U. S. NAVAL SCHOOL, EXPLOSIVE ORDNANCE DISPOSAL

A FIELD GUIDE FOR

CIVIL WAR EXPLOSIVE ORDNANCE

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FOREWORD

During the period of the American Civil War, 1861 to 1865, an estimated 10,000,000 projectiles of all shapes, sizes, and types were fired by the Union and Confederate armies. This can be an alarming figure if one considers the high "dud" rate brought about by imperfections in fuzing.

Fortunately, from the Explosive Ordnance Disposal (EOD) standpoint, the bulk of these unexploded projectiles remain at the major engagement sites such as Gettysburg, Petersburg, Antietam, and the like, and go unmolested by the unwary. However, the National and State Parks control only a small area at each of the battlefield locations found throughout the Eastern United States. Moreover, some of the fringe areas of battle and even some of the bloody areas of conflict and skirmishes are today scenes of rolling countryside populated by farms, modern housing developments, and construction sites. Also countless numbers of these potential hazards were placed in hidden caches intended for later use and then forgotten. Unrecorded amounts were abandoned and lost during the heat of battle or forced retreat.

Today, some one hundred and eleven years later, these remnants of artillery's history provide an additional responsibility for the EOD team. Annually during the spring planting, these relics are surfaced by the plow. Many of them find a place of esteem by their owners and are used as driveway markers, mantlepiece conversation items, and door stops. Literally tons of these explosive projectiles containing dangerous black powder have been amassed by private collectors who evidently disregard or are unconcerned about their ever present explosive hobby.

Interstate transportation of these much sought after souvenirs provides explanation for finding a shell at a great distance to the geographical region of the war.

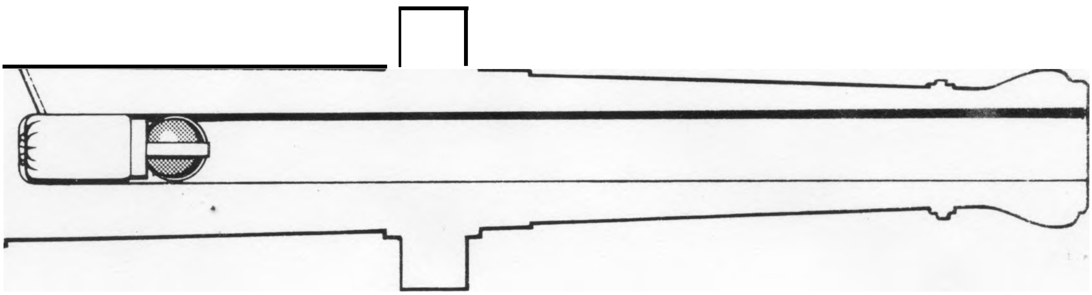
Quite frequently civilians turn in their projectile recoveries to law enforcement agencies and local EOD teams for disposal or inerting. National and State park departments and museum curators will usually request a return of the munitions after the inerting process.

Because of the continuing need for guidance in safe and proper inerting of explosive Civil War ordnance, the printing of this manual is considered appropriate. Information on how to breach the casings and remove the active filler is intended for the exclusive use of qualified EOD personnel of the United States Military services. The United States government, its agents, and the author disclaim any responsibility for the safety of others who attempt hazardous work on explosive ordnance using this document as a guide. The intent of this manual is to provide the EOD Technician with an identification guide for field use. Further, it will serve as a basic reference text for Civil War ordnance data, standard terminology, projectile design, and fuze operation. It is the only known publication of its kind that displays radiographs showing interior construction of projectiles for the effective removal of the main filler.

No attempt has been made to provide coverage on all of the varied projectiles that were produced and used during the war years. Only the more common types that have been recovered, or types that could be expected to turn up will be presented in this manual.

If further study of Civil War ordnance is required, refer to Artillery and Ammunition of the Civil War, by Warren Ripley, published by Van Nostrand Reinhold; Field Artillery Projectiles of the Civil War, 1861 - 1865, by Sydney Kerksis and Thomas Dickey, the Phoenix Press, and Heavy Projectiles of the Civil War, 1861 - 1865, by Sydney Kerksis and Thomas Dickey, the Phoenix Press.

PART I

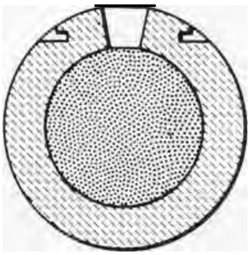


SMOOTHBORE PROJECTILES

PART I

SMOOTHBORE PROJECTILES

A. MORTAR PROJECTILES



The Coehorn mortar found high favor from both sides due to its ease of transportation. Weighing 164 pounds and requiring a maximum propellent charge of only 1/2 pound, its high elevation of fire was extremely effective against entrenched troops. A 24-pounder spherical shell was thrown at ranges up to 1,200 yards. Solid and explosive shells were used extensively. Coehorns were of 12 and 24 pounder in size. Other sizes of mortars came in 8 and 10 inch for siege, and 13, 15, and 20 inch for seacoast use.

A large type was employed mainly in siege service but was used on occasion against a well fortified enemy in the field. The 10-inch mortar shell was converted into case shot by filling it with 30 balls of the size of 12-pounder cannister shot and timed to explode approximately 50 feet above the ground. Shells of this type were first fired by Union artillery at the siege of Petersburg, as was the 8-inch mortar. The deadly fire quickly silenced flanking enemy artillery.

The spherical shell in Figure 1 is of the siege mortar type and probably of Confederate origin, as indicated by the two recessed lifting "ears," a feature usually lacking in Northern manufacture. It is an 8-inch shell weighing about 44.5 pounds. The linear column time fuze was generally used for land service and the metal capped, waterproof seacoast fuze adapter for coastal defense. Often the black powder filler charge was field inserted at the time of action.

Figure I. 8-Inch Mortar Shell.

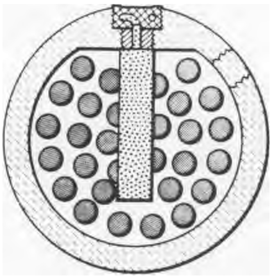
DESIGNATION	DIAMETER (in)	WEIGHT (lb, shell)	THICKNESS (opp. fuze, in)
12 Pdr. (Coehorn)	4.5	8.5	.3
24 Pdr. (Coehorn)	5.7	17.5	.5
8 Inch	7.85	44.5	1.25
10 Inch	9.85	87.5	1.6
13 Inch	12.85	197	2.5
15 Inch	14.9	350	3 (approx.)
20 Inch	19.85	1000	Solid Shot

Note. Shells that are 8 inches and larger that were designed for Columbiads and Seacoast howitzers and Naval shells will be slightly thicker than stated in Table 1 and will be a great deal thicker at the fuze opening.

A radiograph of the mortar shell will not be included because of the simplicity of its design. Refer to Figure 4 for cross sectional views of mortars and comparable shells and Figure 6 for configurations prior to firing. Mortar ammunition was also issued in solid shot form.

See fuze Figures 130 and 131 to obtain information about the fuzes normally used with the mortar shells.

B. SPHERICAL CASE SHOT



Projectiles similar to antipersonnel Civil War spherical case shot were introduced by French artillerymen during the 16th century. These were crude, rock filled devices which created little more than a nuisance effect. Leaden balls were next employed as a filler but it was found that the force and heat of discharge often squeezed them into a hard cake. Colonel Shrapnel of the British army recognized the potential killing power of case shot and developed a lead ball hardened with antimony and zinc. These were placed in the projectile cavity and the space between the balls was filled with melted sulphur which solidified around them forming a solid mass. A portion of the cavity was then partitioned off by a diaphragm of sheet iron and the bursting charge inserted. Communicating with this powder was a paper wrapped mealed composition time fuze which ignited from the cannon discharge flame. The projectile was first successfully used against the French in the Pennisular War.

