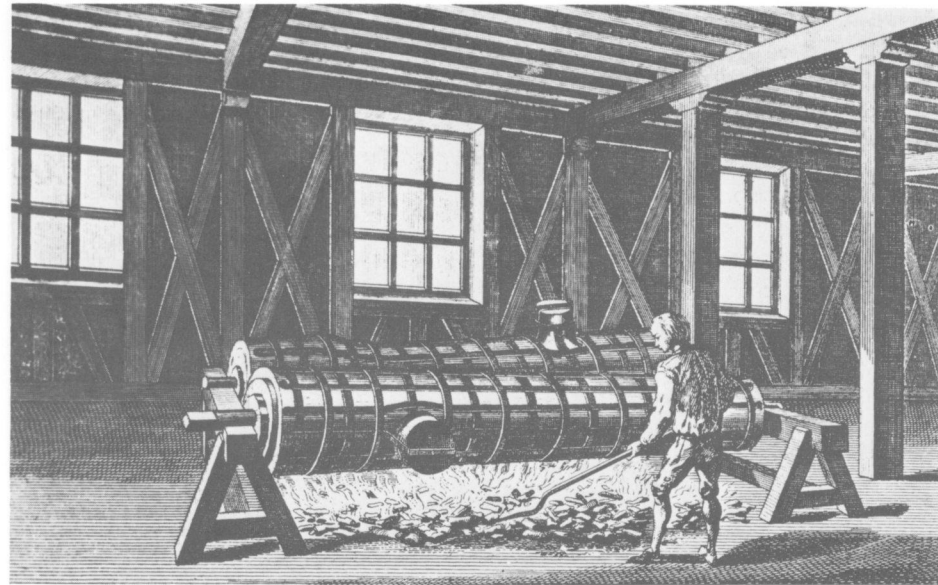




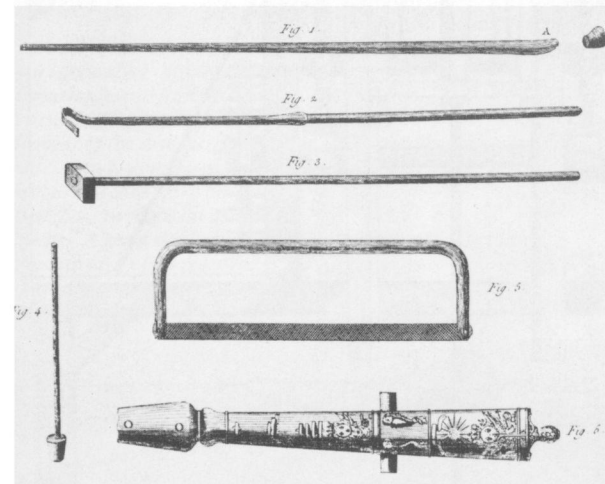
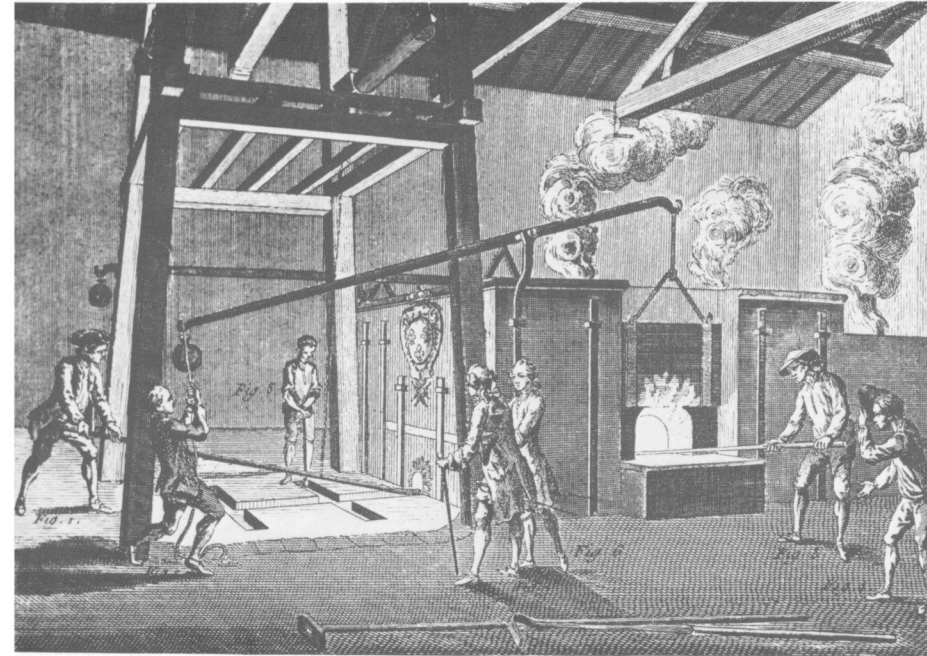
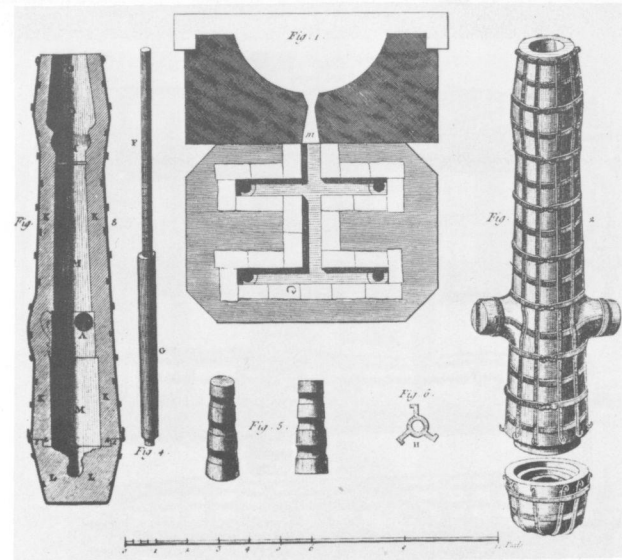
Patterns for the trunnions and external ornamentation are attached to the model. It is then baked hard.



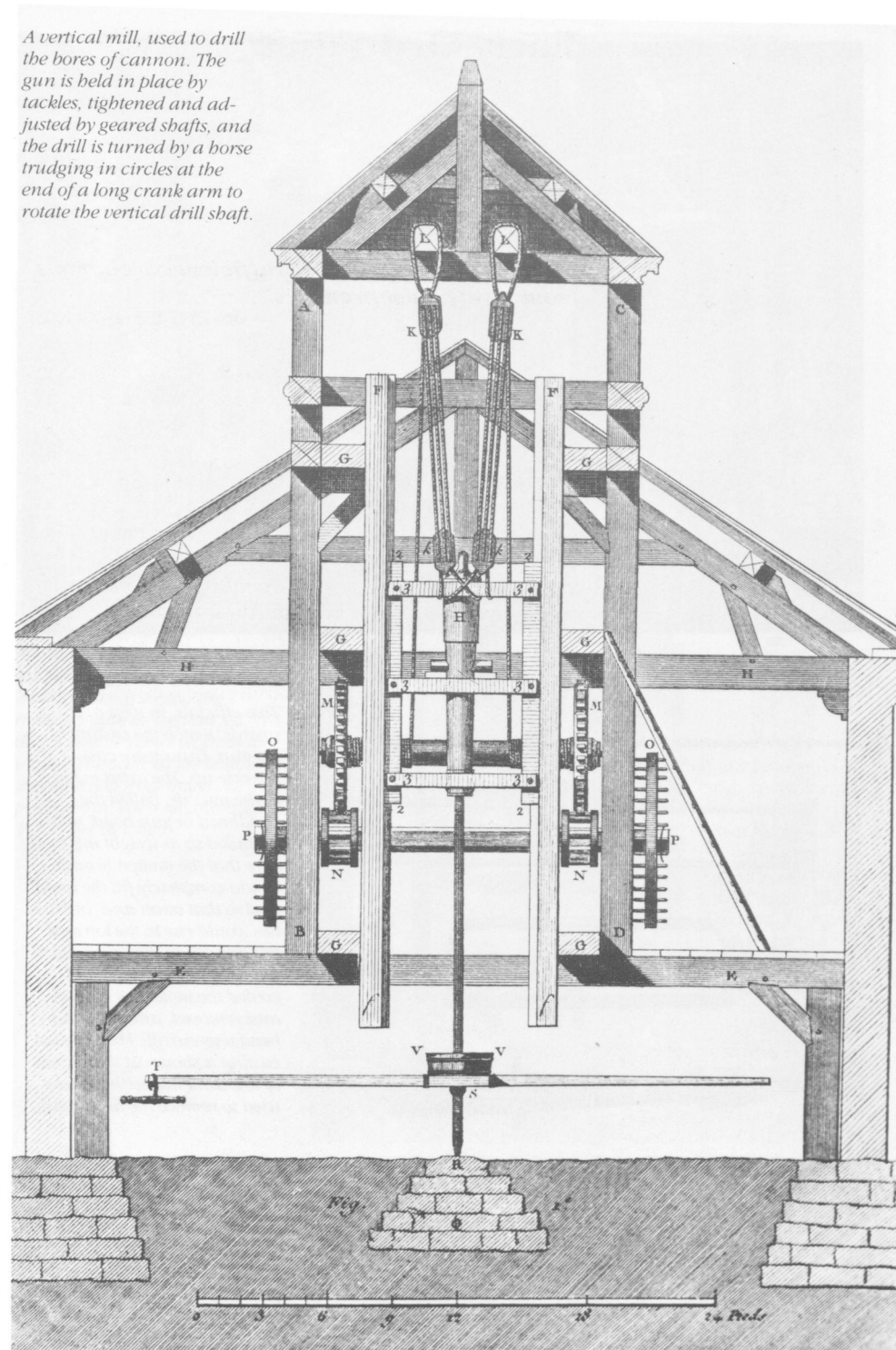
A clay mold is now made from the hardened pattern and strengthened with iron straps. Note that the trunnions are cast below the axis of the bore. This was done for greater strength, but made the breech "whip" downward when the piece fired, straining the carriage. During the late 1700s and early 1800s trunnions began to be cast at or near the gun bore axis.



Like the model from which it was made, the mold is thoroughly dried and hardened by baking. As the lower drawing shows, the mold is made in sections so that it can be removed from the model. The scale at the bottom is graduated from one to 12 pieds de roi, each measuring 1.066 feet in length.



Two officials, in wigs and swords, watch the casting of the gun. Guns were cast muzzle-up. The extra metal at the muzzle, called the deadhead or gun head, was included so its weight might insure that the molten bronze would completely fill the mold and so that scum and impurities would rise to the top and not remain in the gun tube itself. When the casting had cooled the mold was broken and removed, and the deadhead was cut off. The finished casting is shown at the bottom of this drawing, with the saw used to remove the deadhead.



A vertical mill, used to drill the bores of cannon. The gun is held in place by tackles, tightened and adjusted by geared shafts, and the drill is turned by a horse trudging in circles at the end of a long crank arm to rotate the vertical drill shaft.

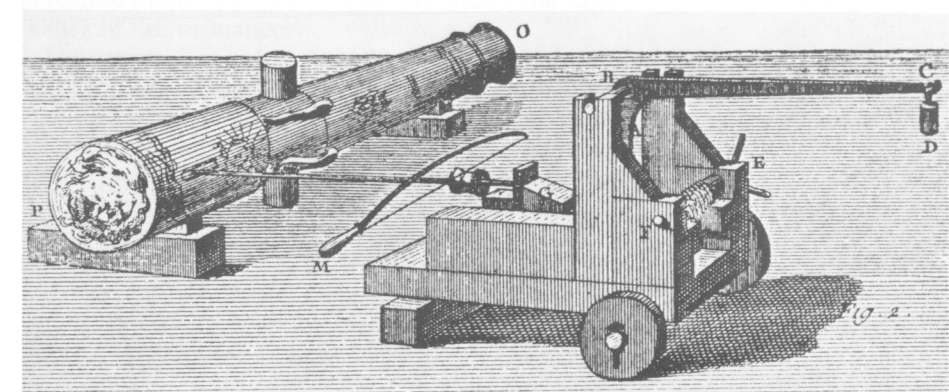
Early Ordnance

Life is the art of drawing sufficient conclusions from insufficient premises.
—Samuel Butler (1835–1902).

For many years guns varied widely from one foundry to another. A great deal of diversity is found in calibers, barrel lengths, and details. This, in turn, complicated logistics as different sizes of shot and loading implements were often required from one gun to another. Attempts to standardize artillery began as early as the 16th century, but real results were not achieved until the 1700s.

Through most of the 17th century, artillery pieces were given names to indicate their type and caliber. Just as the sizes and proportions of ordnance differed, so did the names given to the various types from one country to another; just as artillery evolved through the years, so apparently did the exact meaning of the terms used to describe them.

The vent of this early bronze gun is bored by rapidly sawing a bow back and forth to turn a drill shaft. A hand crank at the rear of the drill carriage raises and lowers the axis of the drill to suit the size of the gun tube, held in place on its side in cradles. A great deal of physical labor was required to manufacture one of these pieces of ordnance.



Broadly speaking, 16th century ordnance can be categorized under four general headings. *Culverins* might be 30 calibers or more in length (i.e., the gun's length was 30 or more times the diameter of its bore), firing a relatively light shot at what, for the time, was a good range. *Cannon* were large-bore, medium-length pieces built to fire heavy shot. *Perriers*, or *pedreros*, were short guns firing medium-weight stone shot at short ranges. Designed for close-range battering, they might be looked at as distant ancestors of the caronade of later days. These pieces all fired solid shot. *Mortars*, the shortest of all, were relatively large in the bore and lobbed explosive shells in a very high trajectory as their descendants do today. At first, the mortar was exclusively a land weapon; but, during the first half of the 18th century, it began to go to sea in specially built bomb vessels for use against land targets. The *howitzer*, a Dutch innovation, made its appearance during the 17th century. Shorter than the cannon but longer than the mortar, the howitzer fired explosive shells in a low-velocity trajectory between that of the cannon or culverin and that of the mortar. Its usefulness and mobility were soon generally appreciated, and field and siege howitzers became common.

Development of Rationalization

God fights on the side with the best artillery.

—Napoleon.

Around the end of the 17th century, the distinction between cannon and culverin disappeared as improved metallurgy and casting techniques allowed the major powers to resolve their ordnance into guns of approximately the same general dimensions within a given caliber. Guns were still produced in various lengths—and, hence, weights—for different purposes. Under the British regulations of 1753, for instance, three different types of 12-pounder guns were manufactured for field, siege, and garrison use. These varied in length from five feet to seven feet, eight inches, and in weight from 1,116 to 2,360 pounds. All three fired the same projectile; the longer-barreled garrison and siege pieces were considered to have a somewhat longer effective range, the heavier garrison gun was best suited for prolonged firing, and the shorter field gun was designed for mobility and ease of handling.

The process of rationalization continued through the 18th century, and systematic research efforts were begun to improve artillery's effectiveness. Extensive firing tests were carried out through the years to obtain information of use to the gunner and the designer. The results of some of these experiments are tabulated in the appendix to give an idea of the capabilities of this ordnance.

Lieutenant-General de Valliere observed the drawbacks of French and foreign artillery during the closing years of the reign of Louis XIV; in 1732 the results of his study were embodied in a royal ordinance which prescribed six standard calibers for guns and two for mortars. The order continued to say that "the dimensions and weight of the pieces of each caliber . . . will remain fixed, in accordance and compliance with the tables, sketches, plans and sections drawn up by His Majesty . . . without any alteration being made thereto under any pretext whatsoever." Valliere's



Rear Admiral John A.
Dahlgren

guns, two fine specimens of which are to be seen in the Navy Yard, with five more in front of Bancroft Hall at the Naval Academy, were long, strong pieces designed to produce a single system of general-purpose artillery.

In 1747 Benjamin Robins advocated the superiority of heavy calibers for use at sea, arguing that bigger guns could do more damage at longer effective ranges. Guns, he said, should be as light as possible within structural limits, with all ornamentation eliminated, and the ships of the Royal Navy should be armed with the heaviest artillery that they could safely carry. John Muller, in the first edition of his famous *Treatise of Artillery* (1757), held that the guns of his day were too heavy and their powder charges too large for efficiency. Muller sought to increase gun calibers without adding weight by modifying the contours of the gun tubes to eliminate unneeded metal as Robins had urged. In artillery's earlier years, little or nothing was known about the scientific measurement of pressure, strains, or velocities. The design and testing of guns was empirical; various combinations of dimensions and powder charges were tried out to see what would work. In 1730, for instance, the Surveyor-General of the Ordnance ordered that British guns should be approximately 20 calibers long. Muller held that such an across-the-board ratio of length to bore was not justified. Siege and garrison pieces, intended for use in static situations where size and weight presented no problem, could be 18 calibers long. Sea-service guns needed to be no more than 15 calibers, he felt, since space was limited in the wooden warships of the day. Field guns should be 14 calibers, since ease of handling was essential. Muller's first edition advocated bronze guns for naval use since the superior toughness of bronze made pieces of that metal less likely to explode than iron guns. By his third edition (London, 1780), Muller had changed his mind. "As good iron cast from virgin ore," he wrote, "has all the quality that can be desired in gun metal, and not one burst all this war that I heard of, what occasion is there for any other?" Artillerymen and ordnance boards seem to have agreed with Muller, since the muzzleloading ordnance of the late 18th and early 19th centuries was predominantly of iron. Robert Simmons' *Sea-Gunner's Vade-Mecum* . . . (London, 1812) does not even mention bronze naval ordnance. The French Navy discontinued production of bronze guns for shipboard use before 1725.

The decline of the bronze artillery piece was gradual and varied from country to country. By the latter part of the 18th century iron guns were in general use at sea; the new United States Army organized under the Federal Constitution used iron ordnance until bronze was specified for new field pieces in 1836. During and after the Civil War, these bronze pieces were gradually replaced by iron rifles. Bronze weapons remained predominant for most foreign field-artillery use through the Napoleonic Wars and continued in production for land use into the 1860s. American naval ordnance of the Civil War was iron, as were heavy siege and garrison pieces. Union and Confederate field artillery was a mixture of iron smoothbores and rifles with bronze smoothbores, but our Civil War and the Austro-Prussian War of 1866 were the last major conflicts in which bronze artillery had a significant part. Several Austrian bronze rifled guns of the 1840s and 1850s are at the Washington Navy Yard, and the Navy Yard's collection includes a United States Army 24-pounder smoothbore howitzer of a type used in the Mexican War and the Civil War. Light bronze smoothbores and rifles were designed by John A. Dahlgren for use in boats and by ships' landing parties and specimens of these are here and at Annapolis. Some of these bronze Dahlgrens served into the late 1800s and were among the last American bronze guns to see service use.

Gun Carriages

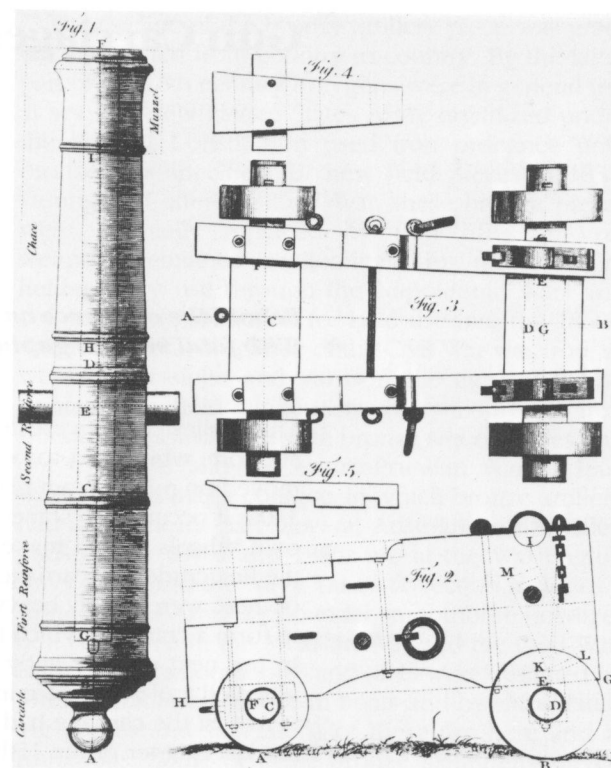
***Behold the ordnance on their carriages,
With fatal mouths gaping on girded Harfleur:***

—Henry V, II: 4.

The earliest guns were mounted on crude wooden supports which had to be picked up and carried, or moved on rollers, from place to place. During the late 1400s it occurred to someone that putting a gun on its own wheels would make it easier to transport, and the first crude gun carriages began to appear. The first of these were simply heavy four-wheeled wagons, cut to form a cradle in which the gun tube was mounted. In the next century early forms of the familiar two-wheeled trail-and-axle gun carriage were seen.

At first the carriage had to cradle the gun tube. By the last quarter of the 15th century gun makers were beginning to cast pieces with trunnions, a pair of cylindrical projections cast into the tube at right angles to the bore axis, one on each side of the gun. This was a large step ahead; the sides, or cheeks as they came to be called, of the carriage were now placed under the trunnions; these acted as a pivot around which the gun tube could easily be elevated or depressed. Trunnions were sighted just forward of the gun's center of balance and made the piece slightly breech-heavy. This difference in weight between breech end and muzzle end (or preponderance, as gunners called it) made the gun sit properly on the carriage and made the assembled gun and carriage stable enough to be maneuvered and fired without capsizing.

Eighteenth-century diagram of a typical gun and wooden "sea-service" truck carriage.