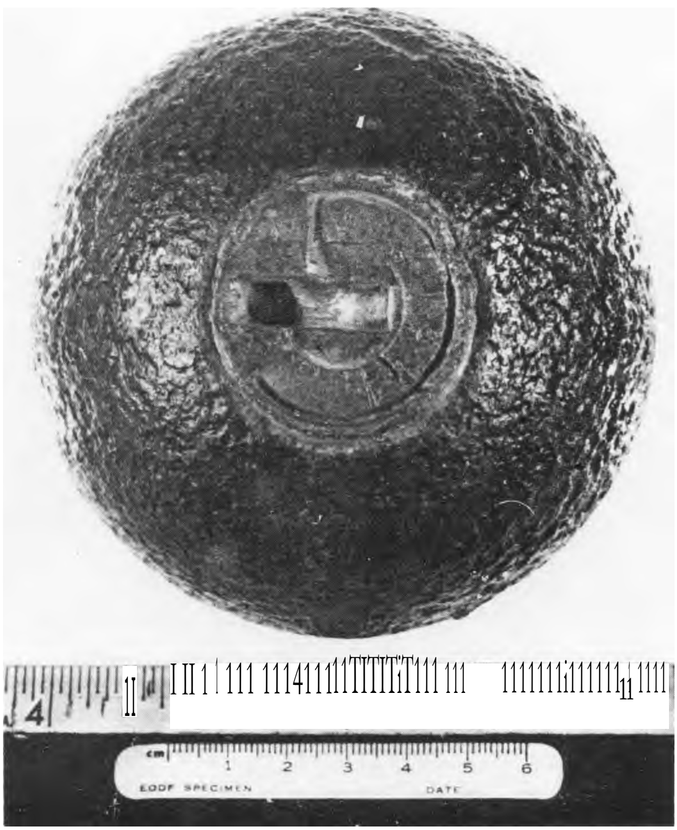


Figure 2. 12 Pdr. Case Shot.

U. S. Ordnance engineers improved the Shrapnel design by filling the thin-walled cast-iron shell with standard musket balls then filling the interstices with a mixture of charcoal and meal :d powder, melted sulphur, or resin. A hole was then bored through the mass to receive the burst ing charge which was only sufficient to rupture the casing. The lower portion of the fuze was partially closed by screwing into it a disk perforated with a small hole for the passage of the flame from the fuze. The annular Bormann-type time fuze was commonly used by the Union.

*The Confederate armies also used case shot of the same calibers differing only in method of manufacture by the manner of inserting the matrix of sulphur or pitch. (A tin cylinder was passed down through the fuze opening to maintain a space for the burster charge as the molten matrix solidified.) A small screwed in plug of brass, steel, or lead was provided about 60° from the fuze opening into which the matrix and musket balls were inserted. The cylinder was later removed and the black powder bursting charge poured in. Normally the South used a copper time fuze adapter which was screwed into the ball and received the common paper time fuze. Refer to Figure 140 for views of the adapter and Figure 129 for the assorted time fuzes.

Spherical case shot generally employed in field service was the more common 12-pounder size, Figure 2, and contained about 80 musket balls weighing 17 to a pound. One ounce of black powder comprised the bursting charge and the total weight was 11.75 pounds - nearly equal to a solid shot of the same caliber. Case shot was manufactured and used in sizes of 6, 12, 18, 24, 32, and 42 pounders and 8 inch. Case shot has been field recovered in larger calibers although purchase records do not indicate that any were intentionally produced. The 6- and 12-pounder sizes of case shot has the wooden sabot strapped into position. A cartridge bag containing the propellant charge was secured to the sabot groove and the complete unit was known as a "stand of ammunition" and was often factory assembled, Figure 5 upper half. More often than not they were merely strapped to their sabots and used a separate propellant charge, Figure 6. A radiograph, Figure 3, is provided to aid in the removal of the bursting charge. Best results in removing the filler is gained by drilling 180° from the fuze thereby gaining access to the entire length of the burster.

With the exception of the 6-pounder size, common shells also existed in the same sizes as case shot. A common shell contains no matrix or shrapnel but merely has its entire cavity filled with black powder. Externally, there is no positive way to distinguish between case shot and common shell. Normally, shells having a wooden paper time fuze adapter fitted in the fuze opening will be a common shell. The majority of all spherical projectiles that have been field recovered containing the Bormann-type time fuze have been filled with case shot. Naval shells were also issued in case shot and shell but were normally fitted with the water-capped time fuze adapter. See Figure 144 in fuze section. The common shell was of the same construction as the mortar, minus the lifting "ears," and had slightly thinner walls. See Figure 4 for shell sizes.

Figure 3. Radiograph of 12 Pdr. Case Shot.