The four-wheeled gun carriage was a simple arrangement of two side pieces—the cheeks mentioned above—which supported the gun and were mounted on a pair of axles with wheels. Two-wheeled carriages also had a pair of cheeks, but the forward end of these rested on a single axle bearing a pair of wheels, while the after end of the cheeks was carried down at an angle to rest on the ground. This after end was called the trail of the carriage; between the 1790s and the 1830s the original "double-trail" carriage was replaced by a stronger and handier "single-trail" version in which the cheeks were shortened and bolted to the sides of a single centerline piece which formed the trail. Four-wheeled carriages were used with ship and garrison guns through much of the 19th century, changing only in detail as time passed. By about 1870, they began to be made of iron. Since their wheels were used only to allow the carriage to recoil when fired or to be shifted for short distances they grew small. Garrison carriages, or fortress carriages as they were also called, were mounted in fortifications and had iron wheels.

Carriages for ship guns had wooden wheels, called trucks, to minimize wear and tear to the wooden decks of warships. Field and siege guns and howitzers had to be mobile, so they were mounted on the two-wheeled trail carriage whose wheels were large, spoked affairs constructed on the principle of the wagon wheel, but strengthened to stand the strain of cross-country travel and the shock of gunfire.

The French ordnance reforms instituted by Lieutenant-General Jean-Baptiste de Gribeauval in the 1770s included a new type of carriage for fortress artillery, in which the carriage recoiled along a wooden track which was pivoted at its forward end and supported by rollers aft. Instead of manhandling a wheeled carriage to train a gun, it could be swung from side to side on its rollers; this made it easier to handle the heavy guns used in fortified places. The same principle was used in carriages for the short-barreled carronades used at sea from the 1700s. During the early 1800s pivot carriages began to come into use in ships. These were mounted on the centerline of a ship and could be aimed to either beam as required. Heavy pivot guns, as guns on such carriages came to be called, formed part of the naval arsenal through the Civil War and were only displaced by a new generation of iron and steel gun carriages developed during the late 1800s.

The mortar was a siege and garrison weapon, so it did not require the mobility of the field gun. Since it fired at a high elevation, it transmitted most of the shock of its discharge downward rather than to the rear. It used a heavily built wheelless carriage, often called a bed, which was carried to its place in a special type of wagon and lowered into position. Like the pivot carriage, these mortar beds continued in use until the birth of steel ordnance; by the mid-19th century they were built of iron rather than of wood.

Gunpowder

***Such I hold to be the genuine use of gun-powder;
that it makes all men alike tall.***

—Thomas Carlyle (1795-1881)

Muzzleloading guns and early breechloaders fire black powder, the combination of saltpeter, charcoal and sulphur originally discovered in the 13th century. When smokeless powder began to be used in small arms in the late 1800s, muzzleloading ordnance was virtually a thing of the past. By the time the new powder was introduced to artillery at the beginning of this century, steel guns had replaced iron and bronze alike. The earliest gunpowders were violent in their action, and the proportions of their ingredients were juggled to obtain a propellant which would generate pressures that could be handled by the guns of the time. Roger Bacon's original formula for gunpowder prescribed 41.2 percent saltpeter to 29.4 percent each of the other ingredients. French powder of 1650 was three-quarters saltpeter, the rest consisting of slightly more charcoal than sulphur. By 1781, British powder was 75 percent saltpeter to 15 percent charcoal and 10 percent sulphur. Through the centuries, formulas varied somewhat, by maker or by nationality, but the eventual basic proportions were approximately the same.

Early gunpowder was a fine-ground mixture called serpentine powder. This was usable, but not very satisfactory. The ingredients tended to separate, and the fine mixture readily absorbed dampness. If packed too tightly or too loosely into the bore of a gun it often refused to ignite or burned slowly instead of detonating. As early as the 1420s, corned powder began to be heard of. This was made by moistening the mixed ingredients and compressing this dough-like substance into cakes from which grains of a suitable size—small for hand weapons, larger for cannon and mortars—were crushed. Corned powder was about half again as powerful as serpentine, and had about three-quarters the strength of modern gunpowder. It ignited more surely and quickly, and burned more regularly, but generated greater pressures which artillery tubes could not at first handle. Not until the 16th century were large guns able to handle the new powder but, as soon as gun fabrication techniques caught up to corned powder, it quickly replaced serpentine. Black powder was less than precise in its effect; its properties could vary considerably from one lot to another, and prudent gunners tested a new batch of powder with an eprouvette before using it. Eprouvettes for small-arms powder resembled pistols, with a graduated scale to indicate the force of the pressure generated. To test artillery powder small mortars, called eprouvette mortars, were used; several of these can be seen at the Washington Navy Yard.

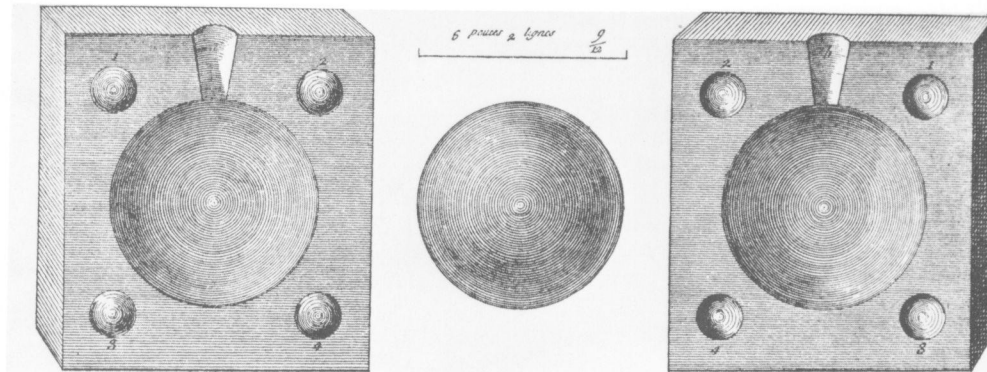
Ammunition

*As swift as pellet out of gonne
When fyr is in the poudre romne . . .*

—Geoffrey Chaucer, *The House of Fame* (c. 1380).

The first guns fired missiles similar to the short, heavy bolts or quarrels used in crossbows. Stone shot came into use for heavier guns, while lead pellets or small iron cubes were employed from early times in antipersonnel guns. Iron shot also began to be cast, though stone shot continued in use for siege work into the 1800s. Throughout the period of iron ordnance, the spherical iron shot—the familiar “cannon ball”—was the standard projectile. Shells, hollow iron shot filled with powder and equipped with a simple wooden tube fuze, were fired from siege mortars in the mid-1500s and by howitzers in the next century for use against fortifications and troops in the field. Late in the 18th century, Lieutenant Henry Shrapnel, of the British Army, devised what he called “spherical case shot,” a round shell containing a quantity of small balls and a powder charge. Fired like other explosive shells, it sprayed its contents upon bursting and proved highly effective against troops. “Shrapnel” continued in use well into the era of modern steel ordnance. Grape and canister were nonexplosive antipersonnel projectiles. A round of grape consisted

Molds for casting iron shot were similar to those used by children in later years to cast homemade lead soldiers.



of a cluster of small shot grouped around a wooden or iron former, the whole wrapped in cloth and tied into shape. Canister, a can packed with smaller iron shot, was used at shorter ranges than grape, but the larger number of balls it contained made it deadly against attacking troops at close quarters.

Dismantling shot, for use against ships, appeared in the 17th century. Chain shot consisted of a large center ring with short lengths of chain attached to it; when fired, this star-like arrangement spread out and damaged an opponent's yards, rigging, and sails. Another form of chain shot consisted of two round shot connected by a short length of chain. Bar shot was two halves of a round shot with a connecting bar in between, and was used in the same manner. The sails of a wooden warship, with their supporting system of yards and tackle, were her engineering plant, and dismantling shot were designed to attack an enemy's ability to move and maneuver.

“Hot shot” was simply iron shot, heated red in a furnace for use against ships and other inflammable targets. The sizzling ball, embedded in the wood of a building or a ship's hull, was enough to ignite a fire if not promptly extinguished. Since fire was a mortal threat to wooden warships, it was seldom fired from ships' guns except, occasionally, in a siege or shore-bombardment situation. The powder charge was loaded into the gun, then followed by a thick wad of wet straw to keep the gun from going off prematurely. The red-hot projectile was then rammed home on top of the wet wad and fired. The carcass was another incendiary projectile, a hollow iron framework filled with a rather nasty-sounding combination of black powder, saltpeter, sulphur, broken glass, pitch, turpentine, tallow, and linseed oil and covered with tarred cloth. Carcasses were primed with fine powder and fired from siege mortars.

The fuzes used with early artillery were simple wooden tubes filled with fine powder and ignited by the flame of the propellant powder. The time of flight was roughly calculated from crude, usually homemade, range tables, and the burning time was set by cutting the fuze to the desired length. In the middle of the 19th century, improved fuzes began to appear, but the shells fired from muzzleloading guns through most of their history continued to use the elementary wooden tube fuze.

Handling Gunpowder

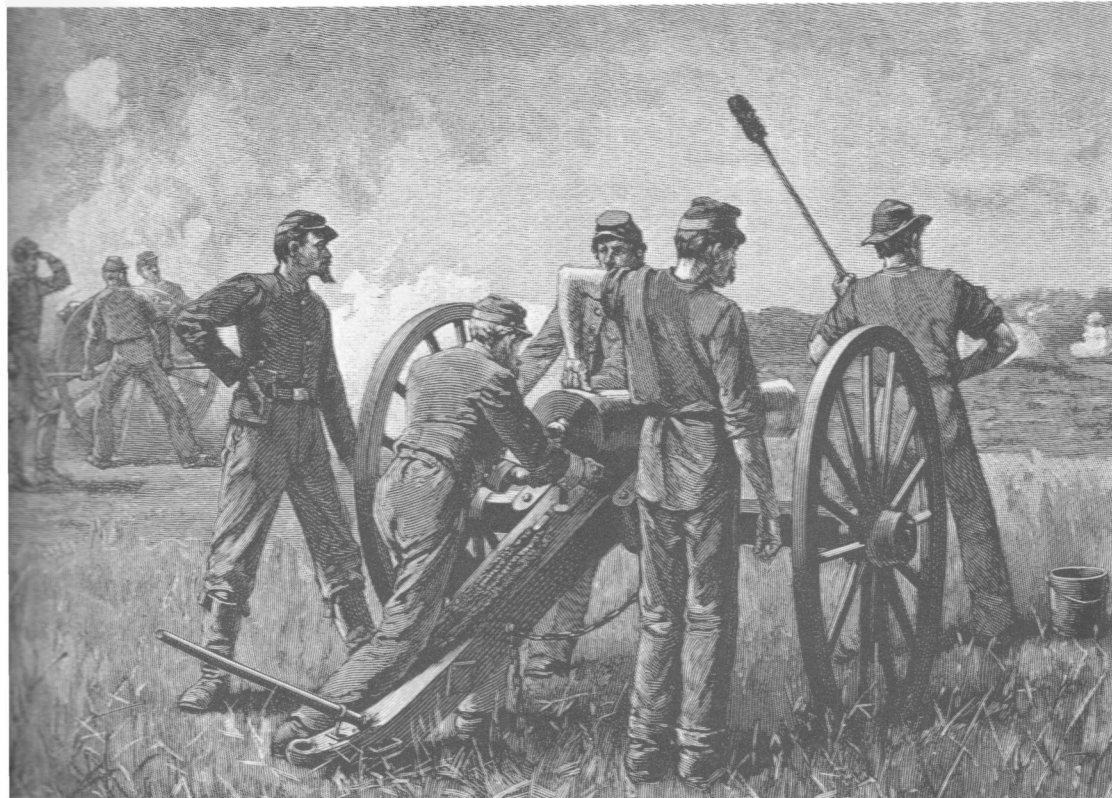
The office of a Master Gunner is, therefore, important and respectable; as, in the person who fills it. . . there should exist no inconsiderable portion of the energies contributive to ultimate success in conflict; to which his preparation and disposal of the materials for serving the guns, in time of action, . . . are essential.

—*The Duty of a Gunner in the Royal-Navy* (1812).

Black powder, even the improved corned powder used by most of the guns seen here, had to be handled with respect. It exploded violently when ignited by a flame or spark and had to be handled with constant care. Corned grains did not absorb dampness as readily as did finely ground serpentine powder, but black powder was still vulnerable to moisture. Cromwell's admonition to "Trust in God and keep your powder dry" was no idle aphorism. Implements used in handling powder could not be of ferrous metals for fear of sparks, and men working around powder magazines had to go barefoot or wear slippers made without nails for the same reason.

Powder was originally brought to guns in small covered buckets from which the loader scooped the charge with a long-handled copper ladle, made in a size to fit the gun so that one scoop measured out the proper charge. The ladle was pushed down the bore and turned to deposit the powder in place and a wad of hay, straw, or tow was rammed down the barrel to compact the powder before the projectile was loaded. Handling loose powder this way was not the safest thing in the world, even in the relatively leisurely circumstances of siege or fortress gunnery; in the hurly-burly of the field, its hazard was aggravated.

During the mid-1600s, powder containers, or cartouches—from which, the modern word cartridge—began to appear. Individual powder charges were pre-packed in small bags or cylinders, and container and all were rammed down the barrel in loading. This made loading quicker and safer, but the cartridge container itself was a problem. Such materials as canvas, parchment, linen, serge, flannel, and even thin wood were used, but none would burn completely when the gun was fired. Bits of unburned material always remained in the bore after firing, and after every few rounds the bore usually had to be cleaned out with a worm, a corkscrew-like affair, on the end of a wooden staff.



Serving a Civil War field piece. The charge has just been loaded and rammed. The man to the right of the breech is "thumbing the vent;" the position of his arm permits the gunner to sight along the barrel as he adjusts the elevation of the piece. The man at left is reaching for a friction primer, which he will clip to the end of a lanyard and insert into the vent.

Loading and Firing

*... and the nimble gunner with linstock
now the devilish cannon touches,
And down goes all before them.*

—Henry V, II: 4.

To prepare a muzzleloading gun or howitzer for firing, its crew took their assigned stations around it. Gun crews varied in competence, but "regulars" of the various armies and navies were military professionals, drilled in their duties to fire precisely and rapidly; precision then, as now, was stressed both for efficiency and safety. Well-trained artillerymen knew the duties of all the members of their crew so that they could fill in for their mates as needed. One man took a powder charge and inserted it in the muzzle, using a cartridge or a powder ladle according to the practice of his time. A second man firmly pushed the charge down the bore with a wooden rammerstaff. When loose powder was ladled, a wad was rammed down after the powder to hold it in place. The projectile—solid shot, grape, canister, or explosive shell—was loaded into the muzzle and rammed. Another man, at the breech of the gun, pushed a heavy piece of wire, called a vent pick, down through the vent to pierce the powder cartridge, if one was used; he then primed the vent. This was done, at first, by pouring fine powder from a flask or horn to fill up the vent. During the 1700s priming tubes, made at first from tin and later from sections of quills and filled with fine powder, began to be used instead. While the piece was being loaded, the gunner crouched behind the breech and squinted down the tube at his target. He adjusted elevation by moving a wedgeshaped quoin to raise or lower the breech while crowbar-like wooden handspikes were used to lever the rear of the gun carriage to the left or right. This process became a bit more precise when the quoin was replaced, begin-

ning in the second half of the 18th century, by an elevating screw. The breech of the gun rested on the upper end of the elevating screw, whose lower end was threaded through the carriage. As the gunner observed the target he turned the screw to elevate or depress the gun. Sighting one of these pieces was simplicity itself. The gun was sighted along the "line of metal," the axis of the gun barrel. Some guns, as can be seen in the Naval Academy collection, had a rear sight notch cut or cast into the breech ring and a front sight button or blade set into the swell of the muzzle. During the 1700s, simple adjustable rear sights began to be used. In those days, there were no range finders for determining the distance of a target. Experience gave a gunner a certain rough-and-ready eye for distance; before opening fire he estimated the approximate range by "seaman's eye"—or its shore-side equivalent—and then adjusted his fire onto the target.

When the piece was loaded and on target, everyone stood out from behind and a man reached over from beside the gun to touch it off. This was done at first with a red-hot iron and later with slowmatch, thought to date from the 15th century. This was cotton cord soaked or boiled in a saltpeter solution or the lees of old wine and, perhaps, treated with lead acetate and lye—formulas varied from one time and place to another. Slowmatch burned at a rate of four or five inches an hour. The slowmatch used to fire a gun was clipped to a *linstock*, a wooden stick about two feet long with a cleft in one end into which the slowmatch was wedged. Slowmatch continued in use for some four centuries, through the period of loose-powder priming and the introduction of tube primers. The *portfire*, a stiff paper tube filled with an inflammable composition, appeared in the 1700s, though it does not appear to have seen naval use until the 19th century. Lighted from a slowmatch, the portfire burned like a cigarette, with a hot coal which was extinguished by cutting off the burning end after use.

Advances in chemistry in the first years of the 19th century led to new methods for firing cannon. Gunpowder can only be set off by a flame or spark; fulminate of mercury, discovered in 1800, on the other hand, is detonated by a blow. In the 1780s flintlocks, like those used in pistols and muskets, were first used with cannon. Instead of touching the vent with a match to fire, the gunner primed and cocked the lock before standing aside and pulling a lanyard. Fulminate of mercury was made into percussion caps, and "caplock"

small arms came to replace the time-honored flintlocks. Percussion locks were also fitted to artillery; a cap was placed on a "nipple" over the vent, and a hammer was tripped by the lanyard's pull to fire the weapon. During the 1800's *friction primers* entered service. These were priming tubes filled with fine powder; the head of each tube contained a mixture of potassium chlorate and antimony sulphate. A roughened wire was embedded in the head of the primer and its end formed into a loop. The tube was inserted into the vent of a gun and a lanyard was clipped to the wire loop; a pull on the lanyard jerked the roughened wire through the priming compound and ignited it. These primers were considered highly reliable and resistant to dampness, a vital consideration for field or naval use.

We have seen that gun crews were careful to stand out from behind their guns before firing, and that the man firing the piece had to reach from one side. There was good reason for this; systems for absorbing the recoil of artillery pieces had not been devised when muzzleloaders were in vogue. When a gun or howitzer fired, the principle of equal action, equal reaction, which hurled the projectile at its target also shoved the gun and carriage rearward, and an unwary artilleryman could be crushed by leaping weight. Shipboard guns were held within bounds by a breeching, a heavy cable attached to the breech and connected to the ship's bulwarks. Siege and garrison guns were usually emplaced on upward-sloping platforms which helped to check their recoil, but field pieces had no such help. An 18-pounder gun, for example, might jump back as far as 18 feet, depending upon the power of the load it was firing.

As soon as the shot was off, the rammerman picked up another wooden staff, this one with its head covered with lambskin with the fleece side out. He wet this *sponge*, as it was called, in a bucket set near the muzzle and pressed out the excess water before running it down the bore to extinguish smoldering bits of cartridge bag or grains of powder that might remain. While the gun was being reloaded, a heavy, thimble-like *thumbstall* was kept pressed to the vent. "Thumbing the vent" was supposed to keep bits of debris from being forced into the vent. There was also a chance that, even after sponging, a bit of smoldering cartridge might still remain in the bore. Holding the vent shut while seating the load prevented a rush of air through the vent which might fan such a spark and prematurely explode the powder. The risk of accidental

detonation was always present with muzzleloading artillery, and a rammerman was taught to stand aside from the muzzle as he seated the powder and shot.

As soon as the shot was rammed home, the piece was "run out," or manhandled back up to firing position. The gunner went through the aiming process again, complicated in a sharp action by clouds of dirty-whitish powder smoke.

Performance

***The touch and the tornado; all our guns give
tongue together
St. Barbara for the gunnery and God
defend the right. . . .***

—Gilbert K. Chesterton, *The Ballad of St. Barbara* (1922).

Information on the performance of early guns is often sparse and contradictory. What bits of performance data are available for early ordnance can usually be taken as no more than generally indicative, since such variables as barrel length, elevation, and powder charge are often not specified, while such others as powder temperature were not even known at the time. They do, however, give us some general ideas of the capabilities of old guns. Sir Howard Douglas' *Treatise on Naval Gunnery* (London, 1820) cites recent British experiments as determining muzzle velocities of 1451.7 to 1497.3 feet per second for a 6-pounder gun using 1.5 pounds of powder. With two pounds, the same gun fired its ball at 1676 to 1761 feet per second. Using four pounds of powder, a "long" 24-pounder (9 feet 6 inches in length) had a muzzle velocity of 1292.6 feet per second, while a "short" (7 feet 6 inches) 24-pounder's velocity was 1242.6 feet per second with the same charge. The ballistics of black-powder smoothbores do not seem to have changed to any unusual extent through the years, all things being equal. A demiculverin of the early 1600s, with a 4.5-inch bore, threw an 11.75-pound shot 1,800 yards. Two centuries later, in 1820, Douglas cited British 9-pounder and 12-pounder iron naval guns as firing their shot the same distance. So, though many of the details of gunnery between the 16th and 19th centuries developed to a considerable extent, the basic performance of the weapons themselves did not seem to have differed in any notable manner.

Smoothbores were anything but weapons of precision. Maximum ranges for such pieces were little more than abstractions to the practicing gunner except in such special situations as siege, fortification, or bombardment work where platforms were level and steady, and shooting could be done in a deliberate fashion.

For field and naval use, *point-blank* was usually the only range with real meaning. Point-blank range was obtained at zero elevation, or by sighting the target directly along the gun barrel. Since most guns tapered toward the muzzle—the tube being thicker toward the breech—point-blank might be the equivalent of one or two degrees' elevation. As a look at early guns will show, this varied from piece to piece. Point-blank range is defined in the texts of the time as the distance a shot should travel at this elevation before striking ground, with the bore level, or dropping below the line of sight when sighting along the line-of-metal. Contemporary works on gunnery use this as a measurement of a weapon's effective, as opposed to its theoretical, capability. Except in the case of mortars and howitzers, specifically designed for high-angle shooting, ranges at elevations above point-blank were called *random* ranges. This was meant literally. The spherical projectile had no directional stability and rapidly lost accuracy at any elevation, and "random" shooting was considered exactly that. So while the British naval guns of 1820 mentioned above could hurl their shot the length of 18 football fields, their realistic fighting range was put at their point-blank range of 300 yards. This helps us to understand why so many battles were fought, on land and sea alike, at "white-of-their-eyes" ranges. Point-blank capability came to be considered so important that Sir Howard Douglas, arguing the general superiority of long-barreled guns, could hold that ". . . when guns . . . are opposed to each other, the chances as well as the power of accuracy are much in favour of the gun which requires least elevation, because the path of the ball coincides more with the horizontal direction. This should always be kept in mind, in naval practice particularly. To disregard this maxim . . . is evidently to add a great projectile inaccuracy. . . ."

Rifling of a weapon's barrel was developed in Germany during the 1500s, but was not successfully applied to artillery for three centuries. This represented the first major breakthrough in improving the range and accuracy of heavy ordnance, though rifled artillery did not attain its full usefulness until greatly improved devices for sighting and rangefinding appeared in our own century. Many of the pieces found in the Washington Navy Yard are rifles. Some of these were manufactured as such; others are older bronze or iron smoothbores modernized by rifling.

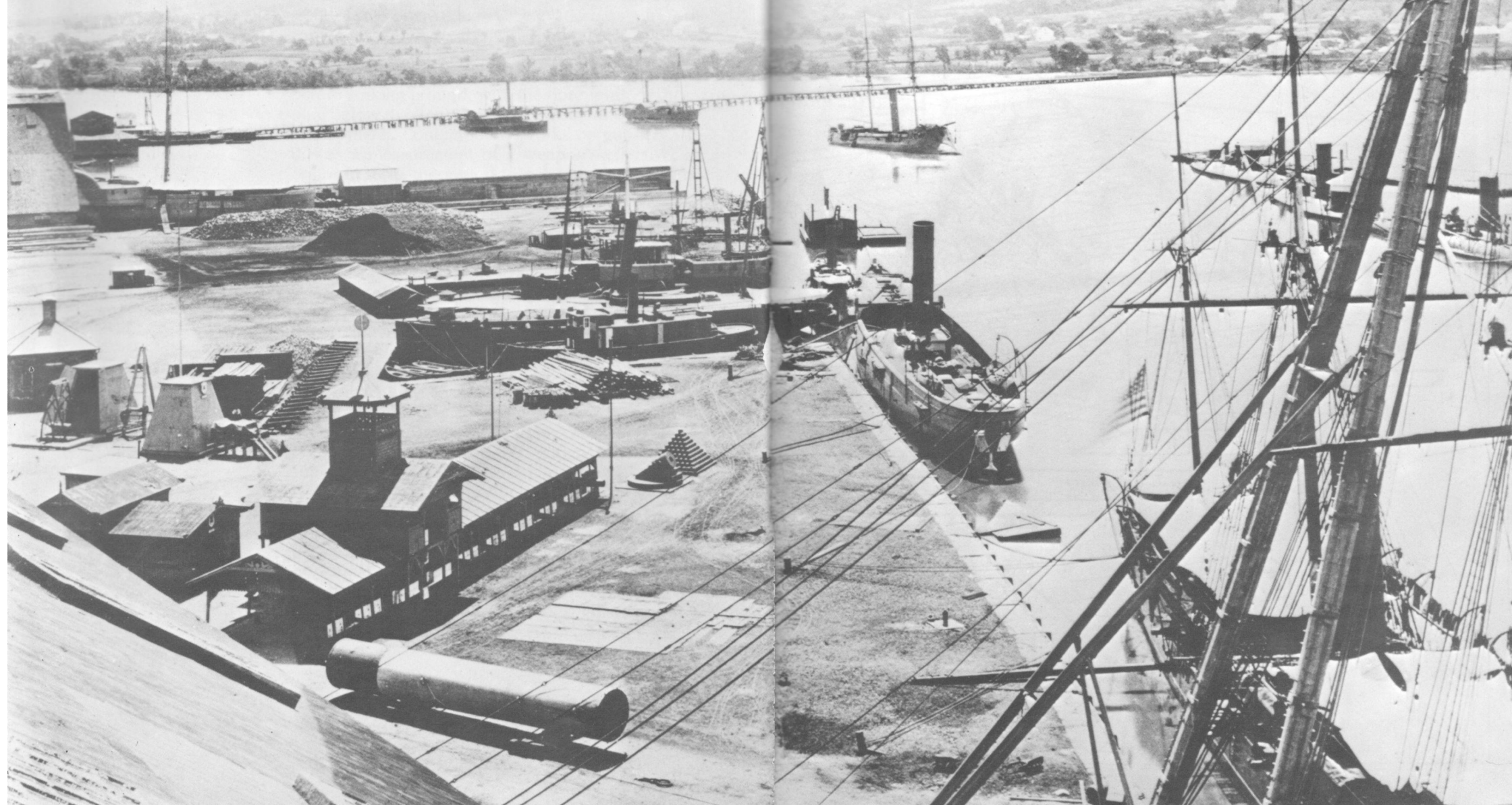
Part II A Walking Tour of Willard Park

The Washington Navy Yard waterfront in June 1866, looking east across what is now Willard Park. In the left foreground is the Experimental Battery, established in 1847 by Lieutenant John Dahlgren and used to accumulate empirical data on the performance of naval guns during the years before the Civil War. Since space for an artillery range was

not available ashore, the Battery fired down the Anacostia River toward the site of the present South Capitol Street Bridge. It was used to such good effect that, by 1853, Secretary of the Navy James Dobbin could report that "the indefatigable efforts of Lieutenant Dahlgren to give accuracy and greater effectiveness to gunnery and to improve the ordnance of the Navy has succeeded well,

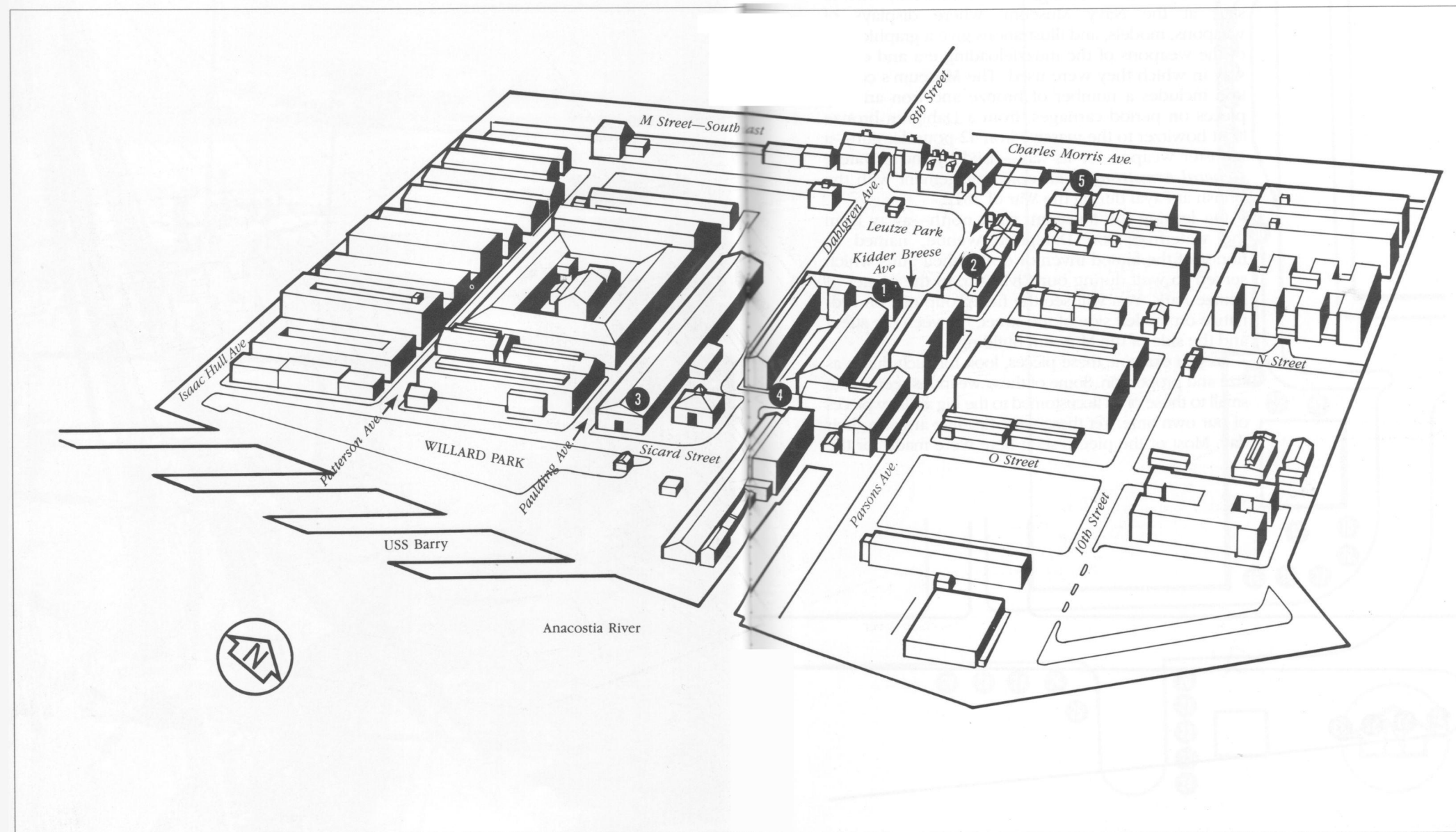
and none can doubt the advantage the service will receive therefrom." Use of the Navy Yard as an operating base during the Civil War pushed gunnery experimentation into the background. The test facility was later moved to Annapolis, then to Indian Head, Maryland, and finally to Dahlgren, Virginia, where it is now the Naval Surface Warfare Center.

The square-rigged steamer at anchor in the center is the seagoing ironclad ram Stonewall, built in France for the Confederate Navy but completed too late to see combat.



U.S. Naval Historical Activities at the Washington Navy Yard, Washington, D.C.

- 1 Dudley Knox Center for Naval History
- 2 Marine Corps Historical Center
- 3 Navy Museum
- 4 Navy Art Gallery
- 5 Main entrance at 9th and M Streets S.E.



Willard Park

The visitor to the Washington Navy Yard may wish to start at the Navy Museum, where displays of weapons, models, and illustrations give a graphic idea of the weapons of the muzzleloading era and of the way in which they were used. The Museum's collection includes a number of bronze and iron artillery pieces on period carriages, from a Dahlgren bronze boat howitzer to the massive iron 42-pounder gun—a monster weapon for its day—used by the privateer *General Armstrong* in an epic engagement with the British at Fayal during the War of 1812.

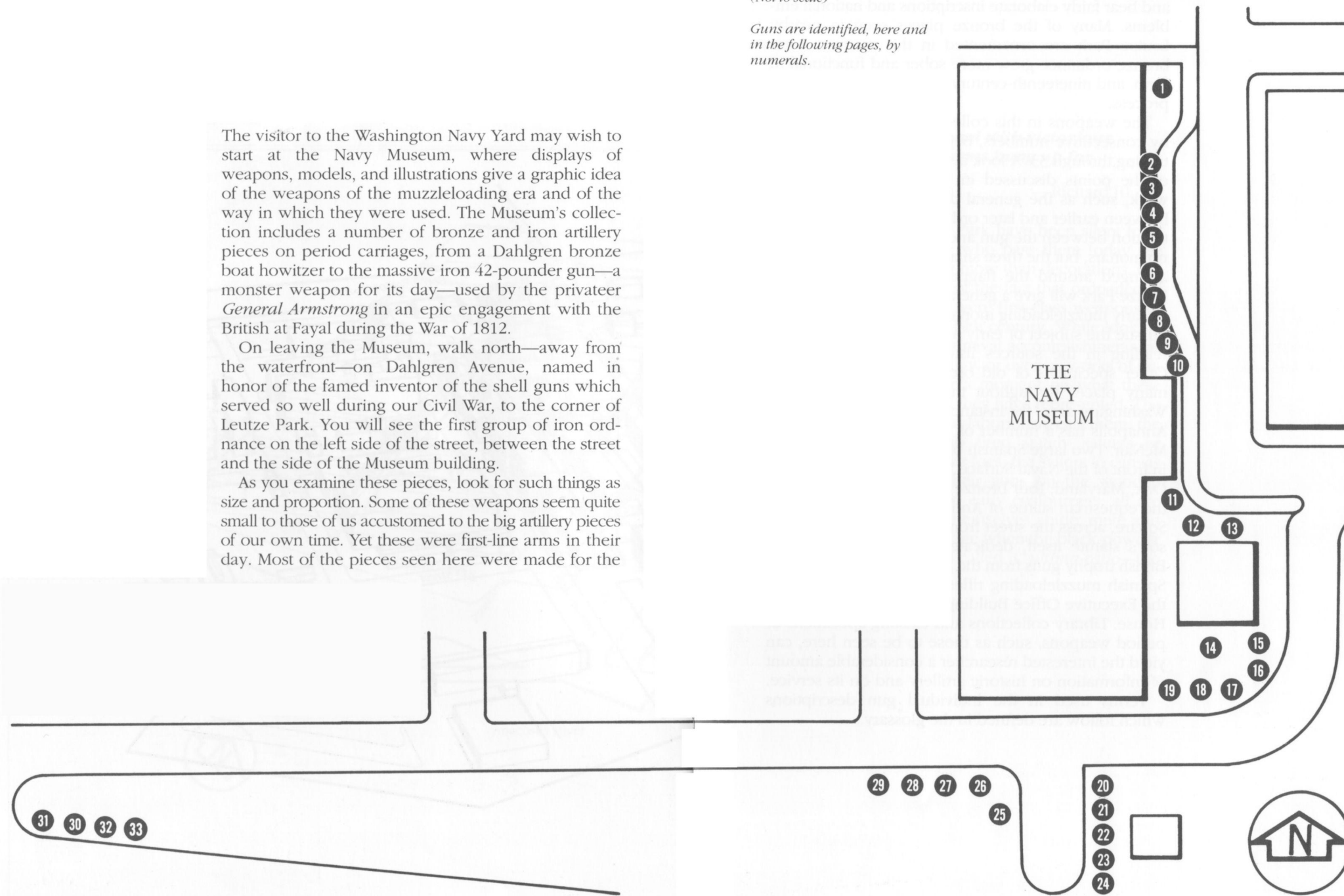
On leaving the Museum, walk north—away from the waterfront—on Dahlgren Avenue, named in honor of the famed inventor of the shell guns which served so well during our Civil War, to the corner of Leutze Park. You will see the first group of iron ordnance on the left side of the street, between the street and the side of the Museum building.

As you examine these pieces, look for such things as size and proportion. Some of these weapons seem quite small to those of us accustomed to the big artillery pieces of our own time. Yet these were first-line arms in their day. Most of the pieces seen here were made for the

A Walking Tour of Willard Park

(Not to scale)

Guns are identified, here and in the following pages, by numerals.



governments of Britain, the United States, or the Confederacy, and have some form of official identification. Earlier bronze pieces were rather flamboyant and bear fairly elaborate inscriptions and national emblems. Many of the bronze pieces seen in nearby Leutze Park are ornamented in this manner. Later bronze ordnance grew more sober and functional in form, and nineteenth-century iron guns continued the process.

The weapons in this collection are identified here by consecutive numbers, beginning with 1 and continuing through 33. A look at them will illustrate some of the points discussed in the introduction to this work, such as the general difference in appearance between earlier and later ordnance, as well as the distinction between the gun and the howitzer. There are no mortars, but the three small iron epouvette mortars arranged around the flagpole at the north end of Leutze Park will give a general idea of the proportions of early muzzleloading mortars. The reader wishing to pursue the subject of early artillery will find valuable reading in the sources listed in the bibliography. Other specimens of old ordnance can be found in many places throughout the United States. In the Washington area, for instance, the Naval Academy at Annapolis has a number of fine pieces, as does Fort McNair. Two large Spanish bronze guns are displayed in front of the Naval Surface Weapons Center at White Oak, Maryland; four bronze Spanish field guns flank the equestrian statue of Andrew Jackson in Lafayette Square, across the street from the White House. Jackson's statue itself, dedicated in 1853, is cast from British trophy guns from the War of 1812. Two bronze Spanish muzzleloading rifles of 1870 are in front of the Executive Office Building, next door to the White House. Library collections and existing specimens of period weapons, such as those to be seen here, can yield the interested researcher a considerable amount of information on historic artillery and on its service.

Terms used in the individual gun descriptions which follow are defined in the glossary.

The Guns of Willard Park

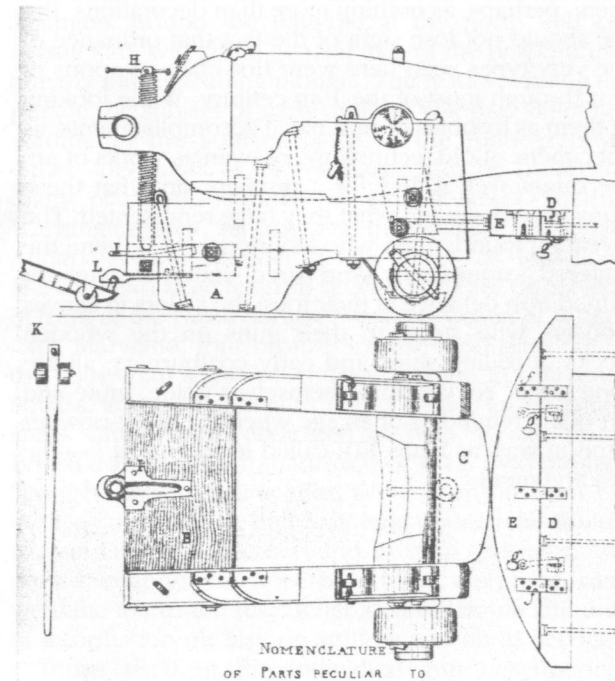
***Now are our brows bound with victorious
wreaths; Our bruised arms hung up for
monuments. . . .***

—Richard III, I:1.

The iron guns of Willard Park have been silent for a century and more. Many who pass them today see them, perhaps, as nothing more than decorations. But we should not lose sight of the fact that ordnance of the very types seen here were first-class weapons of war through most of the 19th century. While looking at them as trophies of past naval accomplishments, as specimens of old technology, or even as works of art, we might well reflect for a moment on what these guns have done and what they have represented. The sweating foundrymen who laboriously cast them; the gaitered cannoneers who fired stately salutes or hurled iron defiance at their foes; the sailors in canvas trousers who stood to their guns on the wooden decks of sailing ships and early coalburners; all are long gone. Yet the guns themselves abide, mute and brooding reminders of an age when the black-powder cannon was, as Louis XIV called it, *ultima ratio*—the last argument.

1. U.S. Navy 9-inch Dahlgren smoothbore shell gun, one of the Navy's principal ship guns during the Civil War. Test-fired here at the Washington Navy Yard in 1850, the 9-inch Dahlgren was widely used as a broadside gun in seagoing warships and continued in postwar service until replaced by steel breechloaders late in the last century. Its design led to the heavier 11-inch and 15-inch Dahlgrens which armed monitors and served as pivot guns in other warships. This gun fired a 72.5-pound explosive shell to a range, at 5 degrees elevation, of 1,710 yards; it also fired shrapnel, an explosive shell loaded with small balls which were

The Marsilly gun carriage was used with the 9-inch Dahlgren gun. The additional friction resulting from the after ends of the cheeks being carried down to the deck, instead of resting on trucks, helped to check the recoil of this heavy weapon.

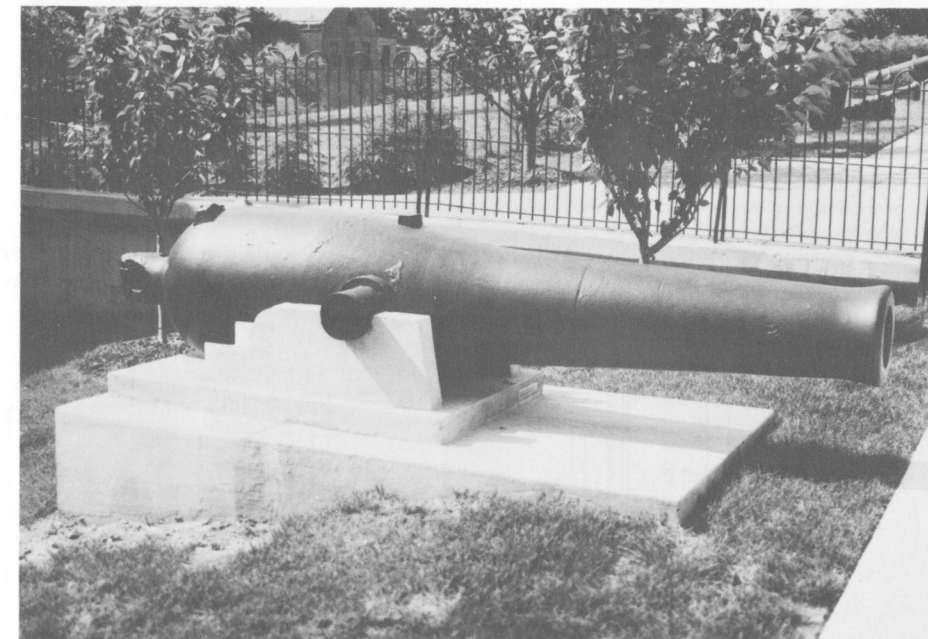


- | | |
|--|--|
| <p>A. The lowest piece of the Bracket, in place of rear truck of ordinary Carriage.</p> <p>B. Rear Transom. in place of rear axle.</p> <p>C. Breast-piece. (fixed)</p> <p>D E. Sweep-pieces.</p> | <p>D. fixed below the Port-sill.</p> <p>E. movable, with brass catches (ff) and hooks & eyes (gg).</p> <p>H. Elevating screw & lever, with saucer (i) in place of bed & quoin.</p> |
|--|--|
- K. Roller Handspike.
L. Loop for d²

sprayed toward the target when the bursting charge ruptured the shell casing. A trained gun crew could load and fire a 9-inch Dahlgren in 40 seconds.