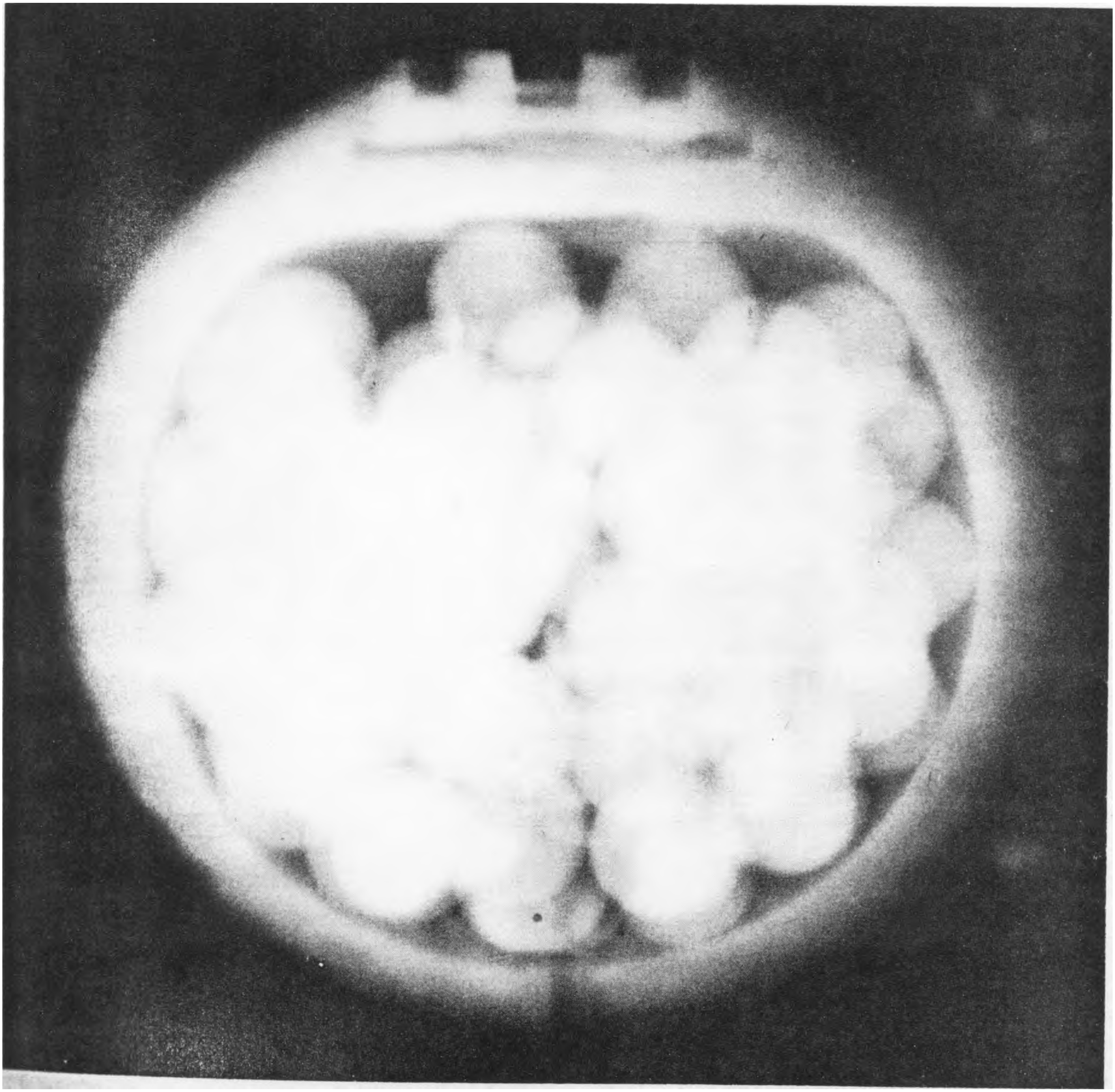
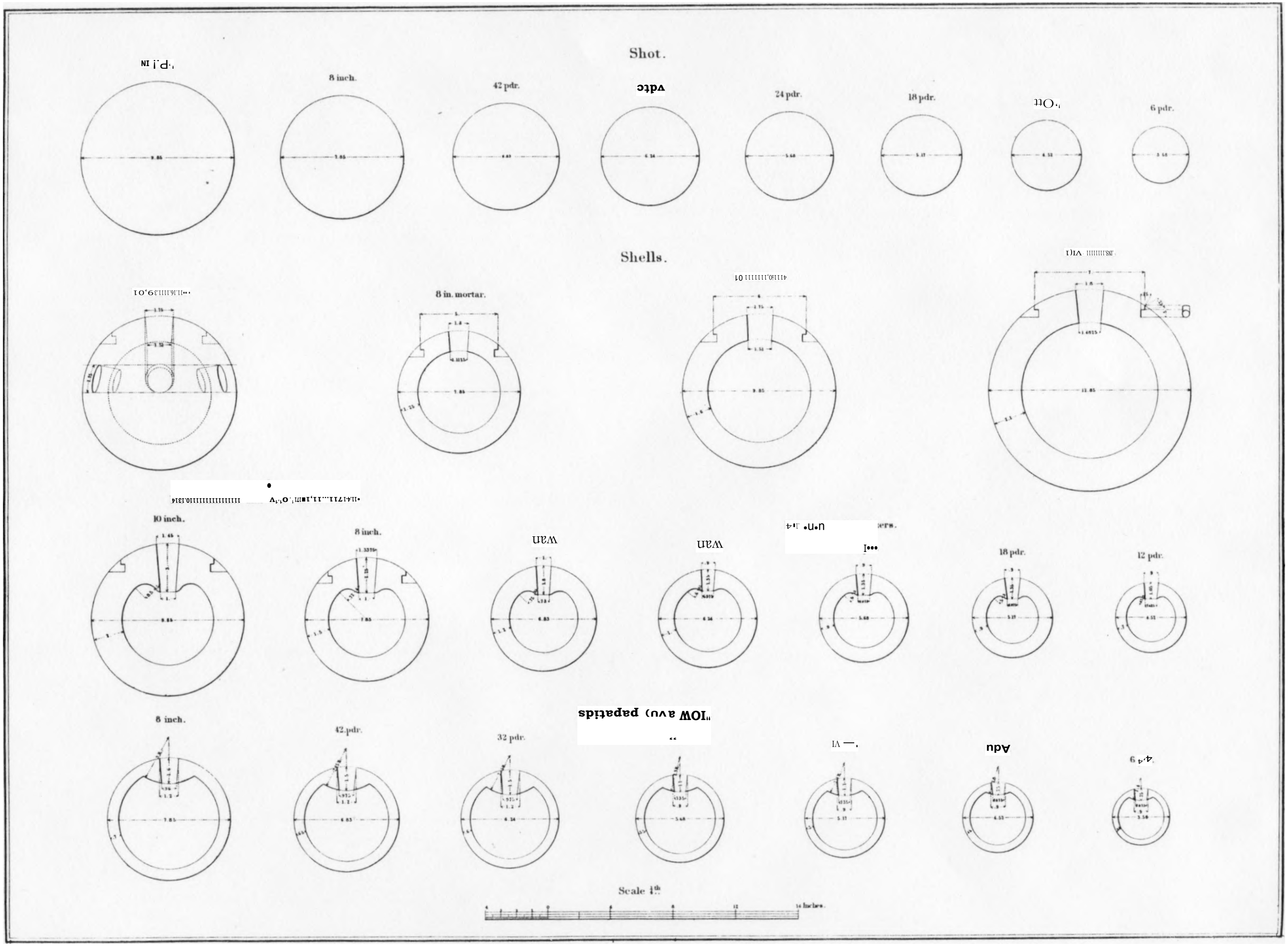


Figure 3. Radiograph of 12 Pdr. Case Shot.


Shot.
8 inch.
42 pdr.
24 pdr.
18 pdr.
6 pdr.
Shells.
8 in. mortar.
10 inch.
8 inch.
18 pdr.
12 pdr.
8 inch.
42 pdr.
32 pdr.
Scale
14 Inches.

s.0

FIXED AMMUNITION.

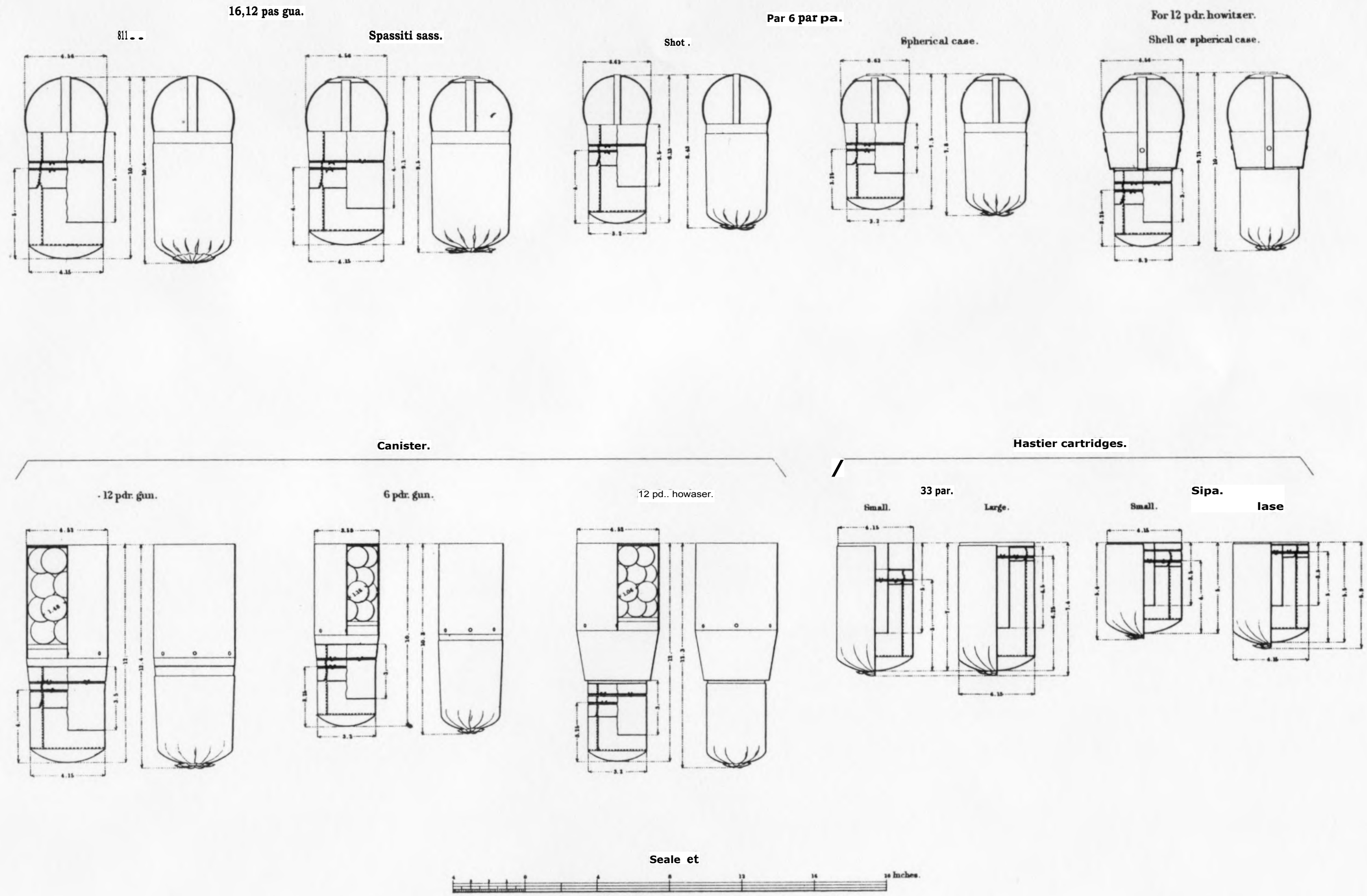


Figure 5. Stands of Ammunition.