Markings

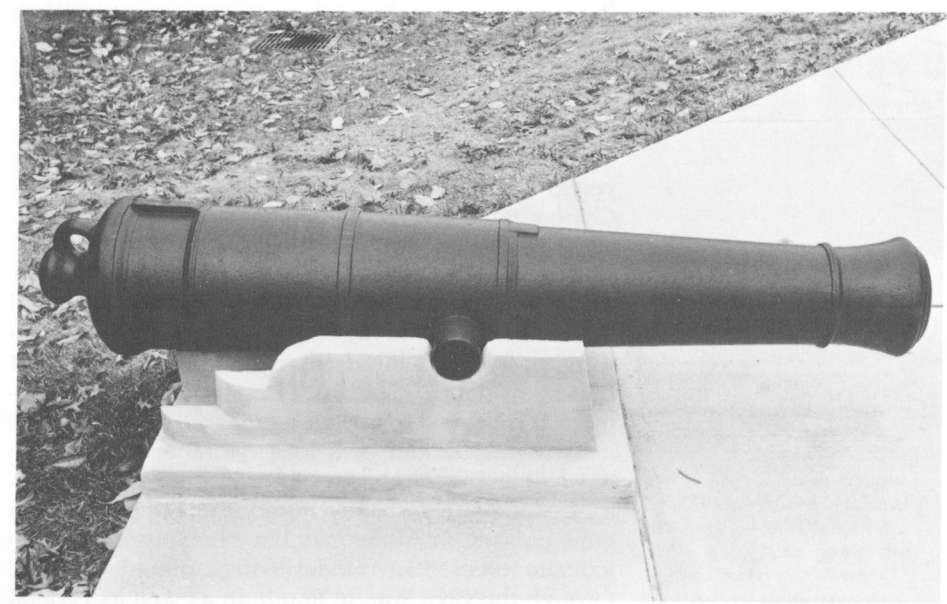
Breech Ring:	C.A. & CO. No. 378 9210 lbs	(Cyrus Alger & Co., Boston) (Navy serial number) (Weight of gun)
Upper Breeching Jaw:	806	(Preponderance of gun, in pounds)
Right Trunnion:	IX inches 1862	(9-inch smoothbore gun) (Year manufactured)
Right Rimbase:	134	(Manufacturer's number)
Left Trunnion:	P. T.A.H.	(Navy proof mark) (Timothy A. Hunt, Navy inspector)



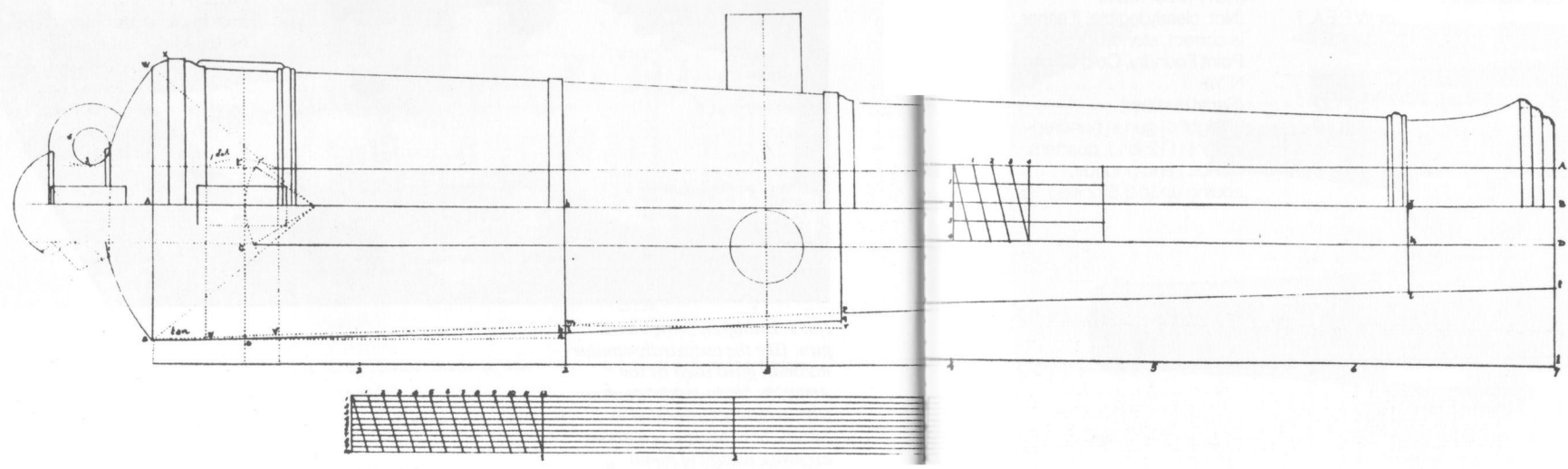
No. 1. Dahlgren 9-inch shell gun. Like the outwardly-similar Rodman guns used by the Army, its "soda-bottle" contour was carefully calculated to handle bore pressures without excessive weight of metal.

2.
 Iron 12-pounder smoothbore gun of 23 hundred-weight. In configuration it matches the general form of British naval guns of the late 18th and early 19th centuries.

Markings
 Breech Ring: M. No. 16 (Probably foundry number; "M." may refer to the founder or may simply mean "Manufacturer.")
 First Reinforce, near vent: IN (or NI) 23.3.10 (Weight of gun in hundred weight (112 lbs), quarters (28 lbs), and pounds, adding up to 2,670 pounds. The 112-pound "hundred weight" is 1/20 of a long ton (2,240 lbs).)



Draught of an Iron 12 Pounder Sea Service Gun of 23 hundred weight shewing the general Principle upon which Iron Sea Service Guns are constructed



No. 2. 12-pounder smoothbore gun. Compare its form and proportions to the following drawing of a British 12-pounder of 1791. A similar gun, manufactured in 1796, is in the nearby Navy Museum. Four inches longer and two hundredweight heavier, the Museum's gun has a chase girdle and a more ornate breech face, but bears a family resemblance.

Construction of a British 12-pounder naval gun, 1791.

3.

U.S. Navy 32-pounder smoothbore gun of 27 hundredweight, Model of 1846. This piece is the smallest in a range of 32-pounder guns adopted for Navy use under the recommendation of a board of officers chaired by Captain Charles Morris. This board, convened in 1845 by order of Secretary of the Navy Charles Bancroft, recommended that American warships be armed with solid-shot guns of 32-pounder caliber in place of the different calibers then in use. Bancroft approved the Morris board's findings, and 32-pounder guns of varying lengths and in nominal weights from 27 hundredweight (3,456 lbs.) to 61 hundredweight (7,708 lbs.) became standard armament for Navy ships of all types and sizes. Like the heavier 32-pounder next to it (Number 4), this gun has had its breaching jaws knocked off, possibly before capture. The trophy numbers stamped on both guns indicate that they may have been used by Confederate forces. Many Model 1846 32-pounders served through the Civil War, in Southern as well as Federal hands.

Markings

Right Trunnion:	32 18__	(32-pounder smoothbore) (Year manufactured; partly illegible, probably 1846)
Left Trunnion:	P. or W.P.F.A.? W.P.F.	(Navy proof mark) (Not clearly legible; if either is correct, stands for West Point Foundry, Cold Spring, N.Y.)
	No. 122 27.3.10	(Serial number) (Weight of gun in hundredweight (112 lbs.), quarters (28 lbs.) and pounds, adding up to 3,522 lbs.)

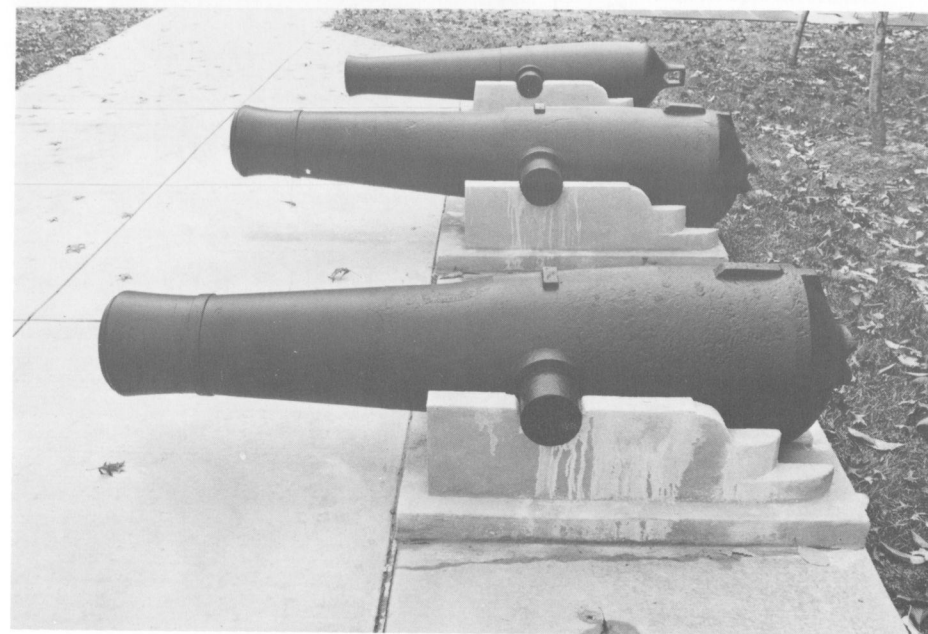
4.

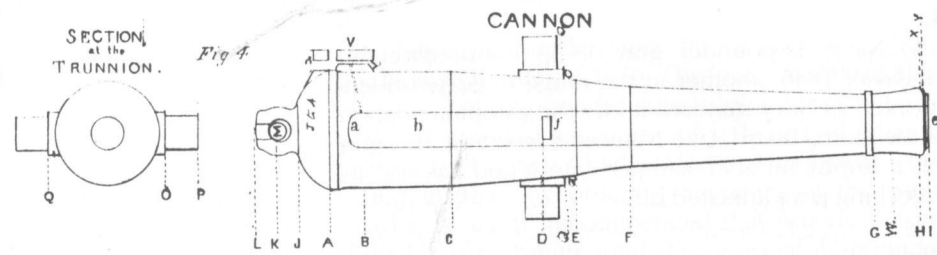
U.S. Navy 32-pounder gun of 33 hundredweight, Model of 1846, another in the range of 32-pounders adopted as Navy standard under the recommendation of the Morris board. Like Number 3 next to it, this gun has a trophy number stamped into it and has had its breaching jaws knocked off.

Markings

Right Trunnion:	32 1846	(32-pounder) (Year manufactured)
Left Trunnion:	P. A.S.M.	(Navy proof mark) (Commander Alexander Slidell Mackenzie, Navy inspector)
Top of Tube:	Anchor, defaced by letter "C"	(Anchor, denotes Navy ownership; superimposed "C" indicates gun has been surveyed and condemned for further service)
Breech Ring:	F.P.F. No. 16 33.2.05	(Fort Pitt Foundry, Pittsburgh, Pa.) (Serial number) (Weight of gun in hundredweight, quarters, and pounds, adding up to 3,757 lbs.)

No. 3. Navy 32-pounder gun of 27 hundredweight (cwt.), Model of 1846. Behind it is No. 4, a 33-cwt. gun of this series. The French, British and American navies adopted families of single-caliber solid-shot guns during the same general period. Guns of the 1846 pattern were made to the same basic configuration, differing in weight and proportion.

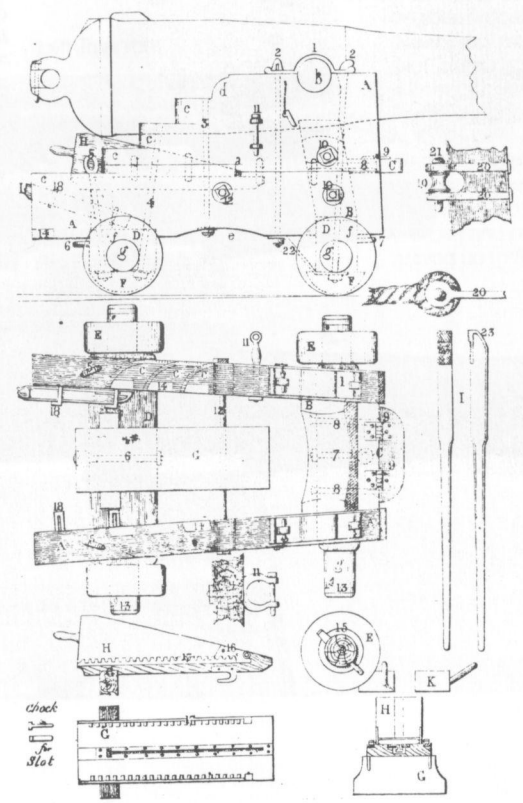




Nomenclature of a Navy 32-pounder gun, Model of 1846.

- | | | |
|--|----------------|--|
| AL — Cascable (alternate spelling of Cascabel) | G — Chase Ring | g — Breech Sight Mass |
| AJ — Base of the Breech | W — Neck | f — Reinforce Sight Mass |
| A — Base Ring | H — Swell | M — Breeching Loop |
| aj — Breech | e — Face | K — Breeching Jaws |
| BC — First Reinforce | D — Trunnions | L — Breeching Block |
| CE — Second Reinforce | QO — Rimbases | AI — Length of Piece (measured from rear of base ring to face of muzzle) |
| FG — Chase | ae — Bore | |
| GI — Muzzle | ac — Chamber | |
| | V — Vent | |

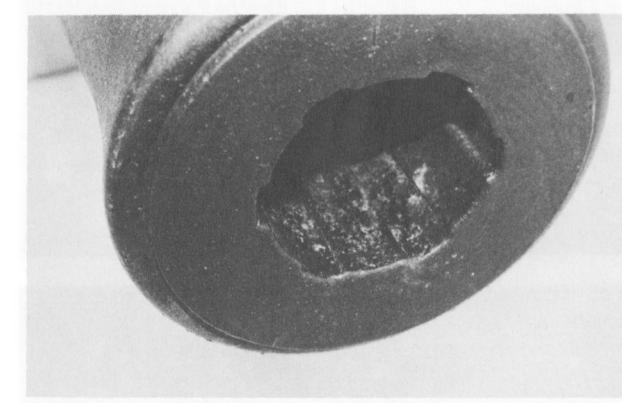
Naval "truck carriage," as used with 32-pounders of the 1846 pattern.



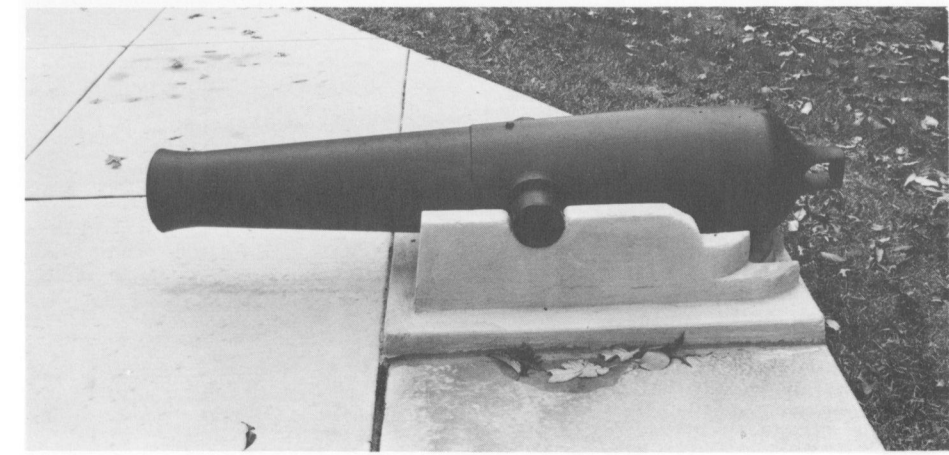
5. 4.62-inch ("30-pounder") Sawyer iron rifle, designed by Sylvanus Sawyer of Massachusetts. It armed the Federal tug *Fanny* when it was captured by Confederate vessels in Pamlico Sound, N.C., on 1 October 1861, and was later recaptured by Federal naval forces at Elizabeth City, N.C. The trophy inscription on the gun incorrectly identifies it with CSS *Louisiana*, actually scuttled by her own crew when New Orleans fell to Farragut in 1862. Small numbers of iron and steel guns of several calibers were produced to Sawyer's design for the Army and Navy.

Markings

Right Trunnion:	C A & Co	(Cyrus Alger & Co., Boston, Mass.)
Left Trunnion:	1856	(Year manufactured)
Muzzle:	1	(Serial number?)



No. 5, Sawyer 4.62-inch rifle. Sawyer's guns were characterized by the depth of their 6-groove rifling. A round for a muzzleloading rifle had to be small enough to slide down the bore, yet be able to expand and grip the rifling when fired. Sawyer approached this problem by casting his shells with flanges to fit the grooves of the bore. The flanges were coated with lead to ensure a tight fit on firing.



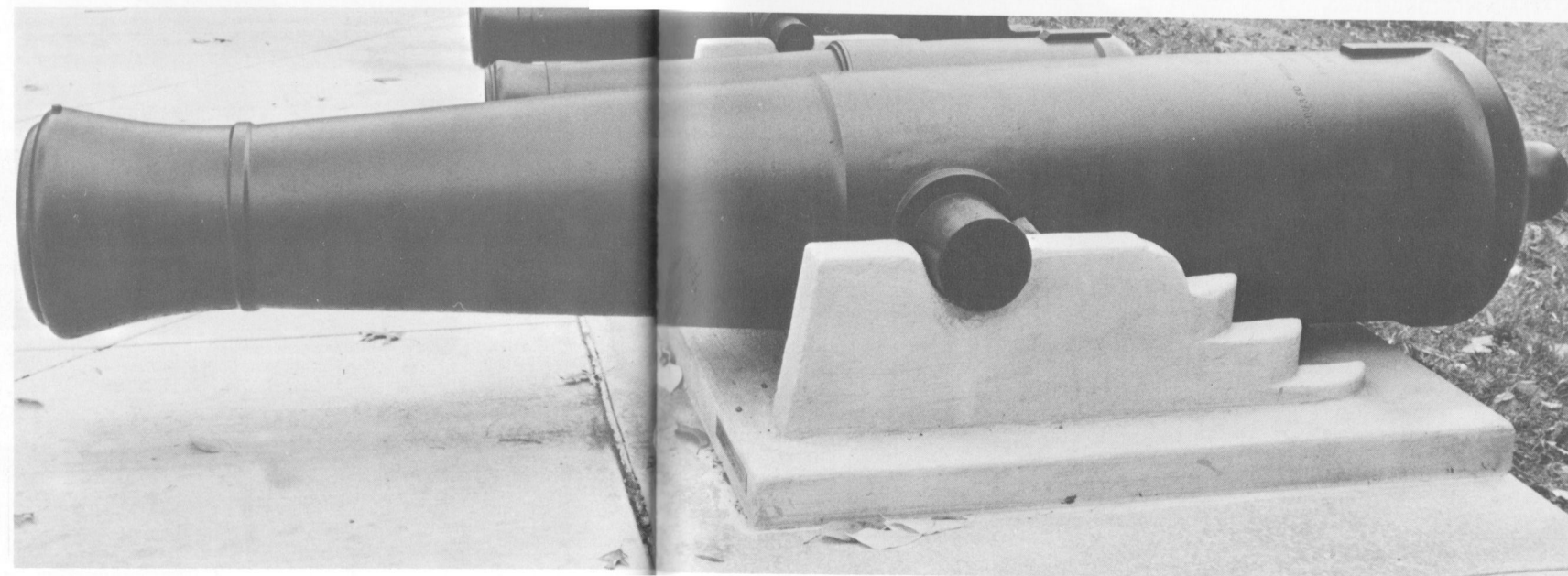
6.

U.S. Army 42-pounder smoothbore seacoast gun, Model of 1841. From the trophy inscription, it armed one of the Confederate batteries on the Potomac River which were evacuated in 1862. The date, however, appears to be in error; these batteries were abandoned in March, not July, of that year. Seacoast guns, mounted in fixed emplacements, were not subject to the constraints of size and weight imposed on field, siege, or naval guns; in its time, this piece was one of the heaviest and most powerful in the American service. Weighing 8,590 pounds with a 7-inch bore, it fired solid shot, shell, shrapnel, grape, and canister. At 5 degrees elevation, it could throw a solid shot 1,955 yards to its first ricochet.

Markings

Cascabel:	8590	(Weight in pounds)
Top of Tube:	U.S.	(U.S. Army)
Right Trunnion:	B.F.	(Bellona Foundry, near Richmond, Va.)
	J.L.A.	(Junius L. Archer, proprietor of Bellona Foundry)
Right Rimbase:	24	(Foundry number)
Left Trunnion:	1860	(Year manufactured)
Muzzle:	No. 24	(Army serial number)
	B.H.	(Benjamin Huger, Army inspector)

No. 6, U.S. Army seacoast 42-pounder of 1841. Weapons of this kind were the "16-inchers" of their day; their size and weight suited them for fortification use at a time when human and animal muscle and such simple mechanical devices as the wheel, pulley, lever, and inclined plane were the tools available to the artillerist. Compare this gun to the French naval 36-pounder in the Navy Museum. The latter piece, calibrated in the heavier Bourbon livre, is roughly equivalent to an English-measured 42-pounder. Some of the largest ships-of-the-line, battleships of the days of sail, mounted guns of this caliber on their lower gun decks; the Royal Navy eventually replaced them with 32-pounders after deciding that the bigger guns were too ponderous for ship-board use.



Trophy inscription on the breech of No. 6.



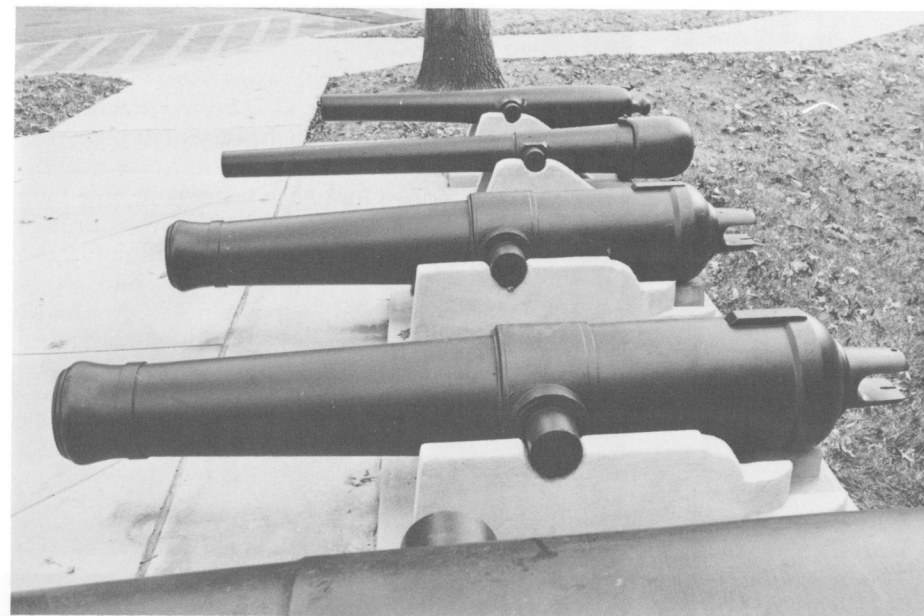
7, 8.

Two Treadwell 32-pounder wrought-iron smoothbore guns. Daniel Treadwell (1791–1872), a Massachusetts inventor, conceived a method of manufacturing cannon of wrought-iron rings, welded together and reinforced by iron hoops. He set up his own foundry and, in 1843, produced some 6-pounder field guns for the Army. In 1844 Treadwell finished four lightweight 32-pounders for the Navy, two of which are seen here. These guns were successfully tested, but were never adopted for service use, probably due to their relatively high cost.

Markings

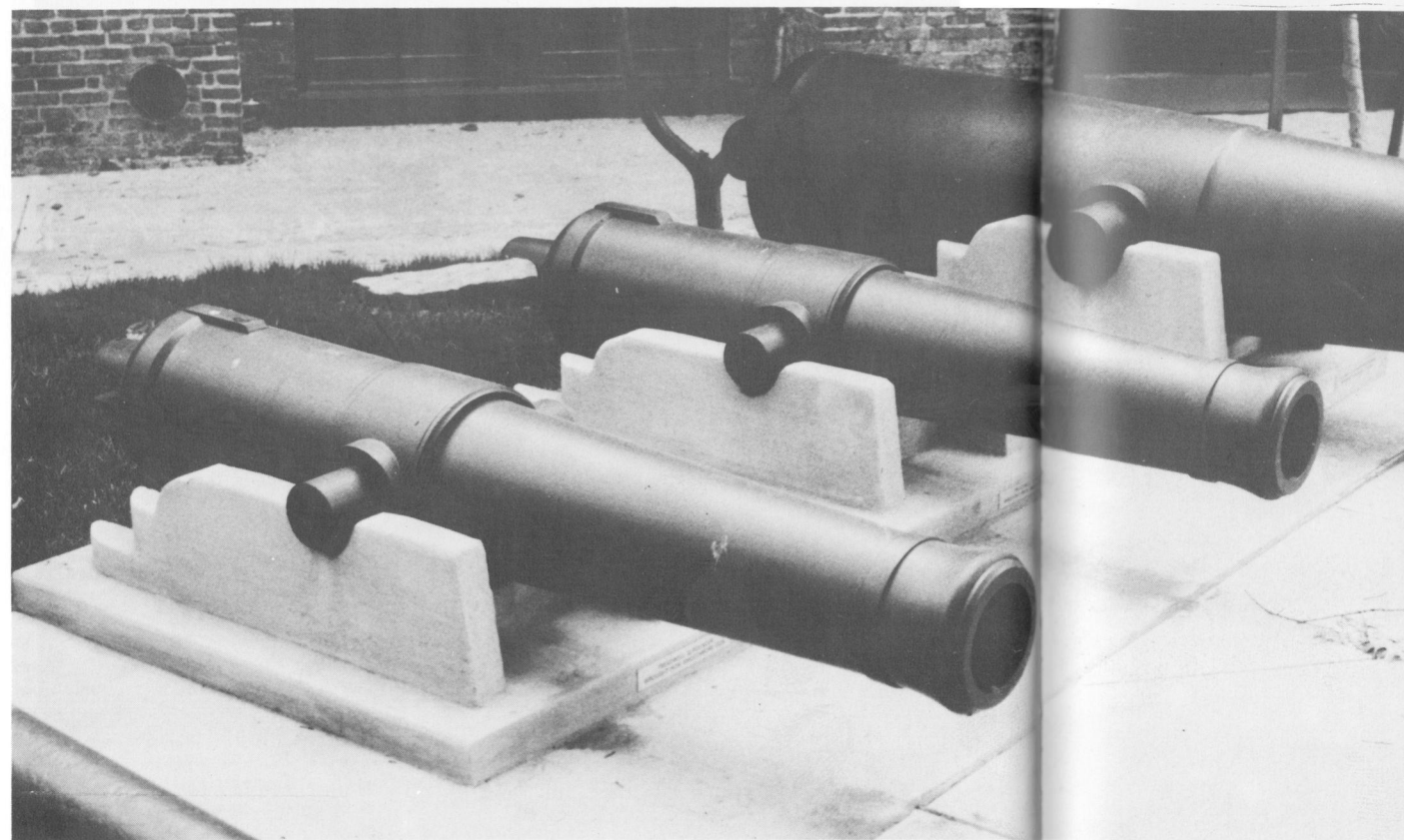
Top of Tube:
Breech Ring:

DANIEL TREADWELL
No. 2 (Manufacturer's
number, Gun 7)
No. 1 (Manufacturer's
number, Gun 8)



7

8



Nos. 7 and 8, Treadwell naval 32-pounders. Captain Rogers Birnie, Jr., USA, noted that the first Treadwell gun was made of wrought-iron rings joined end-to-end by welding. Later guns began with steel ring "and upon . . . this, winding a bar of iron spirally, as a ribbon is wound upon a block. Machinery was devised for making the rings, welding them together, and forming the guns by . . . molds, dies and sets connected with a powerful hydrostatic press.

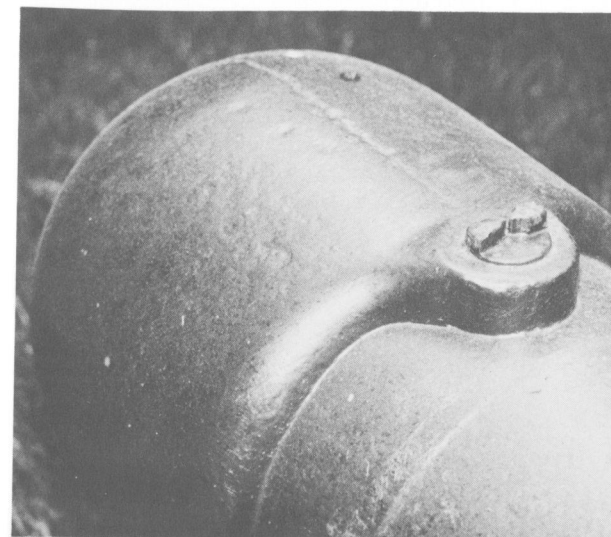
The breech was closed with a screw plug, and a trunnion band . . . was screwed upon . . . the gun. . . . He . . . economized his material and approached, as nearly as could be with the means employed, the conception of his ideal gun of equal resistance (Gun Making in the United States. New York: Military Service Institution, 1888)."

9.

Yates 3.25-inch iron breechloading rifle. No record of this gun, the only one of its kind known to exist, has, so far, appeared. The unusual horizontal "clamshell" breech mechanism, used with a metallic cartridge case, was developed for use in saluting guns; a number of these are known to exist. This gun appears to be a solitary attempt to use this mechanism in a field artillery piece. Many experimental guns and projectiles were designed during the nineteenth century, and little or nothing is known about some of them.

Markings

Left Trunnion: YATES' (Designer)



"Clamshell" breech mechanism of the Yates gun; the upper pivot also serves as a fixed rear sight. The primer was inserted into a nipple at the rear of the breech.

9

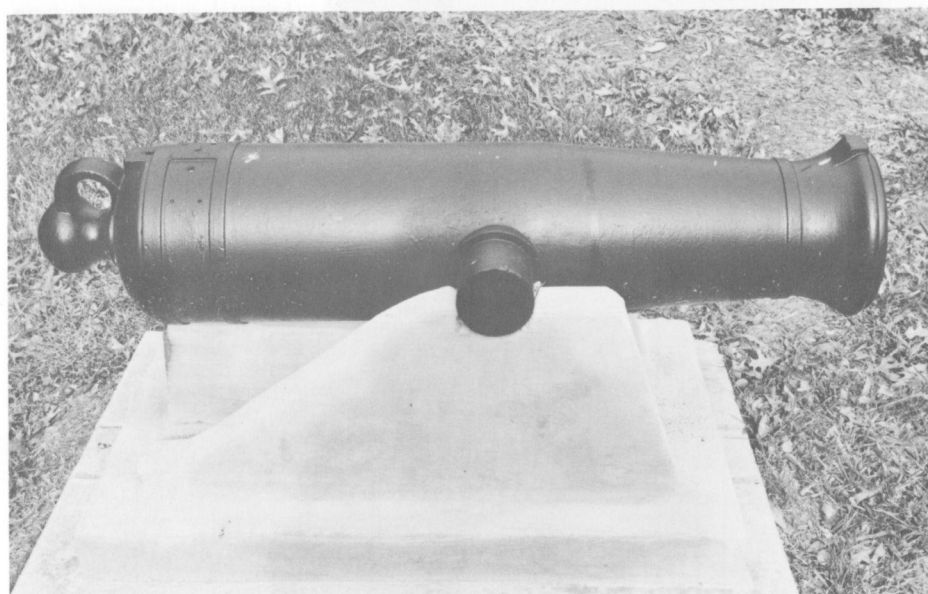
No. 9, Yates 3.25-inch rifle. Colonel Theodore Yates retired from the Army in 1867. In 1881 he patented a breech mechanism which consisted of a pair of clamshell-like clamps which, when closed, supported a gas check or cartridge case which was inserted by hand. An 8-inch Yates rifle, converted from a Rodman 10-inch muzzleloading smoothbore, was tested by the Army and found unsatisfactory. Smaller-caliber Yates guns, such as this field rifle and yacht saluting guns, seem to have worked reasonably well but were overtaken by more sophisticated systems.



11.

Bronze 4.4-inch piece, origin and provenance unknown. In its general configuration it suggests British howitzers of the first half of the nineteenth century, but differs from known standard models in proportion and details. The breeching loop on the cascabel suggests that it may have been made for sea service, possibly as a boat or landing-force piece, but such loops were also cast into some ordnance manufactured for use ashore.

Markings
None visible.



Unmarked bronze 4.4-inch howitzer. A piece of this caliber, considerably shorter in the bore, was adopted for British service in 1728 and used through 1860.

12, 13.

8-inch howitzers, made to the pattern of the U.S. Army siege and garrison howitzer of that caliber, Model of 1841. This howitzer took a charge of 4 pounds of black powder; at 12.5 degrees elevation it threw a 45-pound explosive shell 2,280 yards. Its power and high trajectory made it an effective weapon for the attack and defense of fortified places. Neither of these pieces bears any indication of manufacture, and it is uncertain whether they were originally produced for Federal or Confederate service. They were used in the defense of Charleston, South Carolina, and were captured by Union troops on Morris Island in 1863. Number 12 bears scars inflicted by Federal siege guns.

Markings
Number 12

Muzzle: 62 (Significance not known; apparently not a contemporary marking.)

Number 13
None visible.

No. 13, one of two identical 8-inch howitzers made to the pattern of the Army Model of 1841. "The siege and garrison howitzers . . . are used in the trenches at sieges, and in the defenses of permanent fortifications. . . . The 8-in. is a very short piece, and is loaded by hand. The chamber, instead of being joined to the bore by a conical surface, has a spherical one, thus allowing the shell to fit down close over the mouth of the chamber. . . . This is a matter of considerable importance, as the piece being used in siege batteries, is frequently compelled to fire over the heads of the men in the advanced trenches. . . . The breech of this howitzer is made as heavy as possible, so as to throw the center of gravity to the rear and make



the muzzle project as far as possible to the front, to save the embrasures," (John Gibbon, The Artillerist's Manual (New York, 1869)).

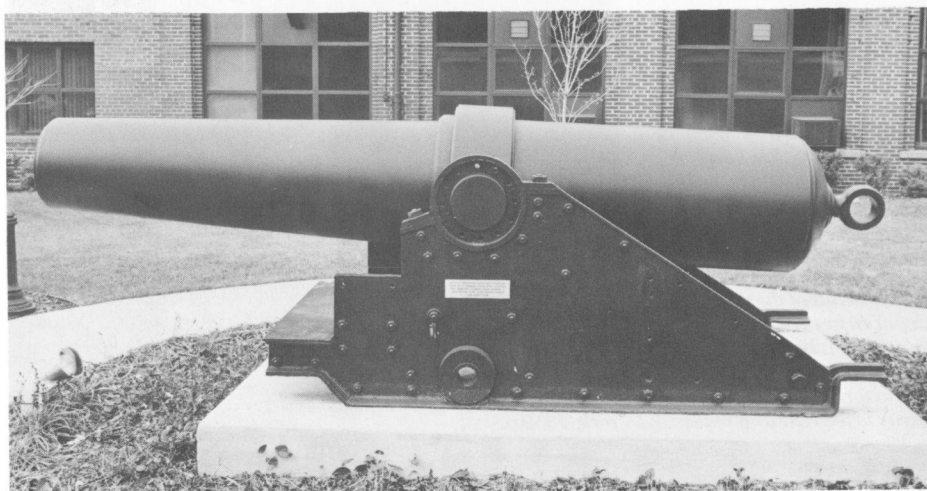
14.

12-inch wrought-iron smoothbore gun of a design developed during the 1840s by Commodore Robert F. Stockton, USN, and made under his direction. Three such guns were produced. The first, nicknamed "Oregon," was forged in England. After extensive testing it cracked, but was reinforced with an iron hoop and fired again, apparently without injury. This gun is now at the U.S. Naval Academy at Annapolis. The second, called "Peacemaker," was made in the United States and exploded during demonstration firing on board USS *Princeton* in the Potomac River on 29 February 1844. This gun, called the "Mersey Gun" or "Third Stockton gun," was forged in England by the Mersey Iron Works in 1845 to replace the "Peacemaker." Investigation of the earlier gun's explosion convinced the Navy that reliable wrought-iron guns of large caliber could not be manufactured. Though the "Mersey Gun" was satisfactorily test-fired with 224-pound shot and 45 pounds of black powder, it was never used in service. A fourth gun of these general proportions, made of cast iron, was made in the United States but blew up after firing a few trial rounds at Sandy Hook, New Jersey.

Markings

Top of Trunnion Ring:	ENGLAND T. CWT 7 10	(Weight of gun in long tons (2240 lbs.) and hundredweight (112 lbs), i.e., 16,800 lbs.)
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No. 14, Commodore John Stockton's 12-inch "Mersey Gun," displayed on an iron carriage made for a Model 1861 Army siege mortar.



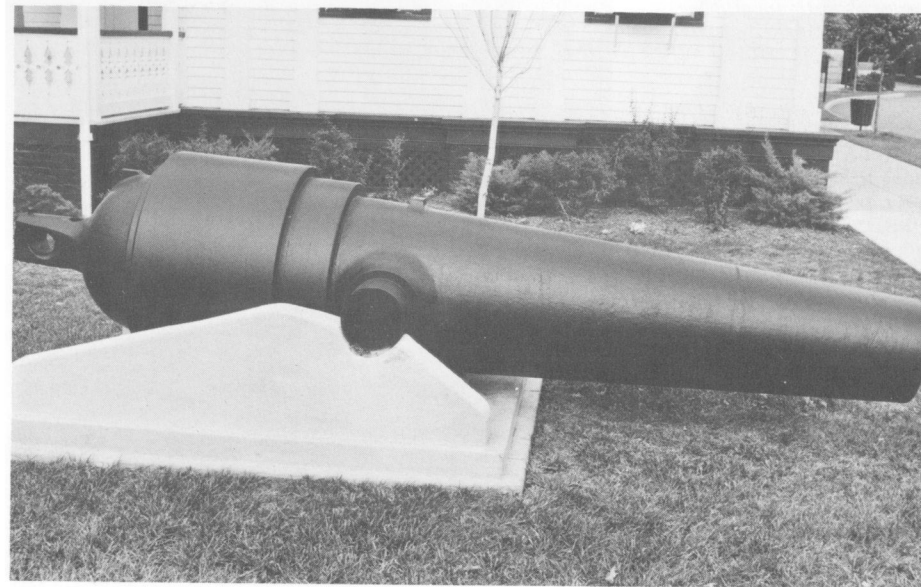
15.

Confederate Brooke 10-inch double-banded smoothbore gun made to arm the powerful ironclad ram *Columbia* at Charleston, S.C. The ram was armed and nearly ready for commissioning when she grounded. Her guns and some of her armor were removed to lighten ship, but she had not been refloated when Charleston fell to Union forces on 18 February 1865. Though most Brooke guns were rifled, this piece is one of a small number of heavy (10- and 11-inch) smoothbores developed by Commander John Mercer Brooke to fire wrought-iron solid shot, with heavy powder charges, against Federal ironclads at short ranges. This is one of two 10-inch Brooke guns known to survive.

Markings

Breech Ring:	TF	(Tredegar Foundry, Richmond, Va.)
	21,140 lbs.	(Weight of gun)
Upper Breeching Jaw:	890	(Preponderance of gun, in pounds)
Right Trunnion:	X	(10-in. bore diameter)
	1864	(Year manufactured)
Left Trunnion:	P	(Confederate Navy proof mark)
	A.D.B.	(A.M. deBree, inspector)
	57	(Possibly Confederate Navy number)
Muzzle:	1923	(Tredegar serial number)

No. 15, Brooke 10-inch double-banded smoothbore gun. Best known for his powerful rifled guns, Brooke also designed heavy smoothbores for short-range work against ironclads.