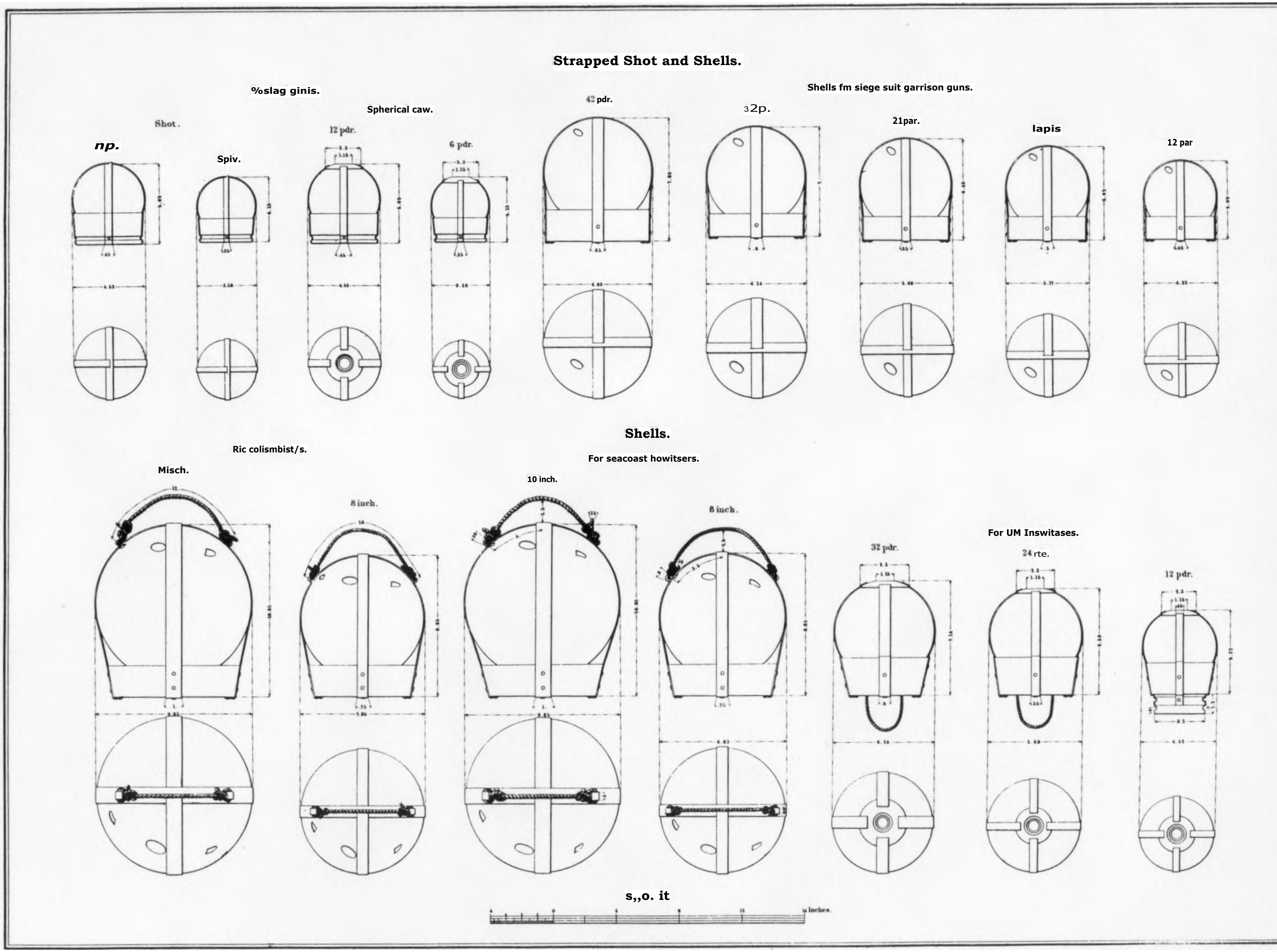


Figure 6. Strapped Shot and Shell.

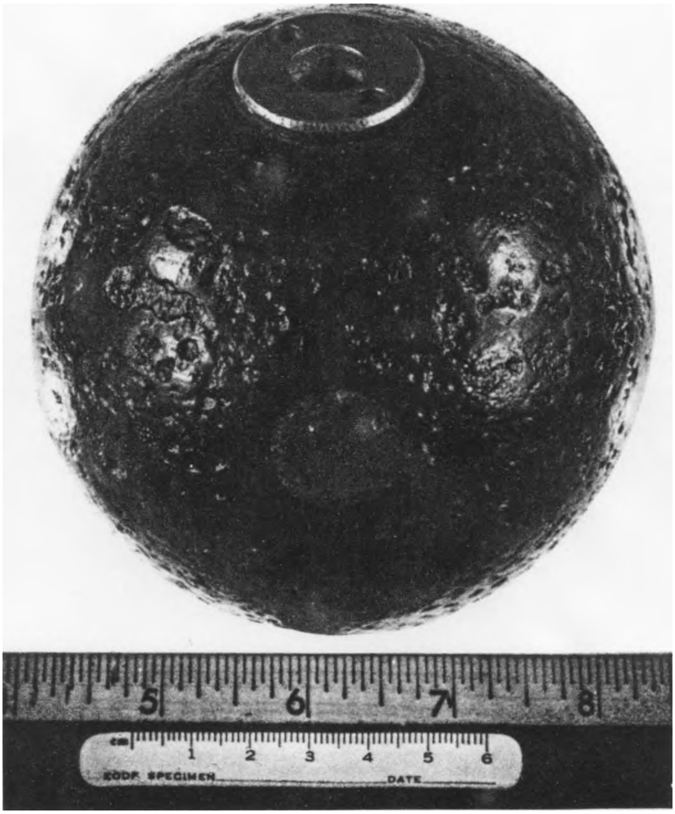


Figure 7. Confederate 12 Pdr. Case Shot.

As stated earlier, the main difference between Union and Confederate 12-pounder case shot was the method of inserting the lead or steel balls and the matrix binder. Figure 7 shows the threaded lead filler plug used by the South to close the matrix filler hole.

Also shown is the more common time fuze adapter used by the Confederacy. Normally made of copper, it had two-spanner holes for threading it into the fuze opening.

Often the Southern artillerists would fill their case shot in the field using field expediency. Some case shot have been found filled with .44 and .58 caliber rifle shot.