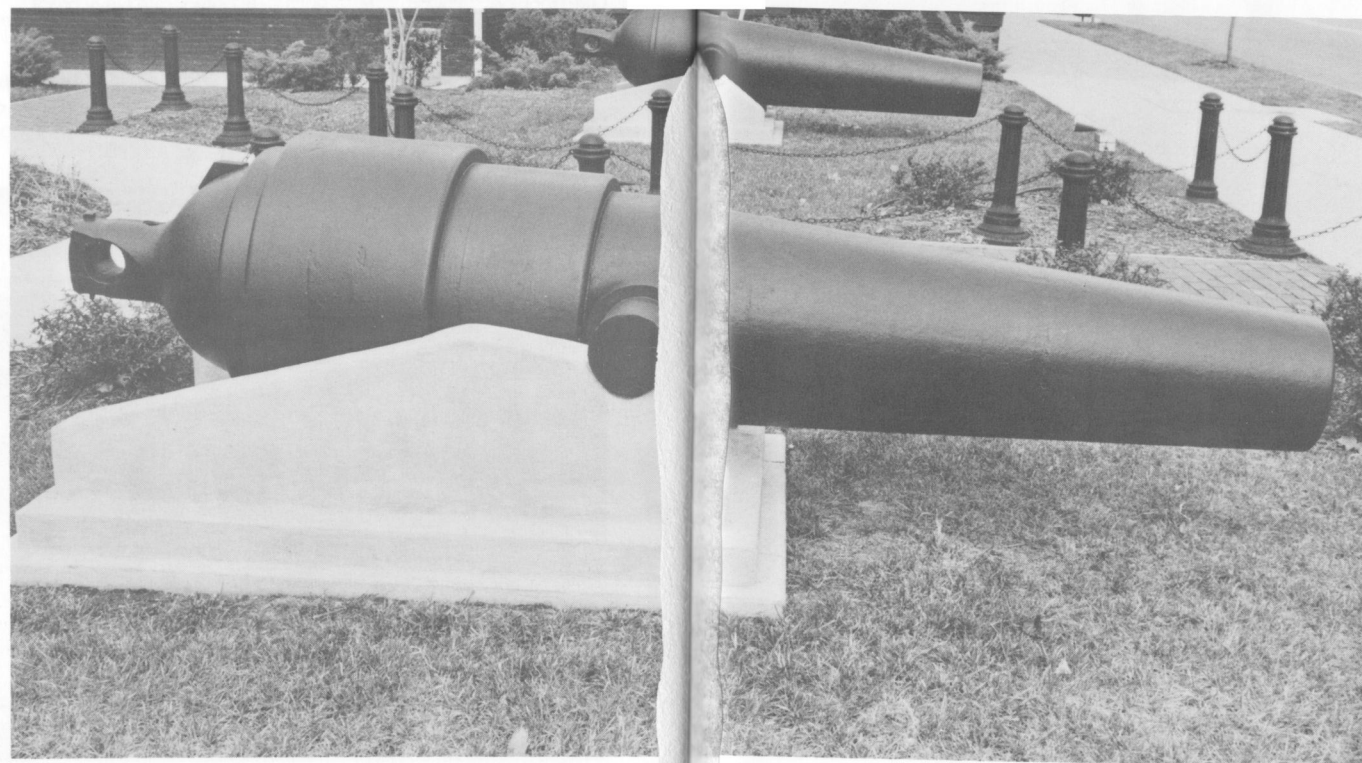


16—19.

John Mercer Brooke entered the U.S. Navy in 1841. He took part in the exploration of the North Pacific and Bering Straits, and surveyed an ocean route from California to China. When the Civil War began he joined the Confederate Navy, attaining the rank of Commander in 1862. He devised the plan for converting the former Federal steam frigate *Merrimack* to the Confederate ironclad *Virginia*, and he supervised the preparation of her guns and armor. From 1863 to 1865 he was Chief of the Bureau of Ordnance and Hydrography and designed the family of powerful Brooke guns for Confederate service. His memory has been honored by the guided missile frigate *Brooke* (FFG 1).

These four Brooke rifles were made for the Confederate ironclad *Tennessee*, and were captured with their ship by Farragut in Mobile Bay on 5 August 1864. Number 16 is a 7-inch rifle, while the remaining three are 6.4-inch pieces. Each consists of a cast-iron tube reinforced, at the breech, by two wrought-iron bands.

No. 16, a Brooke double-banded 7-inch rifle from CSS Tennessee. The first Brooke guns were reinforced by a single band. By 1862 Brooke produced guns with a second band shrunk over the first for added strength; some later Brookes had three such bands. After the action between Monitor and Virginia, Confederate Secretary of the Navy Stephen Mallory noted, of the 7-inch Brooke, that "in strength, accuracy, and range it is superior to all of our guns. During the action . . . after being fired several times, it was doubly charged by mistake, and stood the test . . . without the least complaint."



Markings

Number 16:

Inner, Outer Bands;
Trunnions; Middle
Sight Mass:

S5

(Selma Naval Ordnance Works, Selma, Alabama; manufacturer's number 5.)

Number 17:

Breech Ring:

TF
R.N.O.W.

(Tredegar Foundry) (Richmond Naval Ordnance Works) (This combination of markings indicates that this gun was cast by Tredegar, but rifled by the Richmond Works.)

Right Trunnion:

10,680
6.4 in.

(Weight of gun) (Bore diameter)

Left Trunnion:

1863
P

(Year manufactured) (Confederate Navy proof mark)

A.D.B.
47

(A.M. deBree, inspector) (Possibly Confederate Navy number)

Muzzle:

1841

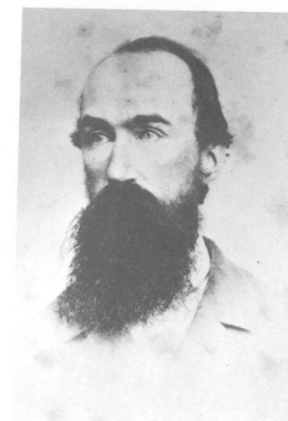
(Tredegar serial number)

16

17

18

19

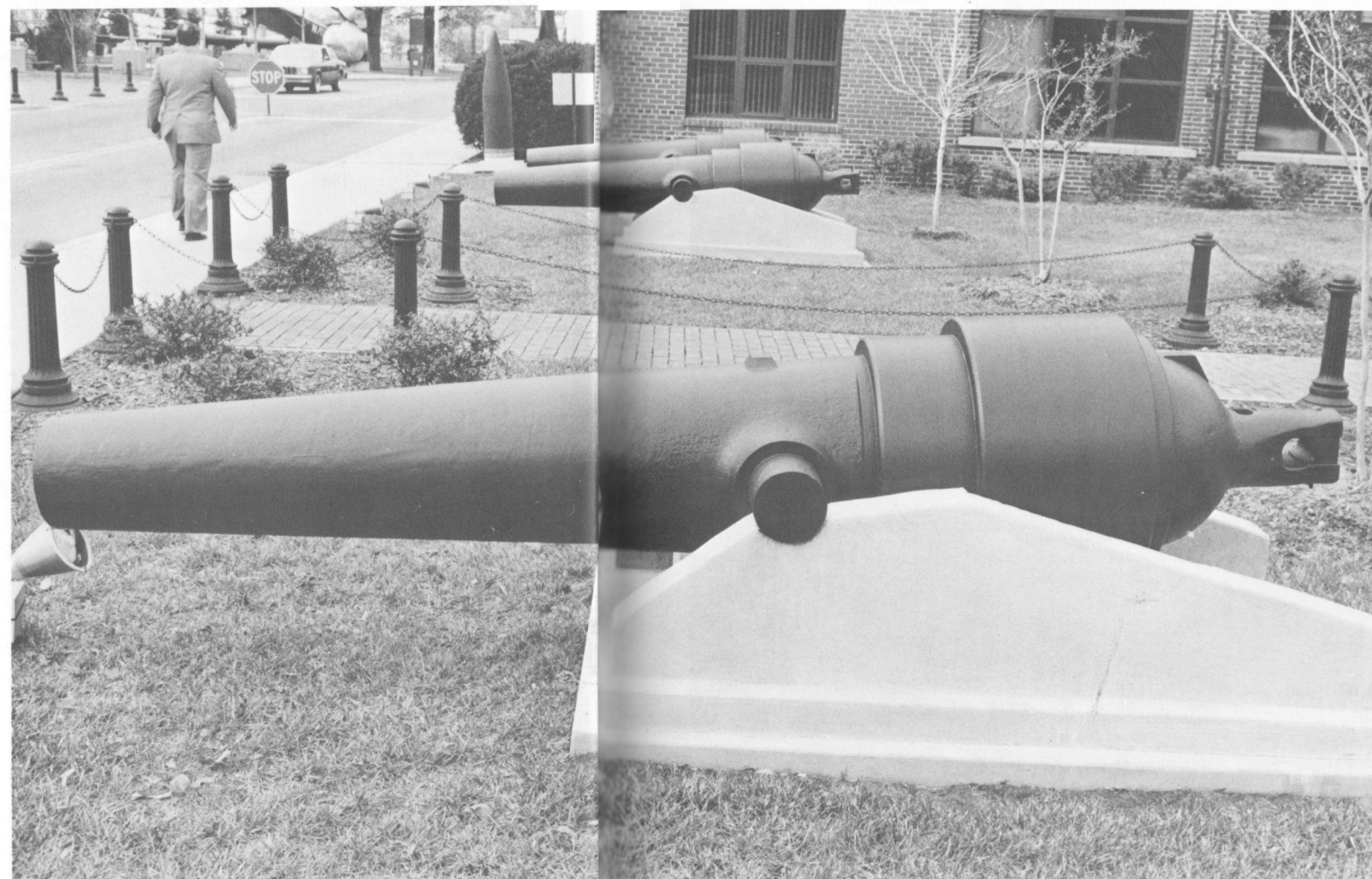


Lieutenant John Mercer Brooke, circa 1851; from a painting. Courtesy George M. Brooke, Jr.

Number 18:		
Breech Ring:	TF	(Tredegar Foundry, Richmond, Va.)
	10,790	(Weight of gun)
Upper Breeching Jaw:	880	(Preponderance of gun, in pounds)
Right Trunnion:	6.4 in.	(Bore diameter)
	1863	(Year manufactured)
Left Trunnion:	P	(Confederate Navy proof mark)
	A.D.B.	(A.M. deBree, inspector)
Muzzle:	1714	(Tredegar serial number)

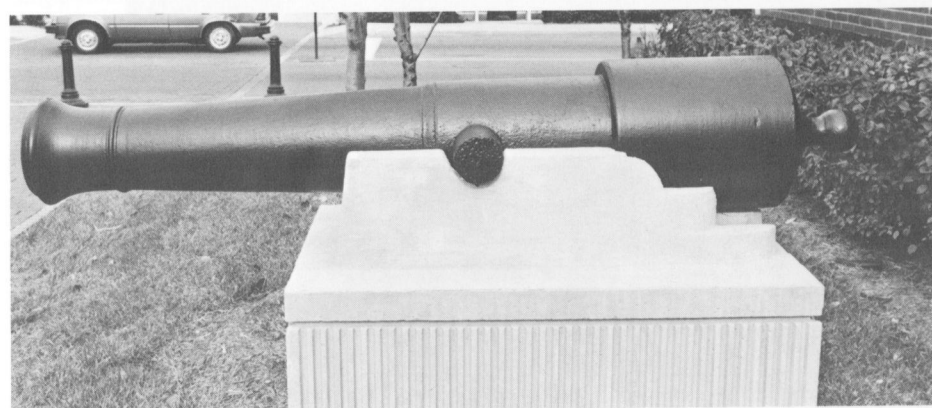
Number 19:		
Breech Ring:	TF	(Tredegar Foundry, Richmond, Va.)
	10,675	(Weight of gun)
Upper Breeching Jaw:	912	(Preponderance of gun, in pounds)
Right Trunnion:	6.4 in.	(Bore diameter)
	1863	(Year manufactured)
Left Trunnion:	P	(Confederate Navy proof mark)
	A.D.B.	(A.M. deBree, inspector)
Muzzle:	1711	(Tredegar serial number)

Nos. 17-19, Brooke double-banded 6.4-inch rifles from Tennessee. Like their heavier sisters, these were formidable weapons. In October, 1862, a single-banded Brooke loaded with 12 pounds of black powder put an 85-pound solid bolt through three 2-inch iron plates.



20.
 12-pounder (4.62-inch) iron smoothbore field gun, banded and rifled. The gun is believed to be of American make, cast before the War of 1812. It was apparently rifled for Confederate service; the inscription on the breech identifies it as being a Confederate trophy.

Markings
 No identification marks discernible.
 Breech: RECEIVED FROM AN-NAPOLIS MD., APRIL 1886, IN-VOICED CAPTURED. (Trophy Inscription)



No. 20, 12-pounder iron smoothbore banded and rifled. Lack of rimbases, and an ogee at the reinforce, indicates that it may predate the War of 1812.

21.
 British 32-pounder naval smoothbore, converted to a 6.25-inch rifle and possibly unique. Its 8-groove bore has the characteristic pattern of rifling developed by Captain T. A. Blakely, the English inventor and manufacturer of rifled ordnance. It armed the Confederate commerce raider *Florida*, commissioned in England in 1862. Before this successful cruiser was captured by the Union steam sloop-of-war *Wachusett* at Bahia, Brazil, on 7 October 1864, she had taken 37 prizes.

Markings
 Left Trunnion: LOW MOOR (Iron Co., England) 10666 (Maker's number)
 Breech Face: 32-PDR (Trophy Inscription) RIFLED FROM ANGLO-REBEL PIRATE FLORDIA



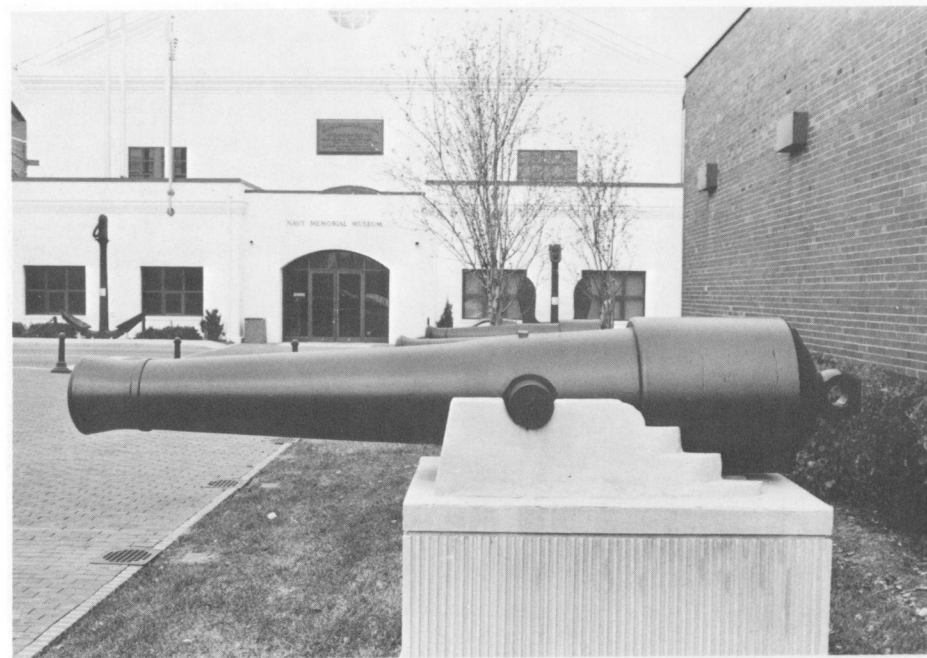
No. 21, a British 32-pounder naval gun, thought to date from the 1850s, rifled on the Blakely pattern.

22.

U.S. Navy 32-pounder (6.4-inch) smoothbore, model of 1846, banded and rifled for Confederate service. Like the former Army 32-pounder next to it, it is rifled in the Brooke "sawtooth" pattern. This gun was one of two which armed the Confederate tug *Teaser* when she was disabled and captured by the Federal gunboat *Maratanza* in the James River on 4 July 1862.

Markings

Breeching Jaw:	3	
Breeching Block:	3 (?)	
Right Trunnion:	32	(32-pounder)
	1852	
Left Trunnion:	P	(Navy proof mark)
	C.W.S.	(Captain Charles W. Skinner, inspector of ordnance)
Muzzle Face:	642	(Added at some time after manufacture)



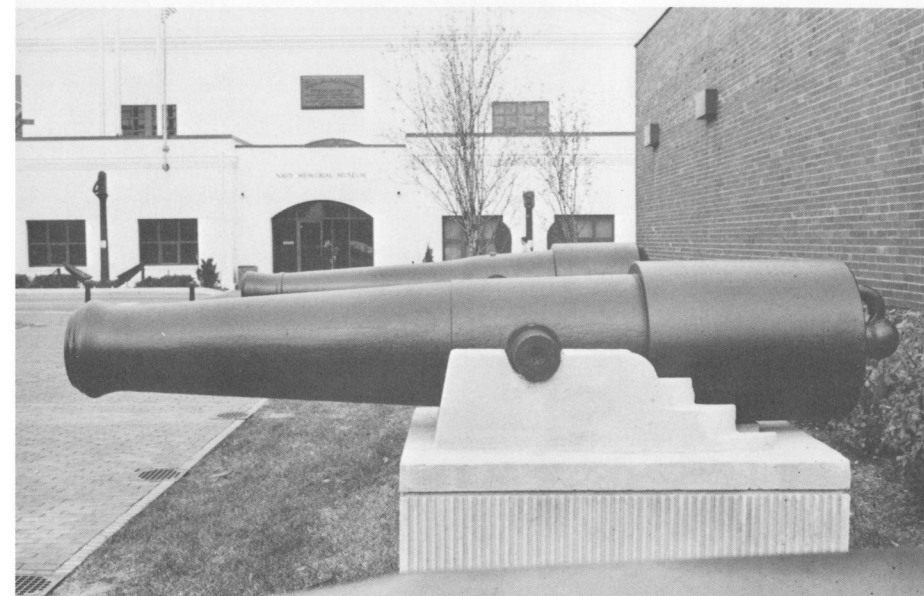
No. 22, Navy 32-pounder of 57 cwt., one of the Model 1846 series of guns of this caliber exemplified by Nos. 3 and 4, but banded and rifled by a Confederate arsenal.

23.

U.S. Army 32-pounder smoothbore made at Columbia Foundry, Georgetown, Washington, D.C., in 1834, and banded and rifled by Confederates during the Civil War. Its "sawtooth" rifling is a pattern used by Commander John Mercer Brooke, the noted designer of ordnance for the Confederate forces. It was captured by Union gunboats under Rear Admiral David D. Porter at Fort DeRussy, Louisiana, on 12 March 1864 during the Red River campaign.

Markings

Top of Tube:	U.S.	
Right Trunnion:	I.M.	(John Mason, foundry proprietor)
	C.F.	(Columbia Foundry)
Left Trunnion:	1[83]4	
Muzzle Face:	W.J.W.	(William J. Worth, Army ordnance inspector)
	No. 289	(Army serial number)



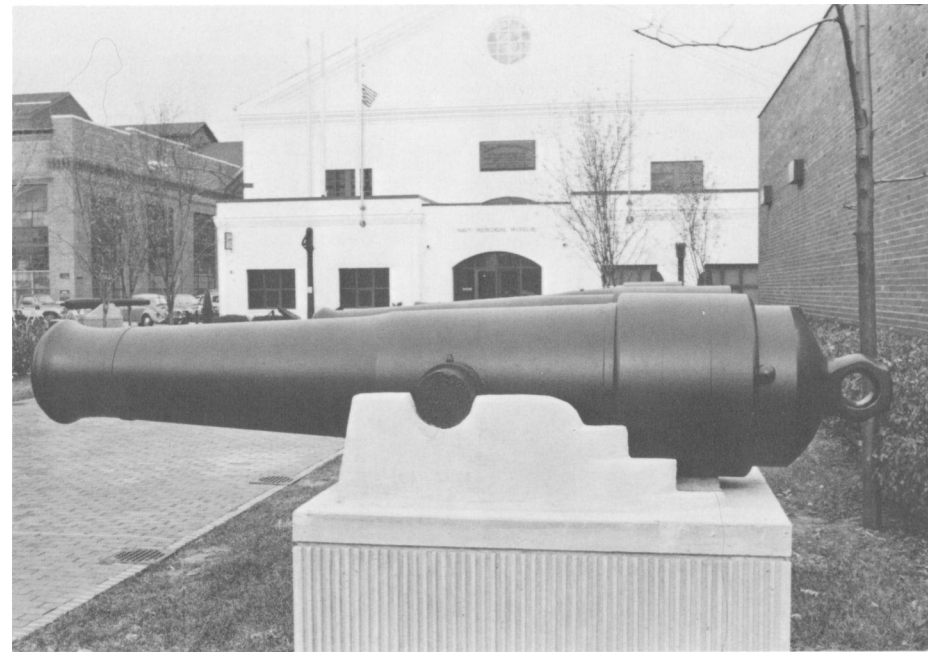
No. 23, Army 32-pounder seacoast gun, Model 1829, banded and rifled by Confederates. Many guns of this general pattern appeared in Federal and Southern fortifications.

24.

Blakely 7.5-inch rifle, possibly a British 42-pounder iron smoothbore rifled and reinforced, at the breech, by a band. In its configuration and type of rifling, it matches the "Widow Blakely" gun at Vicksburg, Mississippi. This gun was abandoned by Confederate forces when they evacuated a battery at Shipping Point, on the Potomac River at the mouth of Quantico Creek, on 9 March 1862.

Markings

Top of Tube:	BLAKELY'S PATENT 1861	
Firing lock mass:	13	
Left Trunnion:	LOW MOOR 10759 1861	(Iron Co., England) (Maker's serial number)



No. 24, Blakely 7.5-inch rifle, seemingly a 42-pounder smoothbore rifled and banded. A lug for an adjustable rear sight appears at the left side of the breech, with a blade front sight on the left rimbase.

25.

British Blakely 4-inch rifled gun, captured near Fort Fisher, N.C., on 23 August 1863 by a Union landing force from the steam frigate *Minnesota*. This is the only piece of its kind known to exist in the United States.

Markings

Top of Tube:	FAWCETT, PRESTON & CO. LIVERPOOL 1862	
Right Trunnion:	136	(Possibly a serial number)
Muzzle face:	921	(Possibly a serial number)



No. 25, a Blakely 4-inch rifle similar to the Federal 3-inch Ordnance rifle (No. 10) in its functional appearance.

26. Whitworth 2.75-inch muzzleloading rifled field gun, one of a small number known. Like its breechloading contemporary, it is made of steel with hexagonal rifling. Several principal types of Whitworth rifles were brought into this country during the Civil War, though references are found to other models.