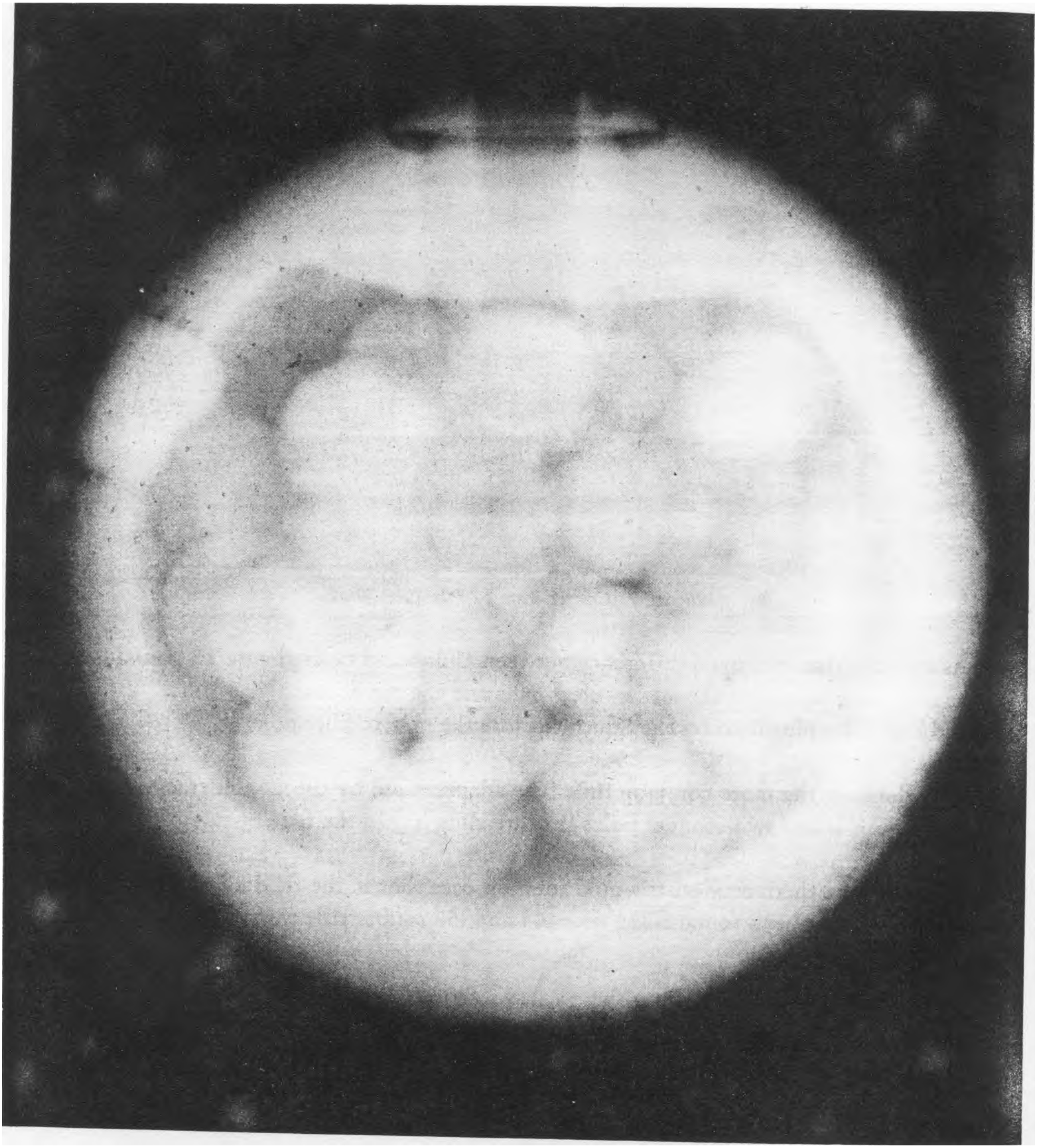


Figure 8. Radiograph of Confederate 12 Pdr. Case Shot.

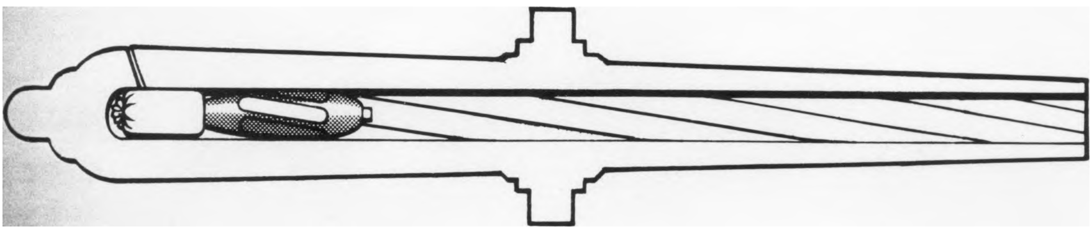
Figure 9. 24 Pdr. Case Shot, Sectionalized.

The "cannon ball" was fired from muzzle loading smoothbore cannon which accounted for more than 50 percent of the estimated 10,000,000 battlefield rounds fired during the entire war.

Field recoveries of this case shot, Figure 9, have been numerous. The diameter is 5.68 inches and its weight approximately 17 pounds. It is armed with a Bormann-type time fuze having a diameter of 1 5/8 inches and 1/2-inch thick. See fuze section on the operation of the Bormann-time fuze.

The subject of solid shot will not be dealt with in this manual. The solid shot is a solid casting of steel and contains no explosive. Figure 4 is considered to provide sufficient coverage of manufactured sizes of solid shot. It is safe to assume that if a spherical projectile is found to contain no opening or fuze whatsoever that it will be a solid casting and present no hazard.

PART II



CONFEDERATE RIFLED PROJECTILES

PART II

CONFEDERATE RIFLED PROJECTILES

A. ENGLISH ARMSTRONG

Breach and muzzle loading Armstrong rifles were among the first Confederate foreign field artillery importations. Armstrong projectiles were of at least two types; the compression, lead covered shells shown in Figures 10 and 12 and the copper studded or shunted projectile shown in Figure 14. The English manufactured and exported many projectiles of different designs. Several of these patterns reached the United States during and after the war. Some have been brought into the country by collectors. Shells shown in Figures 10, 12, and 14 were brought into the U. S. from England in 1970 by the author, and are presented as representative examples of those actually used by the South.

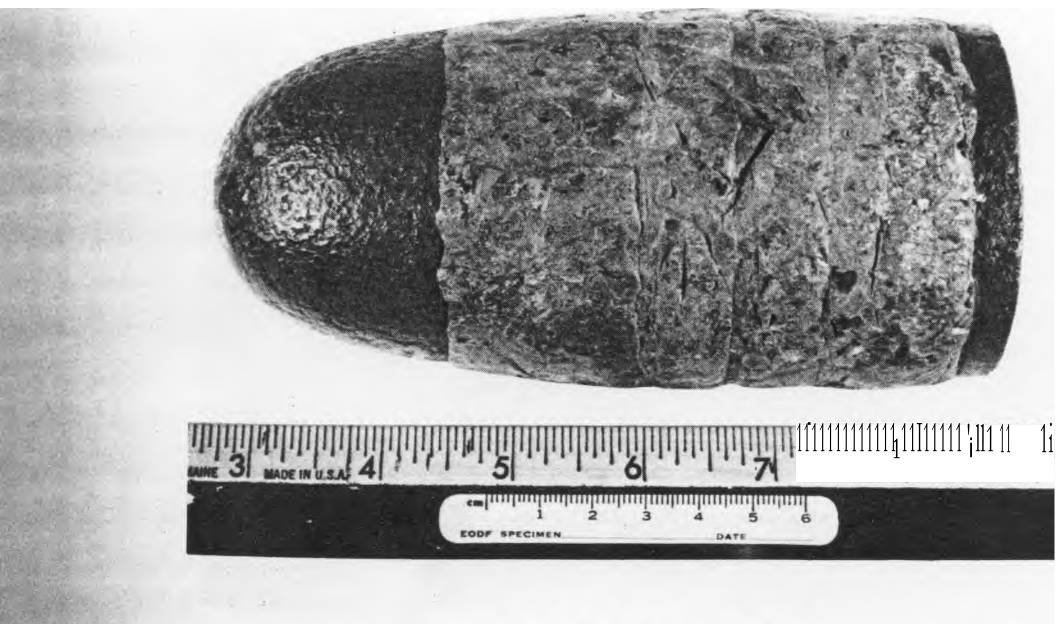


Figure 10. 3-Inch Armstrong Shell.