Markings
 Both Trunnions: MAN-CHESTER ORDNANCE & RIFLE CO. (Manufacturer)
 WHIT-WORTH PATENT (Sir Joseph Whitworth, English inventor)
 No. 115 (Manufacturer's number)
 1863 (Year manufactured)



No. 26, one of a few existing 2.75-inch Whitworth muzzle-loading rifled field guns. This steel gun has the same hexagonal rifling used in the better-known Whitworth 2.75-inch breechloader, specimens of which can be seen at Petersburg and Gettysburg. The socket at the breech held the rear sight; the front sight blade is located on the right rimbase.

27. Experimental breechloading rifle of unknown design, probably one of the many prototype pieces of ordnance tested by the Army and Navy during and after the Civil War. It bears a superficial similarity, in general size and proportion, to the breechloading Whitworth 2.75-inch rifle used, in small numbers, by the Confederacy and well liked by them. Its 7-groove rifling, however, is conventional rather than the hexagonal Whitworth spiral, and its horizontally rotating cylindrical breechblock bears no resemblance to Sir Joseph Whitworth's design. The breech mechanism is similar to some devised by Joseph Needham, an Englishman, after the Civil War for cannon and small arms.

Markings
 None visible.

No. 27, experimental post-Civil War breechloader, possibly of Needham's pattern. Many prototype schemes, such as this piece and the Yates gun (No. 9), were devised during the second half of the last century before interrupted-screw and sliding-block breech mechanisms were combined with metallic-case ammunition to produce satisfactory breechloading artillery.

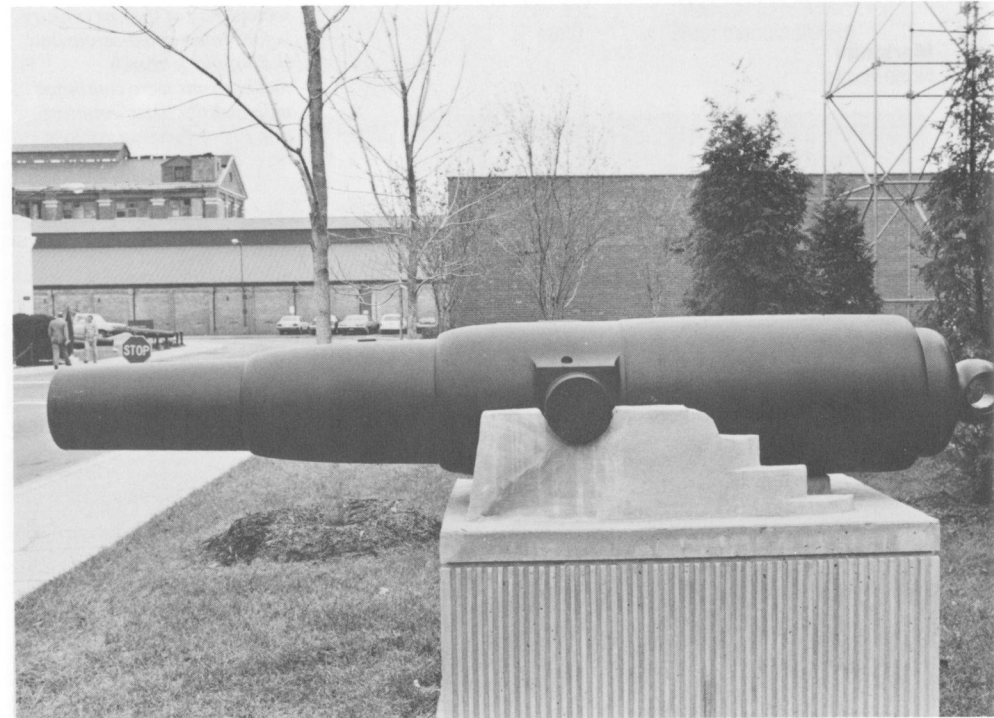


28.

Whitworth 5-inch muzzle-loading rifle, one of four such British-made guns captured in the blockade runner *Princess Royal* off Charleston by the gunboat *Unadilla* on 29 January 1863. Some writers refer to this gun as a "70-pounder" or "80-pounder" Whitworth. A second gun of this model is at West Point.

Markings

Top of Tube: WHIT-
WORTH (Whitworth Ordnance Co.,
Manchester, England)



No. 28, Whitworth 5-inch rifle. Two similar Whitworths, captured in a blockade runner, were used by the Federals against Charleston but were deemed highly unsatisfactory. Shells exploded prematurely and tended to

jam in the bore during loading, and accuracy was poor. When the inner tube of one gun slipped back an inch on firing, both pieces were taken out of service; the disabled gun is now at West Point.

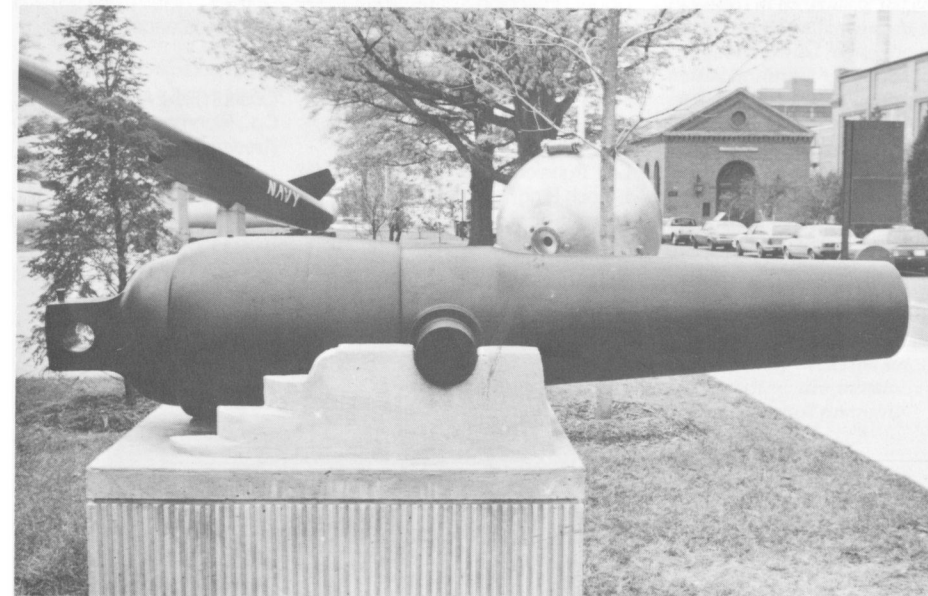
29.

English Blakely 7-inch (100-pounder) muzzleloading rifle, one of two which armed the Confederate cruiser *Florida* when she was captured at Bahia, Brazil, on 7 October 1864 by the Union steam sloop *Wachusett*. Guns of this type were used at sea and in coastal fortifications. This may be the only gun of its type in existence.

Markings

Right Trunnion:	J.D.B.	(Possibly a British inspector)
Left Trunnion:	80	(Manufacturer's serial number?)
Top of Tube:	BLAKELY'S PATENT No. 37	(Blakely's number?)
	FAWCETT, PRESTON & CO., LIVER- POOL, MAKERS	
	1861	(Year manufactured)
Upper Breeching Jaw:	80	(Matching numbers indicate that this block was hand- fitted to the breeching jaws of this gun)
Breeching Block:	80	
Muzzle:	80	

No. 29, 7-inch Blakely rifle. This gun, from the Confederate raider *Florida*, may be generally similar, in configuration, to the 6.4-inch pivot gun which armed the cruiser *Alabama* in her duel with *USS Kearsarge*.



30-33.

These four single-banded Brooke rifles made up the battery of the Confederate ironclad ram *Atlanta*. Originally the British blockade runner *Fingal*, this ship was purchased in 1862 and converted into an armored warship at Savannah. She served in the Savannah area, often flying the flag of Commodore Josiah Tattnall, until her capture in Wassaw Sound, Georgia, by the Federal monitors *Weehawken* and *Nahant*. Generally similar to the four Brooke guns from CSS *Tennessee* (Numbers 16-19), these pieces have one wrought-iron reinforcing band, a relatively scarce configuration. The reinforcing band is made up of iron rings, heated and shrunk into place around the gun's cast-iron tube. A single-piece iron band was similarly used in the well-known Parrott rifles of this period. Numbers 30 and 33 are 7-inch guns, while 31 and 32 are 6.4-inch weapons.

Markings

Number 30:

Right Trunnion:	VII. in.	(Bore diameter)
	1862	(Year manufactured)
Left Trunnion:	P	(Proof mark)
	A.D.B.	(A.M. deBree, Navy inspector)
Breech Ring:	TF 15,162	(Tredegar Foundry; weight)
Muzzle; Upper Breeching Jaw; Breeching Block:	1652	(Tredegar serial number)
Upper Breeching Jaw:	908	(Preponderance)

Number 31:

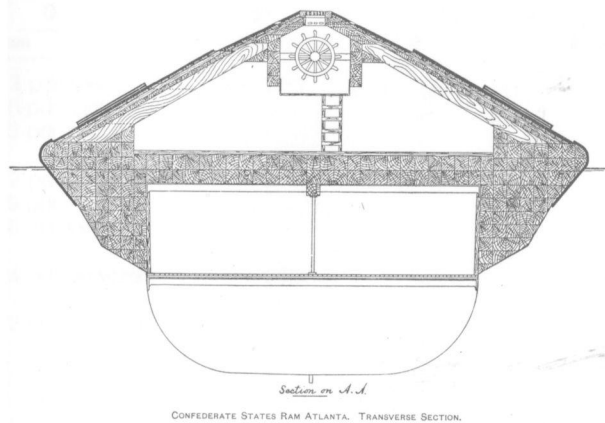
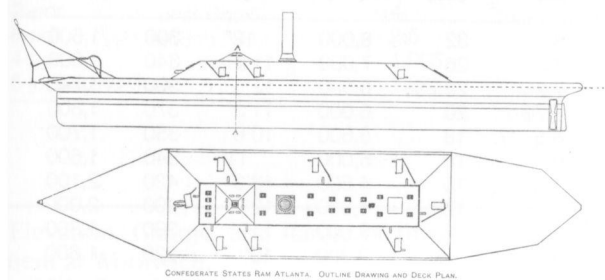
Right Trunnion:	J.R.A. & Co.	(Joseph Reid Anderson & Co., Richmond, Va.)
	TF	(Tredegar Foundry)
Left Trunnion:	1862	(Weight)
Breech Ring:	9120	(Weight)
Muzzle; Upper Breeching Jaw; Breeching Block:	1610	(Tredegar serial number)

Number 32:

Right Trunnion:	J.R.A. & Co.	(Joseph Reid Anderson & Co.)
	TF	(Tredegar Foundry)
Left Trunnion:	1862	(Weight)
Breech Ring:	9110	(Weight)
Muzzle; Upper Breeching Jaw; Breeching Block:	1587	(Tredegar serial number)
Upper Breeching Jaw:	9?	(May have indicated preponderance)
	(eroded)	

Number 33:

Right Trunnion:	VII in.	(Bore diameter)
	1863	
Left Trunnion:	P	(Proof mark)
	A.D.B.	(Inspector's initials)
	40	(Last digits of founder's serial)
Breech Ring:	TF	(Tredegar Foundry)
	15,315	(Weight)
Muzzle:	1740	(Tredegar serial number)
Upper Breeching Jaw:	910	(Preponderance)



Profile, plan view, and cross-section of CSS *Atlanta*, drawn to accompany USS *Wabash*'s report of her capture. The sloping casemate was protected by 4" of iron over 3" of oak and 15" of pine. Two 7" Brooke rifles were mounted at the ends of the casemate, on pivot carriages that could be trained along the centerline or through ports to either beam. Two 6.4" Brookes fired through the staggered broadside ports shown, one forward and one abaft the boiler uptakes. ATLANTA's stem forms a waterline ram. The pole at the bow connected to a curved iron lever, carries a black-powder spar torpedo fired by an impact ("percussion") detonator. 17" timbers, supported by 10" beams, make up the battery deck; the sides, at the waterline, are massively reinforced to resist ramming.

Characteristics and Performance of Early Ordnance

These tables illustrate the variety of calibers and weights of early ordnance in service. There was considerable variation in the dimensions and performance of actual guns; contemporary tables, earlier ones in particular, should be taken as general indications only.

"A Table of the Names of the Great Ordnance Now Used,"
from Thomas Smith, *The Complete Soldier* (London: 1628)

Name	Shot (lbs.)	Calibe (ln.)	Powder (lbs.)	Weight (lbs.)	Length	Range (yards)	
						Point-Blank	Maximum
Cannon	64	8	32	8,000	12"	300	1,500
Cannon, serpentine	52	7.5	26	7,000	11'6"	340	1,600
French cannon	46.75	7.25	23.25	6,500	12'	360	1,740
Demicannon, eldest	36.63	6.75	20	6,000	11'3"	370	1,800
Demicannon, ordinary	32	6.5	18	5,600	10'6"	350	1,700
Demicannon	24.5	6	16	5,000	11"	340	1,600
Culverin	19	5.5	15	4,600	13'3"	420	2,100
Ordinary culverin	16.25	5.25	12.5	4,300	12'	400	2,000
Demiculverin	11.75	4.5	9	3,000	11'	380	1,800
"Demi-something less" culverin	9	4.25	7.67	2,300	10'	320	1,600
Saker	6	3.75	5	1,900	9'6"	300	1,500
Minion	4.75	3.25	3.5	1,100	8'	280	1,400
Falcon	2.33	2.75	2.25	750	7'	260	1,200
Falconet	1.13	2.25	1.5	400	6'	220	1,000

"TABLE of experiments to find the best length of GUNS, and their fittest CHARGES, deduced from actual trials, 1775,"
from Captain George Smith, *A Universal Military Dictionary* . . . (London, 1779).

Gun	Length	Weight (lbs.)	Powder (lbs.)	Elevation (degrees)	Range (yds.)
42-pdr., heavy	9'6"	6,898	21	6	2,368
32-pdr., heavy	8'	5,675	10.75	5.5	2,118
24-pdr., heavy	9'	4,399	8	5	2,218
24-pdr., medium	8'	4,508	8	5	1,863
12-pdr., heavy	8'	2,184	6	4.5	1,780
12-pdr., light	5'	998	4	4	1,189
6-pdr., light	4'6"	546	2	5	1,107
3-pdr., light	3'6"	312	1	4.5	956

Muzzle velocities of French smoothbore guns, measured in firings at the Auxonne artillery school,
from Louis de Tousard, *American Artillerist's Companion* (Philadelphia, 1809).

Gun	Powder (lbs.)	Point-Blank Range (yds.)	Muzzle Velocity (ft./second)
12-pdr.	4	300	1,375.26
8-pdr.	2.5	290	1,356.22
4-pdr.	1.065	270	1,381.54
6-in. field howitzer	1.0625	—	559.86

"Elevation, Charge, and Range of Brass Ordnance, deduced from actual Experiment at Woolwich,"
from John T. Hyde, *Elements of Gunnery* (London, 1861).

Gun	Range (yds.):			
	Point-Blank	3 degrees Elevation	3.5 degrees Elevation	3.75 degrees Elevation
12-pdr. light; 6-pdr. light; 3-pdr. heavy	200	1,000	—	—
12-pdr. medium; 9-pdr.; 6-pdr. long	300	1,200	—	—
24-pdr. howitzer	250	—	—	950
12-pdr. howitzer	200	—	950	—

Ranges of British naval guns,
from Sir Howard Douglas, *A Treatise of Naval Gunnery* (London, 1820).

Gun	Range (yds.):	
	Point-Blank	5 degrees Elevation
32-pdr.	350	2,085
24-pdr. long	248	1,590
24-pdr. short	221	1,545
12-pdr.	300	1,580
9-pdr.	300	1,622

Dimensions and Performance of British Howitzers,
from Smith, *Universal Military Dictionary* (1779).

Caliber (in.)	Length	Weight (lbs.)	Shell (lbs.)	Powder (lbs.)	Elevation (degrees)	Range (yds.)	Time of Flight (sec.)
8	3'1"	1,232	42	3.5	16	1,800	11.48
5.8	2'2"	462	15	1	15	1,600	10.1
4.4	1'10"	238	8.5	0.53	11	900	—

Characteristics of French Howitzers,
from Tousard, *American Artillerist's Companion* (1809).

Caliber (in.)	Weight (lbs.)	Shell Weight (lbs.)	Shell Bursting Charge (lbs.)	Powder (lbs.)	Range, 45 deg. Elevation (yds.)
8" siege	1,120	43	4.0625	1.75	3,200
6" field	630	23	2.5	1.75	2,400

Performance of land and naval mortars,
from Smith, *Universal Military Dictionary* (1779) and William Falconer, *An Universal Dictionary of the Marine* (London, 1771).

Caliber	Length	Weight (lbs.)	Shell (lbs.)	Powder (lbs.)	Maximum Range (yds.)	Time of Flight (sec.)
13" land	3'8"	2,800	205	6.75	1,900	19.03
13" sea	5'3"	9,194	198	31.5	4,085	31.0
10" land	2'9"	1,232	94	3.583	1,900	19.03
10" sea	4'9"	3,696	93	12.0	3,500	26.0
8" land	2'2"	448	42	2.0	1,800	18.72
5.5" land ("Royal")	1'4"	140	15	0.563	1,400	16.72
4.5" land (Coehorn)	1'1.5"	84	8.33	0.313	600	—

(Note: Naval mortars, mounted in ships, were longer and heavier than their army equivalents and could attain greater ranges. The Coehorn mortar was a small piece named for its 17th-century Dutch inventor, Baron Coehorn; these light, handy weapons were used through our Civil War.)

Calibers of Ordnance prescribed by the Board of Navy Commissioners, 28 April 1816, in connection with the post-War of 1812 program for the "gradual increase of the Navy."

	Bore Diameter*	
	Guns	Carronades
68-pdr.	—	8.05
42-pdr.	7.018	6.85
32-pdr.	6.410	6.25
24-pdr.	5.824	5.67
18-pdr.	5.292	5.14
12-pdr.	4.623	4.50
9-pdr.	4.200	—
6-pdr.	3.668	—

* A tolerance of one-fifteenth of an inch, plus or minus, was permitted.

U.S. Navy Guns, 1852

	Caliber	Weight (cwt.)	Length	Crew (Includes one powder boy)	Powder Charge:		Mean Range (yds.) "Distant" Charge:	
					Distant Firing	Service	Point-Blank	5 degrees elevation
Shot Guns:	64-pdr	106	10' 10"	17	16	12		
	32-pdr	61			10	8		
	"	57	9' 4"	13	9	8	360	1930
	"	51	9' 0"	13	8	7		
	"	46	8' 6"	11	7	7		
	"	42	8' 0"	11	6	6	313	1756
Shell Guns:	"	33	6' 7"	9	4.5	4.5	287	1598
	"	27	6' 0"	7	4	4	250	1469
	10-in.	89	9' 4"	17	10	9		
	8-in.	63	8' 10"	15	9	7*	330	1770
	"	55	8' 4"	13	7	7	283	1657
	"							

*Increased to 8 lbs., 1854.

Performance of Army Ordnance, 1863

	Type	Projectile	Powder Charge	Elevation (degrees)	Range (yds.)	
Smoothbores:	6-pdr. Field Gun	Shot	1.25	0 5	318 1520	
	12-pdr. Field Gun, M1841	"	2.5	0 5	345 1660	
	12-pdr. Field Gun, M1857 ("Napoleon")	"	"	0 5	325 1680	
	"	Shrapnel	"	0.5 3.75	300 1135	
	"	Shell	2.0	0 3.75	300 1300	
	12-pdr. Field Howitzer	"	1.0	0 5	195 1070	
	24-pdr. Field Howitzer	"	2.0	0 5	295 1320	
	24-pdr. Siege Gun	Shot	6.0	0 5	410 1900	
	42-pdr. Sea-coast Gun	"	10.5	1 5	775 1955	
	8" Siege Howitzer	Shell	4.0	0 5	250 1240	
	Rifles:	10-pdr. Parrott & 3" Rifle	Shot	1.0	0 5 10 15	380 1835 2900 3820
		30-pdr. Parrott	Shell	3.25	3.5 10	1506 3642
		100-pdr. Parrott	Shot (100 lbs.)	10.0	5 15 20	2220 4795 6240
			Shell	10.0	10 20	3370 5695

Performance of Navy Guns, 1878

	Gun	Projectile	Powder Charge	Initial Velocity (ft./sec.)	1 degree elevation	Range (yds.) 5 degrees elevation	8 degrees elevation
Rifles:	8-inch Rifle	Battering Shell, 180 lbs.	35 lbs.	1450	709	2817	4017
	80-pdr. Parrott	Shell, 80 lbs.	10 lbs.	1250	521	2154	3133
	100-pdr. Parrott	Shell, 100 lbs.	10 lbs.	1080	405	1835	2767
	60-pdr. Parrott	Shell, 48 lbs.	6 lbs.	1320	656	2242	3165
Smoothbores:	11-inch Dahlgren	Shell, 135.6 lbs.	15 lbs.	1240	500 (1 deg. 3 min.)	1700 (5 deg. 5 min.)	2300 (8 deg. 16 min.)
	9-inch Dahlgren	Shell, 73.5 lbs.	10 lbs.	1320	500 (0 deg. 57 min.)	1700 (5 deg. 9 min.)	2200 (8 deg. 6 min.)

Glossary

The terms which appear here are defined in the sense in which they apply to early ordnance. Many are still used, in the same or in different senses, with modern ordnance. Cross-references to other terms defined here are indicated by *italics*.

Astragal. Small, convex, half-round molding, usually found with a *fillet* on one or both sides. Moldings of this kind are thought to be vestigial traces of the iron bands originally shrunk around the first wrought-iron gun tubes. Their forms, as well as the terms used to identify them, were, for the most part, borrowed from architecture.

Band. Another term for *ring* (*q.v.*).

Base of Breech. Another term for *breech face* (*q.v.*).

Base Ring. Another term for *breech ring*, widely used 19th C.

Bore. The interior of a gun barrel, from the *chamber* forward to the muzzle.

Breech. The portion of a gun tube from the rear end of the *chamber* aft to the *cascabel*.

Breech Face. Also called *Base of Breech*; the rearward-facing portion of the gun tube between the *breech ring* and the knob of the *cascabel*.

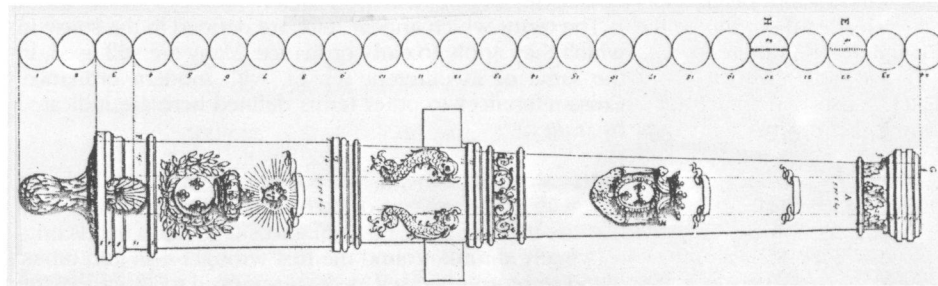
Breech Ring. Also called *base ring*. A band of metal around the base of the *breech*, at the point where the tube tapers sharply inward to the *cascabel*. A V-notch rear sight was often cast into the upper side of this ring, and identifying inscriptions were also cast or scribed into it.

Breeching. Heavy line secured to the breech of a naval gun to check its recoil.

Breeching Jaws. Late-pattern *cascabel* knob shaped in the form of a pair of jaws, into which the breeching was inserted.

Breeching loop. Loop, or ring, cast into the breech face of a gun just above the *cascabel* knob. The gun's breeching was threaded through this. On guns without such a loop, the breeching had to be looped, or spliced, around the *cascabel* knob; the breeching loop was devised to provide a more secure attachment.

Caliber. This 1707 French drawing shows how gun lengths were expressed in multiples of the bore diameter.



Caliber. (a) The diameter of a gun's bore; (b) the nominal length of its bore, expressed in multiples of its diameter. This expresses the length of a piece in proportion to its bore; a gun described as 18 calibers long would have a bore 18 times as long as its diameter. This term is still used today.

Canister. Frequently called *case shot*, this short-range, anti-personnel ammunition was used as early as 1453 and continued in service as long as muzzleloading artillery remained. A metal can, or case, contained iron or lead balls or metal scrap. Fired from a cannon, the container burst and scattered its pellets in the manner of an enormous shotgun. Canister did not have the longer-range effect of *grape*, but was more effective within a few hundred yards and replaced grape during the 1800s. Great quantities of canister were used during our Civil War.

Carriage. The wooden structure upon which the tube of a gun, howitzer, or mortar was emplaced for use. Mortars were mounted on fixed wooden beds; howitzers used wheeled trail carriages which permitted relatively high elevation; guns used field or siege carriages with two large wheels and a trail, or were mounted on naval or garrison carriages with four wheels of the same small size.

Cascabel. Also spelled *casable*; the rear of the gun tube aft of the *breech ring*. It includes the *breech face* and the *cascabel knob*, the protrusion extending to the rear from the breech face. This knob was used as an attachment point for tackle when mounting or dismounting a piece from its carriage; breeching cables, used with naval guns to check their recoil, were also attached to it. The cascabel knob of late iron naval guns took the form of a pair of jaws, into which the breeching fitted. See *Pomilion*. Modern works often apply the term *cascabel* only to the knob itself.

Chamber. The rear end of a gun barrel, into which the powder charge was rammed when loading. Chambers of howitzers and mortars were usually smaller in diameter than the *bore*.

Chase. The portion of the barrel between the *reinforce(s)* and the *muzzle*. This was the thinnest portion of the gun barrel, since powder pressure was lower here than at the breech.

Elevating Screw. Vertical threaded shaft, its lower end rotating in a socket in a gun *carriage* and its upper end supporting the breech of the gun. A small cross-handle was attached to the screw; as the gunner observed the target, he turned the screw handle to raise or lower the gun to the proper elevation. The elevating screw replaced the *quoin* in the 19th century.

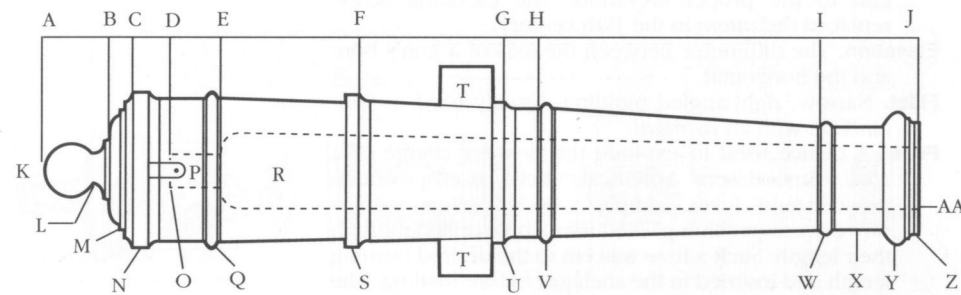
Elevation. The difference between the axis of a gun's bore and the horizontal.

Fillet. Narrow, right-angled molding, usually used in conjunction with an *astragal*.

Fuze. A device used to explode the powder charge of a *shell*. Smoothbore spherical shells used wooden powder-train fuzes, simple wooden plugs with a powder composition packed into a hole drilled through their length. Such a fuze was cut to the desired burning length and inserted in the shell just before loading. The flame of the propellant powder ignited the powder train, and—theoretically—it exploded at the desired moment. Rifled muzzleloaders, and some late smoothbores, used cylindrical shells which usually hit nose-first. These had powder-train nose fuzes ignited by percussion caps detonated by setback, or "concussion," as it was then called. The shock of firing snapped a firing pin into the percussion cap to ignite the powder train; this burned a preset time to fire the shell. Fuzes of this kind also had an impact, or "percussion," feature designed to explode the shell when it struck a solid surface. Like the accuracy of smoothbore guns, the functioning of early fuzes was uncertain; unexploded ammunition is found to this day on old battlefields.

Grape. Also called *grapeshot* in some modern works; an anti-personnel projectile consisting of large iron shot grouped around an iron or wooden *stool* (a base disk supporting a vertical core), wrapped with cloth and tied into shape. A round of grape disintegrated when fired and scattered its fragments, and was widely used against troops during the 18th century before being replaced by *canister* during the 1800s. Its larger shot made it effective at longer ranges than *canister*, but it was less deadly at the critical shorter range. Grape continued in use at sea after passing out of land service; it was considered effective against decks and upperworks of unarmored ships.

Gun. A relatively long-barreled artillery piece, firing its projectile at higher velocities and flatter trajectories than the *howitzer* or the *mortar*. This term is also sometimes used to refer to heavy ordnance in general. The gun's velocity and trajectory made it suitable for use as a "battering piece" against fortifications, or for long-range firing.



AC—Cascabel (some modern works define only as AB)
 BD—Breech (some works refer to the entire section AD)
 DE—Vent field
 CF—First reinforce
 FG—Second reinforce
 GH—Chase girdle (omitted in later pieces)
 GI—Chase
 IJ—Muzzle
 K—Cascabel knob

L—Cascabel neck
 M—Breech face and moldings
 N—Breech ring (also called base ring)
 O—Vent
 P—Chamber
 Q—Vent astragal and fillets (omitted in later pieces)
 R—Bore
 S—1st reinforce ring and ogee
 T—Trunnion

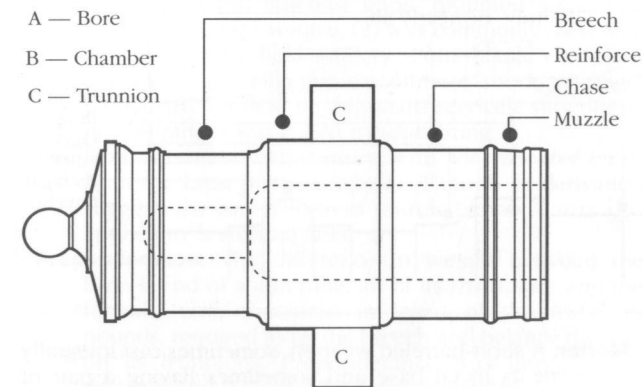
U—2nd reinforce ring and ogee
 V—Chase astragal and fillets (omitted in later pieces)
 W—Muzzle astragal and fillets (often called chase astragal when (V) was omitted)
 X—Neck
 Y—Swell
 Z—Muzzle moldings
 AA—Muzzle face

Handles. Rings, often stirrup-shaped but sometimes semi-circular, cast in pairs on the upper side of gun and howitzer tubes at the center of balance. With the *cas-cabel*, the handles were used to attach tackles when lifting a piece to or from its carriage. The handles of ornately decorated early ordnance were often cast in the form of dolphins, and early works call them by that name.

Handspike. Heavy wooden crowbar used to shift the trail of a gun *carriage* from side to side, or to raise the breech of the gun tube so the *quoin* could be adjusted.

Hausse. French term, widely used in the American service in the mid-1800s, for an adjustable rear sight.

Howitzer. Shell-firing artillery piece of medium length, firing its projectiles with a lighter charge—and, hence, a lower velocity and higher trajectory—than a *gun* of equivalent caliber. While the howitzer's maximum range was shorter than the gun's, its explosive shells were valuable against troops, and its wheeled carriage let it be used in the field. Larger-caliber howitzers were used in sieges.

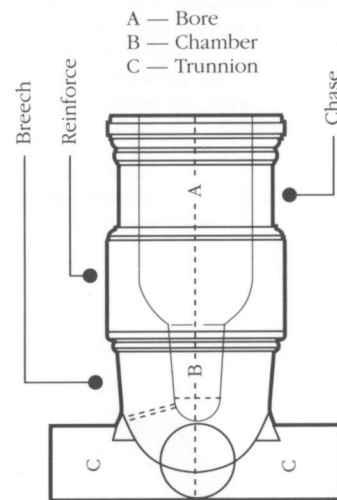
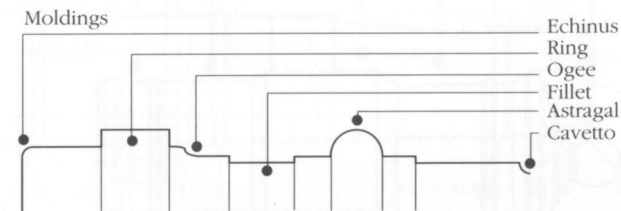


Line of Metal. The line of sight drawn directly from the *breech ring* to the *muzzle*; many early guns had fixed sights cast or attached to these positions. This was the line of sight used when firing at *point-blank* range, usually considered the effective shooting range with field and naval guns. The diameter of the muzzle was usually smaller than that of the breech ring (this difference was called the *dispart*), and the piece was thus slightly elevated when sighting along the line of metal. *Dispart sights* were developed to provide a line of sight parallel to the bore.

Lock. Flint or percussion lock, tripped by a lanyard to fire a piece of ordnance.

Lock Piece. Block of metal near the *vent*, to which a firing lock is attached.

Molding. A recess or projection, curved or rectangular, at right angles to the bore axis and cast as part of a gun tube. These were both decorative and functional, being used at points where the exterior diameter of the piece changed or where additional strength was required. The principal forms seen on ordnance of this period were the rectangular *ring*, the semicircle *astragal*, the right-angled *fillet*, and the reversed-curve *ogee*. Moldings became fewer and smaller during the late 1700s; many 19th-century artillery pieces dispensed with them entirely, or nearly so.



Mortar. A short-barreled weapon, sometimes cast integrally with its metal base and sometimes having a pair of *trunnions* at its breech end. Mortars were used in siege and bombardment work to “lob” explosive shells in a high, arching trajectory. Mortars did not have the mobility of the gun or the howitzer, but their ability to “drop” shells at high angles made them valuable siege and fortress weapons. Naval mortars were mounted in special “bomb vessels” and did not have to be picked up and moved from place to place; they were, thus, usually longer and heavier than their land equivalents.

Muzzle. The opening at the forward end of the bore. The flat forward portion of the gun tube surrounding this is the *muzzle face*. The forward end of the gun tube is often strengthened by a tulip-like enlargement called the *muzzle swell*; where a front sight, or *muzzle sight*, is used, this is mounted on the upper side of the swell. In some pieces a rectangular-shaped *muzzle band* is cast instead of a swell for reinforcement.

Muzzle Velocity. The speed, expressed in feet per second, of a projectile as it leaves the muzzle of a weapon; in current artillery terminology this is called *initial velocity*. Muzzle velocity is the highest velocity attained by a projectile; its speed drops off as it travels, particularly in the case of old-style round shot whose form offered considerable resistance to the friction of the atmosphere.

Ogee. A molding in the form of a reversed curve; that is, having a profile in the form of the letter S. An ogee is often used at the junction of two portions of a gun tube with differing diameters, or it may be used with a *ring* as a *fillet* is used with an *astragal*.

Point-blank. Range at which a projectile (1) strikes the ground when fired at zero elevation, or (2) drops below the line of sight when a piece is sighted along the *line of metal*, *i.e.*, along the gun tube from breech to muzzle. While (1) appears usually to have been used with naval and seacoast guns, mounted some feet above the water's surface, (2) was commonly used with land, especially field artillery. Point-blank was often considered the effective smoothbore shooting range, particularly for field or shipboard services; shooting at greater ranges was called *random* firing.

Pomilion. Alternate 19th-century term for *cascabel knob*, from the Latin *pomum* (apple). Though its derivation suggests the earlier form of rounded knob, it was also applied to *breeching jaws*.

Preponderance. The difference in weight between the breech end of a gun tube, aft of its *trunnions*, and the forward end, measured in terms of the force, in pounds, required to lift the breech and balance the gun on its trunnions. Preponderance was important to designer and gunner alike; breech-heaviness made the gun sit properly on its carriage and kept it from capsizing when it fired.

Quoin. Wedge set beneath the breech of a gun and moved in or out to adjust elevation. It was eventually superseded by the *elevating screw*. Sometimes spelled *coin* in contemporary works.

Random. Term applied to ranges beyond *point-blank*, or to firing at such ranges. Accuracy—a relative term at best—of smoothbore artillery began to drop off sharply as a gun was elevated and could not be predicted with anything like certainty except in such leisurely circumstances as siege or garrison work, hence the very literal use of the word *random* in references to shooting at longer ranges. Because of this loss of accuracy, most gun carriages of this time did not permit more than a few degrees of elevation; howitzer carriages permitted somewhat more.

Range. The horizontal distance between a gun and its target, or the distance at which a piece can hurl its projectile. To this day, there is a difference between *maximum* range and *effective* range, the latter being the range at which reasonable accuracy and effect can be counted on. With smoothbore artillery, the difference between the two—*random* and *point-blank ranges*—was particularly marked. Firing ranges had to be estimated, since rangefinders did not exist at this time. Ranges were roughly expressed in such terms as “pistol shot” (about 50 yards); “musket shot” (200–300 yards); or “cannon shot” (1,000–1,500 yards). Fractions of these terms, such as “half-pistol shot,” were also used. Effective ranges of rifled ordnance were notably greater, but still depended on the accuracy of rangefinding and sighting devices.

Reinforce. The portion of the barrel between the *breech ring* and *chase*, extending forward past the *trunnions*. Since powder pressure was greatest toward the breech, this part of the gun tube was thicker than the chase. Howitzers and mortars normally had one reinforce, as did some guns. Other guns had two. The heavier breech reinforce is called the *first reinforce*; the lighter one, between the first reinforce and the *second reinforce*.

Ricochet. Point at which a shot from a naval or seacoast gun strikes the water and rebounds. “Ricochet firing”—skipping a shot across the water toward a target at long range—was used by seacoast artillery. Toward the mid-1800s navies thought in terms of it for shipboard gunnery. Dahlgren carried out extensive experiments with shell guns and 32-pounder shot guns at the Washington Navy Yard before the Civil War, firing down the Anacostia River and plotting the ricochet and fall of shot from triangulation stations along its banks.

Rifling. Arrangement of spiral *grooves* cut or cast into the bore of a piece to impart an axial spin to its projectile, thus giving it directional stability and greater accuracy. The raised section between grooves are called *lands*, and the caliber of a rifled weapon is measured from land to land rather than groove to groove. Early rifled artillery pieces were muzzleloaders; some were manufactured as rifles while others were older smoothbores modernized by having grooves cut into their bores. Since fire control was still quite primitive in the 19th century, there was still a gap of some size between maximum ranges and practical shooting ranges. The theoretical accuracy of a rifled gun was much greater than the capability of the means available to control its fire, except in such special situations as fortress or siege firing.

Rimbase. A stepped “shoulder” at the base of a *trunnion* where it joins the gun tube. Some pieces, as seen in the Navy Yard’s collection, had what were called *trunnion sights*, set to one side of the gun with the front sight mounted on the rimbase rather than on the muzzle. All trunnions, particularly earlier ones, did not have rimbases.

Ring. A rectangular molding, sometimes used with an *ogee*. Also called a *band*.

Shell. An explosive projectile, made of cast iron and filled with black powder. Smoothbore weapons fired spherical shells; rifled guns and some later smoothbores used elongated projectiles. Round shells used simple powder-train time *fuzes*. Since the direction of impact of a cylindrical rifled shell could be approximated, fuzes used in such rounds were also designed to detonate on impact.

Shot. A solid round projectile, of stone or cast iron, used in smoothbore muzzleloading artillery. The solid shot used in rifled muzzleloaders were cylindrical and fitted with an expanding base or band so that they could be rammed down the bore from the muzzle and yet grip the rifling on firing. Smoothbore guns long fired only solid shot, while mortars and howitzers used explosive shells. Later guns used shells as well; these were called “shell guns” to distinguish them from the earlier “shot guns.” The caliber of a shot gun was expressed as the weight of its shot (e.g., 6-pounder), while shell-firing ordnance was identified by bore diameter.

Shrapnel. Frequently called *spherical-case shot*, this was an iron *shell* containing a number of *canister*-sized balls with a blackpowder bursting charge and a powder-train time fuze. It was fired and exploded in the same manner as a conventional shell but, when detonated, scattered its small shot as well as the iron fragments of the shell itself. This ammunition was used by the British as early as 1808, but was not given its inventor’s name until the 1850s. Shrapnel rounds were used in modern steel breechloading artillery well into the 20th century. The term is often, incorrectly, applied to the casing fragments scattered by a bursting shell.

Sight. A device used to aim a piece at its target. These may be fixed or adjustable, and may be mounted over the centerline of the gun bore or offset to one side. Fixed rear sights were usually cast or permanently mounted on, or just forward of, the *breech ring*. Adjustable rear sights were normally dismountable, carried separately and installed when preparing to fire. Front sights were fixed (nonmovable), mounted at the muzzle or on a *rimbase*, depending on the type of sight arrangement used. All of these sights were metallic. Telescopic gun sights were not introduced until steel breechloading rifled artillery came into use in the late 1800s. High-angle mortars did not use sights; the wooden carriage was first leveled, and the mortar was then aligned with the target in train with the help of a plumb line. The weight of the powder charge was varied to adjust the weapon in range. Some gun sights were mounted on a base, of varying shape, cast as part of the gun tube or fastened to it. This sight base was called a *sight piece* in the early United States Army; the Navy referred to it as a *sight mass*.

Trajectory. The curving path followed by a projectile from muzzle to target. *Guns* fired their shot at high velocities, and relatively flatter trajectories, while low-velocity *mortars* had high trajectories.

Trunnion. Twin cylindrical projections, cast as part of a gun tube and projecting to left and right at right angles to the bore, slightly forward of the center of gravity. The trunnions supported the weight of the gun as it rested on its *carriage*, and the piece pivoted on them as it was raised or lowered in elevation. Placing trunnions forward of the center of balance ($4/7$ of the distance from breech to muzzle was an 18th-century rule of thumb) placed the *preponderance* of tube weight at the breech end and kept the piece stable when fired.

Vent. The narrow opening leading from the upper side of the *breech* to the after end of the *chamber*, used for igniting the powder charge to fire the piece. Earlier guns were primed with loose powder, and their vents are often surrounded by cup-shaped moldings to receive powder. Later guns used priming tubes, and their vent openings are flush with the barrel. Hot powder gases are highly erosive, and the vents of guns were enlarged by repeated firing. In later guns a copper *vent bushing*, or *vent piece*, was screwed into a threaded socket. When the vent became enlarged, the bushing was replaced.

Windage. The difference between the bore diameter of a smoothbore artillery piece and the size of its shot or shell. Windage facilitated loading from the muzzle and allowed for black-powder fouling during firing as well as for irregularities in casting iron shot or forming stone ones. By the 18th century, windages were being standardized; Muller, in 1780, describes the bores of English ordnance as being made with a windage $1/20$ the diameter of their shot. A 6-pounder gun fired a 3.498" shot from a 3.668" bore; a 32-pounder had a 6.410" bore and used a 6.105" shot. Though windage had its justifications, it further impaired accuracy since the loose fit of a round shot made it tend to "carom" from side to side as it went down the bore of a gun and emerge from the muzzle with an inherent "wobble" in its flight which increased with range.

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