The compression type of Armstrong projectile made use of a lead jacket cast over two-thirds of the shell body. This lead jacket was in fact the sabot of the shell which was compressed outward into the rifling at discharge of the gun. In Figure 10 the sabot was retained on the hell body by four to five semicircular ribs cast as an integral part of the shell body. The rib casting was one of the many designs utilized by the opposing armies to help secure lead sabots from stripping off the shell body immediately after the projectile leaves the gun muzzle. The ribbed construction also added to the shell's fragmentation pattern. The radiograph shown in Figure 11 illustrates the ribbed construction and also shows the main filler cavity.

Battlefield recoveries of Armstrong lead compression-type projectiles have contained the Confederate time fuze adapter, Figure 141, and the author is unaware of any percussion-time fuzes being found. Another interesting note is that the projectile shown in Figure 12 has fuze opening threads of a left-handed nature, while the Confederate time fuze adapter has right-hand threads. This would indicate that Armstrong projectiles recovered in the U. S. were constructed specifically for the right-handed fuze adapter or that the Confederates copied the Armstrong pattern and began manufacturing their own versions, especially after their overseas supply was cut short by the Union naval blockades along the Atlantic seacoast. This is but one of a long list of peculiarities that continues to baffle modern day students of Civil War Artillery which is brought about because of poor record keeping of details.

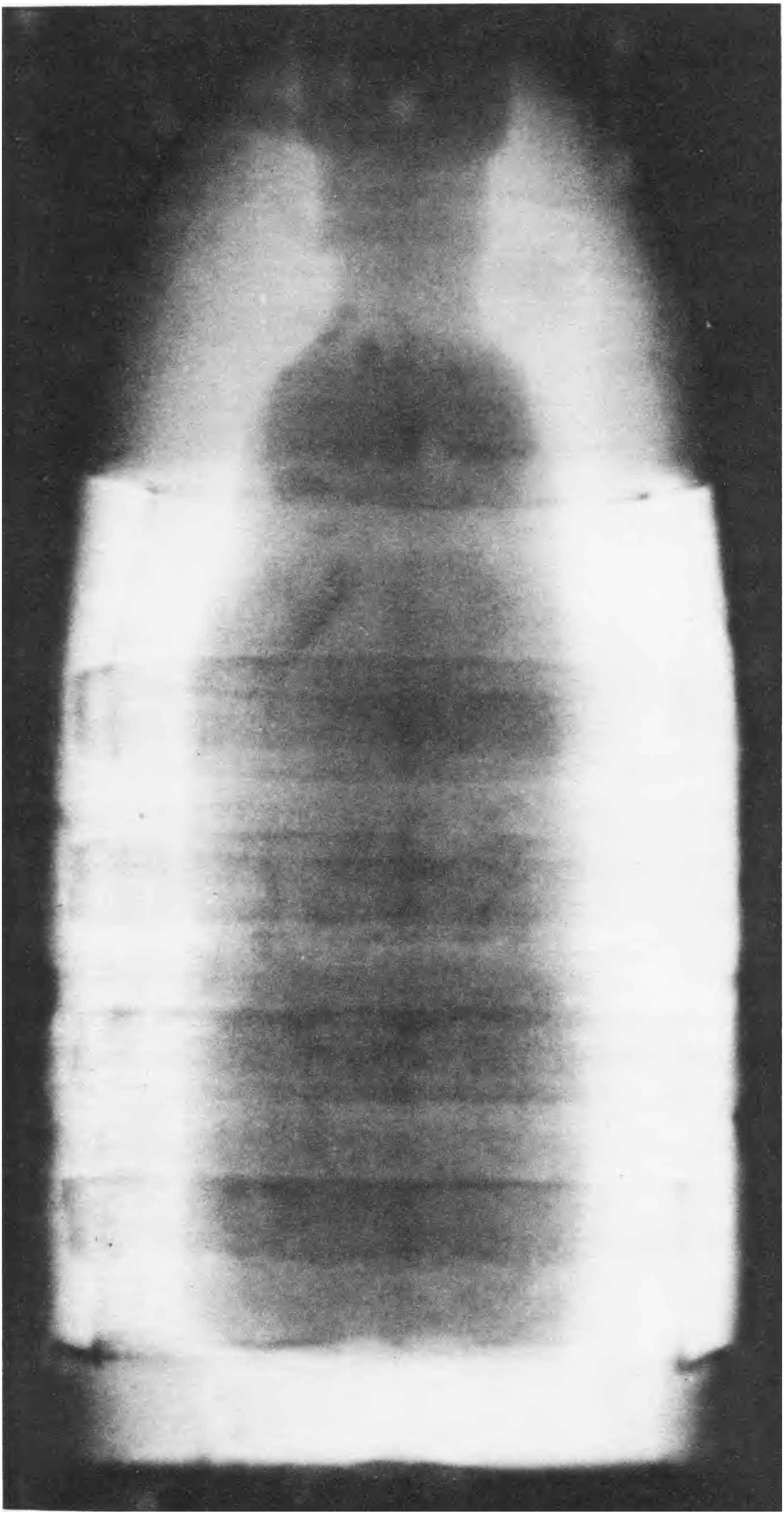


Figure I I. Radiograph of 3-Inch Armstr6rng *Shell.*

Figure 12. 3.5-Inch Armstrong Shell.

Another specimen of the Armstrong compression shells bears the initials "BOC," which are located slightly forward of the ogive. This shell maintains the main identification feature of the lead jacket covering two-thirds of the shell body. The meaning of the initials is unknown to the author. The fuze for this projectile is missing and the fuze opening is closed by the typical English shipping plug, Figure 139. Normally this projectile would contain an English Armstrong percussion fuze, Figure 148. A close study of Figure 13 will reveal the unusual construction of this shell.

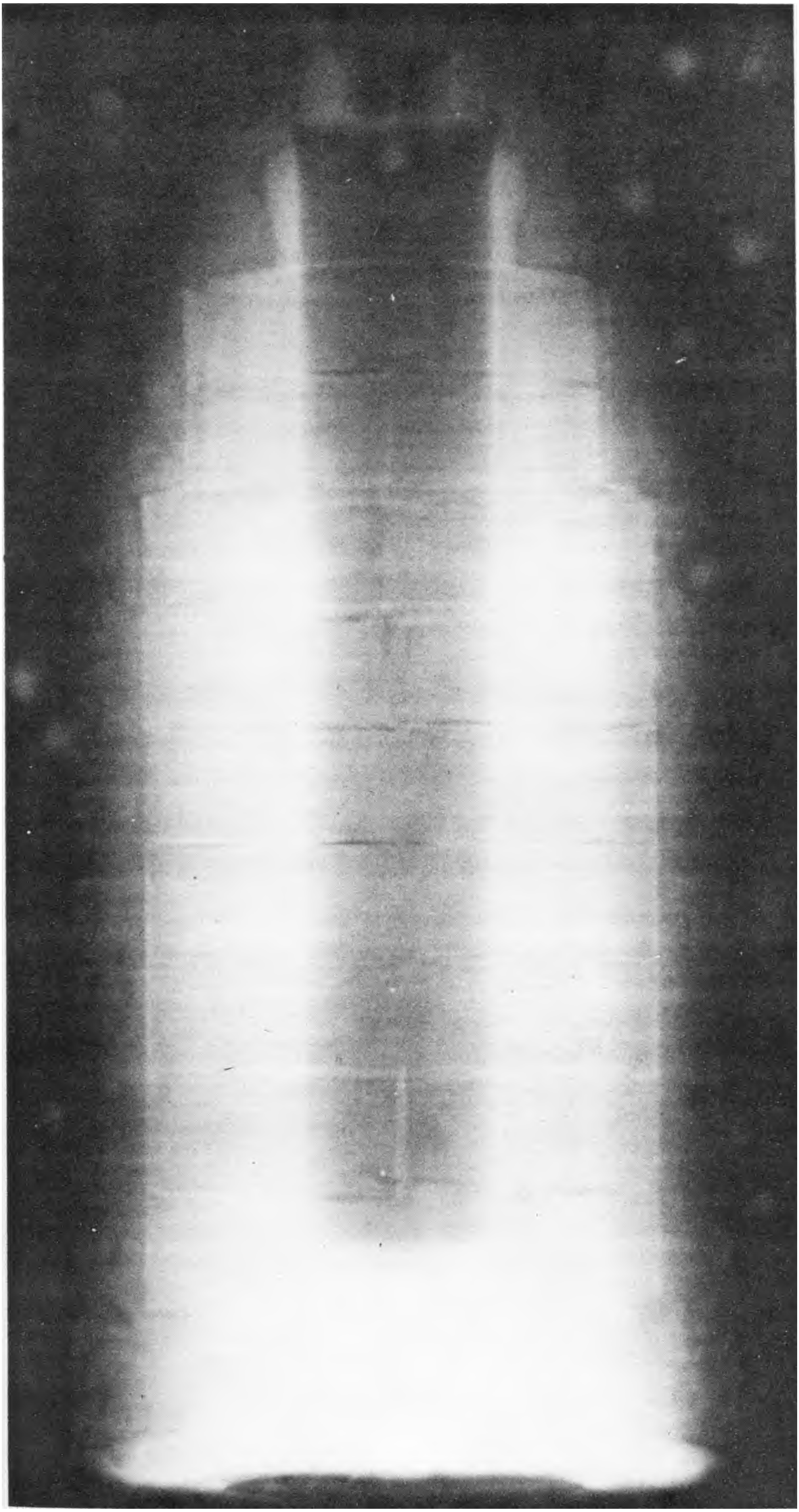


Figure 13. Radiograph of 3.5-Inch Armstrong Shell.

Figure 14. 3-Inch Studded Armstrong Shell.

The second of the two more common types of Armstrong projectiles was the "shunt" type or as referred to by modern day enthusiasts, the studded projectile. Armstrong used copper studs exclusively while Blakely used hardened lead studs.

The shell was made of cast iron, with two or three rows of studs encircling the shell body, with a minimum of three studs in each row. The larger caliber shells had numerous studs configured around the shell body. The copper studded projectiles could be either initiated by time, percussion, or combination fuzing. A fuze sample for this shell is unavailable at this time and will not be presented. Battlefield use of this particular type was evidently very limited; the reason is unknown.

Figure 15 provides a radiograph of this projectile should future projectiles of this type be recovered.

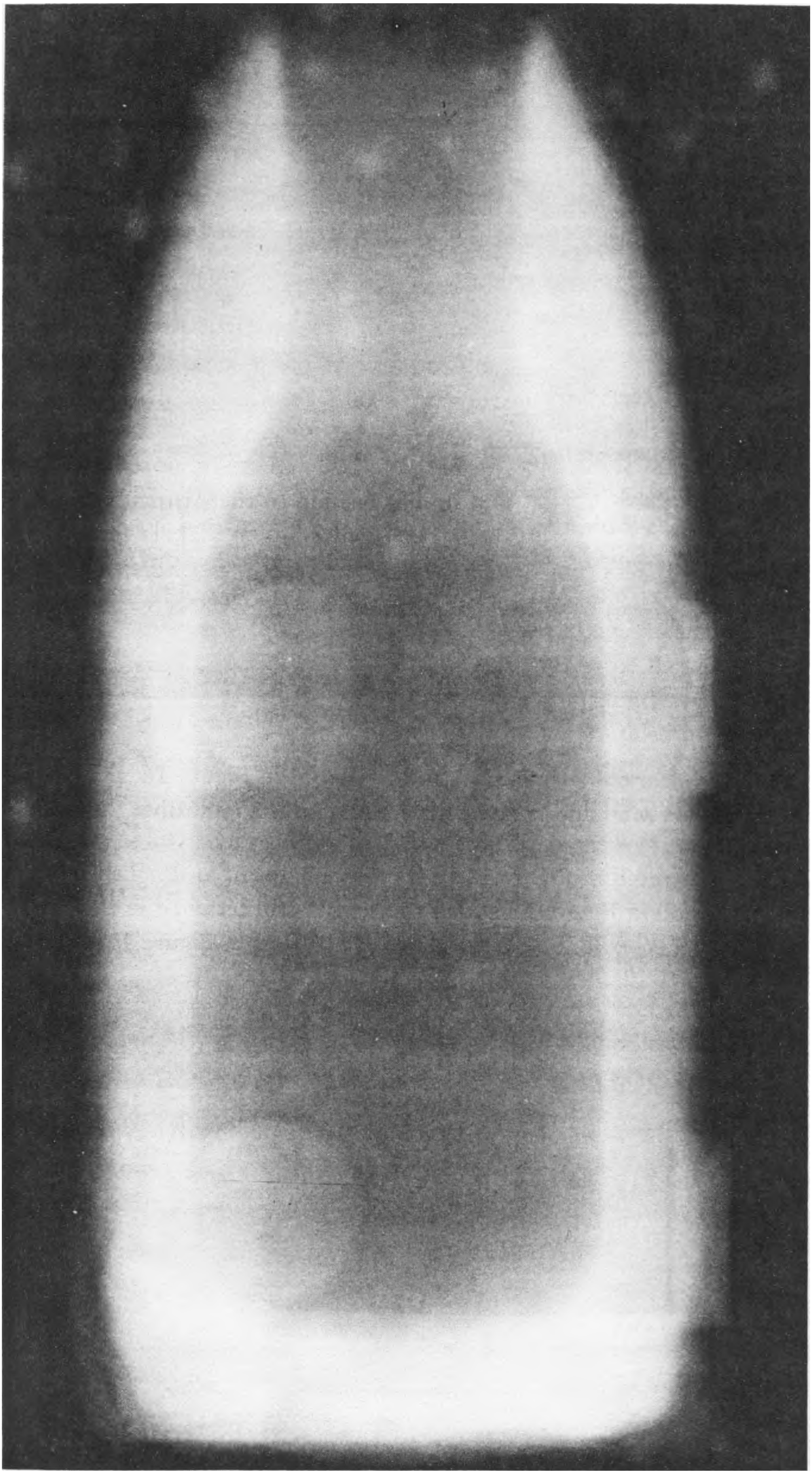
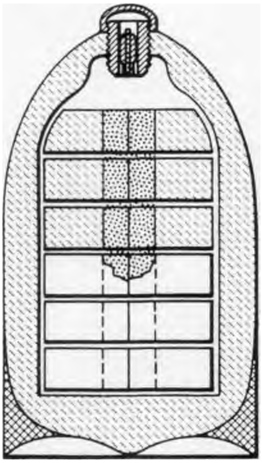


Figure 15. Radiograph of 3-Inch Studded Armstrong Shell.

B. ENGLISH BLAKELY



Probably the most widely used of all foreign made rifles and projectiles were the various Blakely types ranging from field guns to the mammoth 13-inch seacoast pieces. Constituting an important category in Confederate ordnance, Blakely field pieces were imported in two dissimilar types: one firing formed projectiles which accepted the rifle grooving by means of hardened lead studs molded onto the outer shell body, the other was the lead sabot type similar to the U.S. Dyer. This second type had a cast on lead sabot at the rear covering about one-third of the shell body and would upset into the gun's rifling in a similar fashion to the Armstrong compression-type shell. The small 3.5-inch Blakely featured in Figure 16 was said to be of the same type and caliber first fired at Fort Sumter in Charleston, South Carolina, the so called first shot of the war. The special design feature of the shell is the placement of semicircular shaped cast-iron segments into the interior of the shell. When properly positioned, these segments form the hollow core into which the explosive charge is placed.

Judging from the clear cut rifling marks on the sabot in Figure 16, this type of Blakely projectile took its rifling very well and created little stress on the gun tube.

The projectile illustrated in Figure 16 bears the remains of an English percussion fuze. A study of the radiograph in Figure 18 shows the striker still retained in the fuze body, with the fuze anvil missing. The 4.5-inch Blakely Shell is featured in Figure 17.

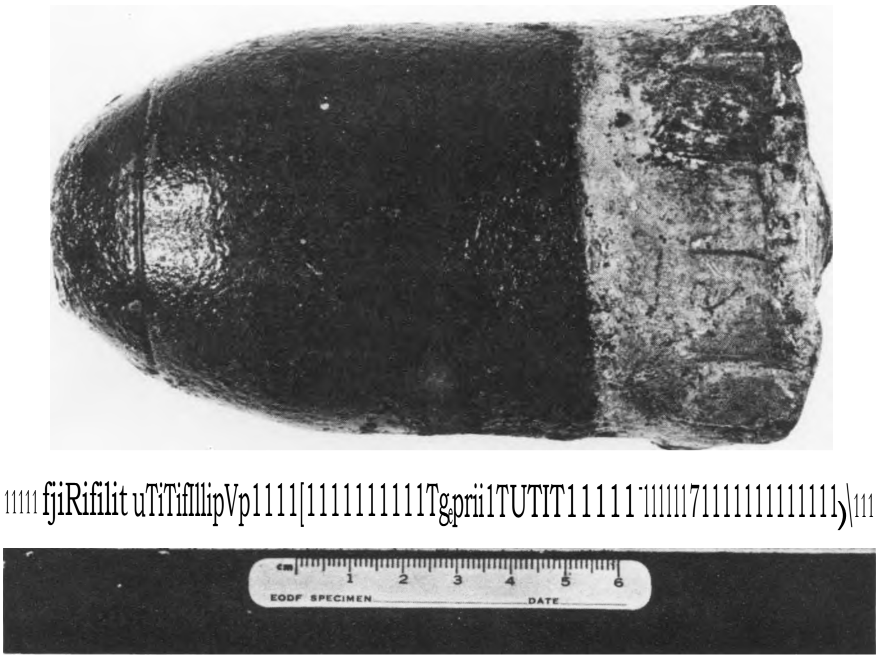


Figure 16. 3.5-Inch Blakely Shell.

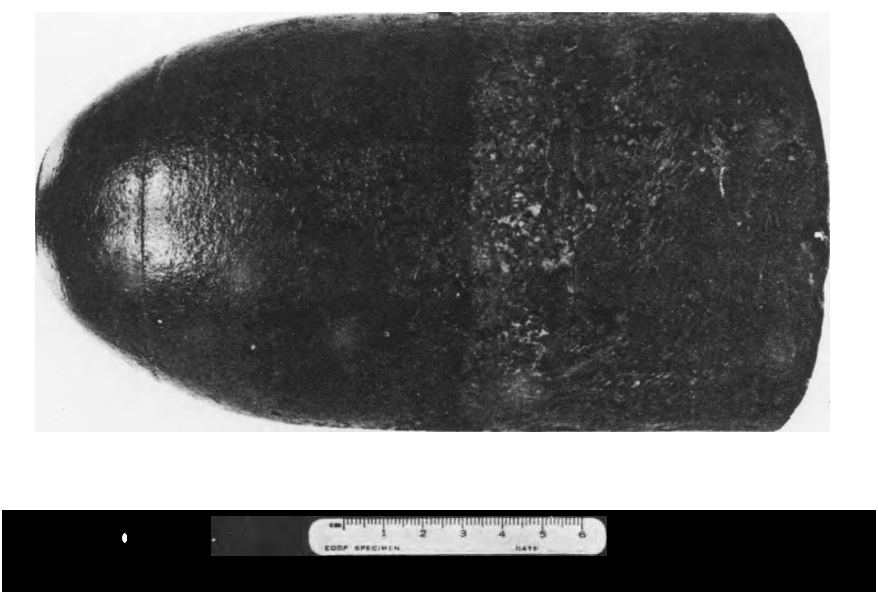


Figure 17. 4.5-Inch Blakely Shell.

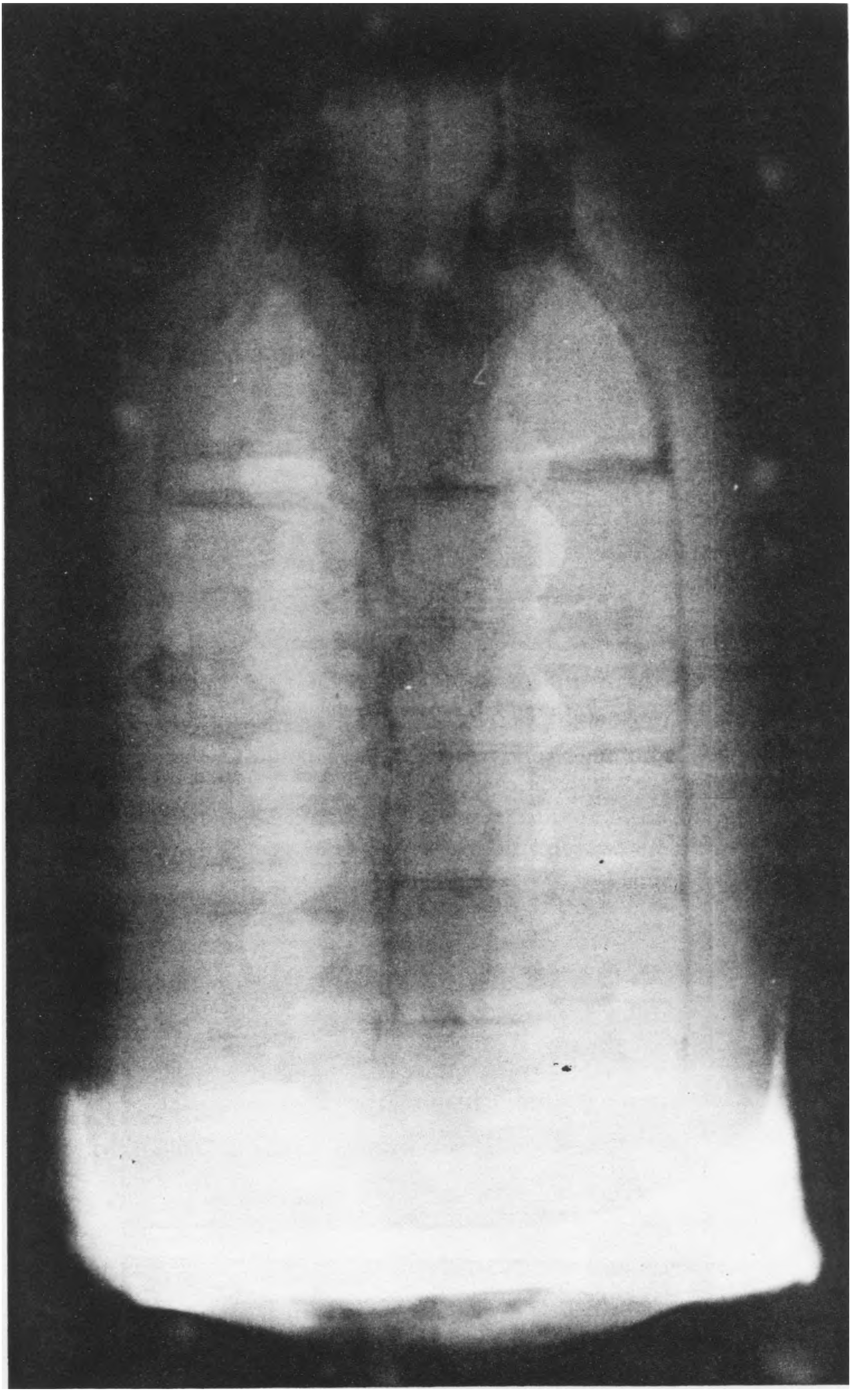


Figure 18. Radiograph of 3.5-Inch Blakely Shell.

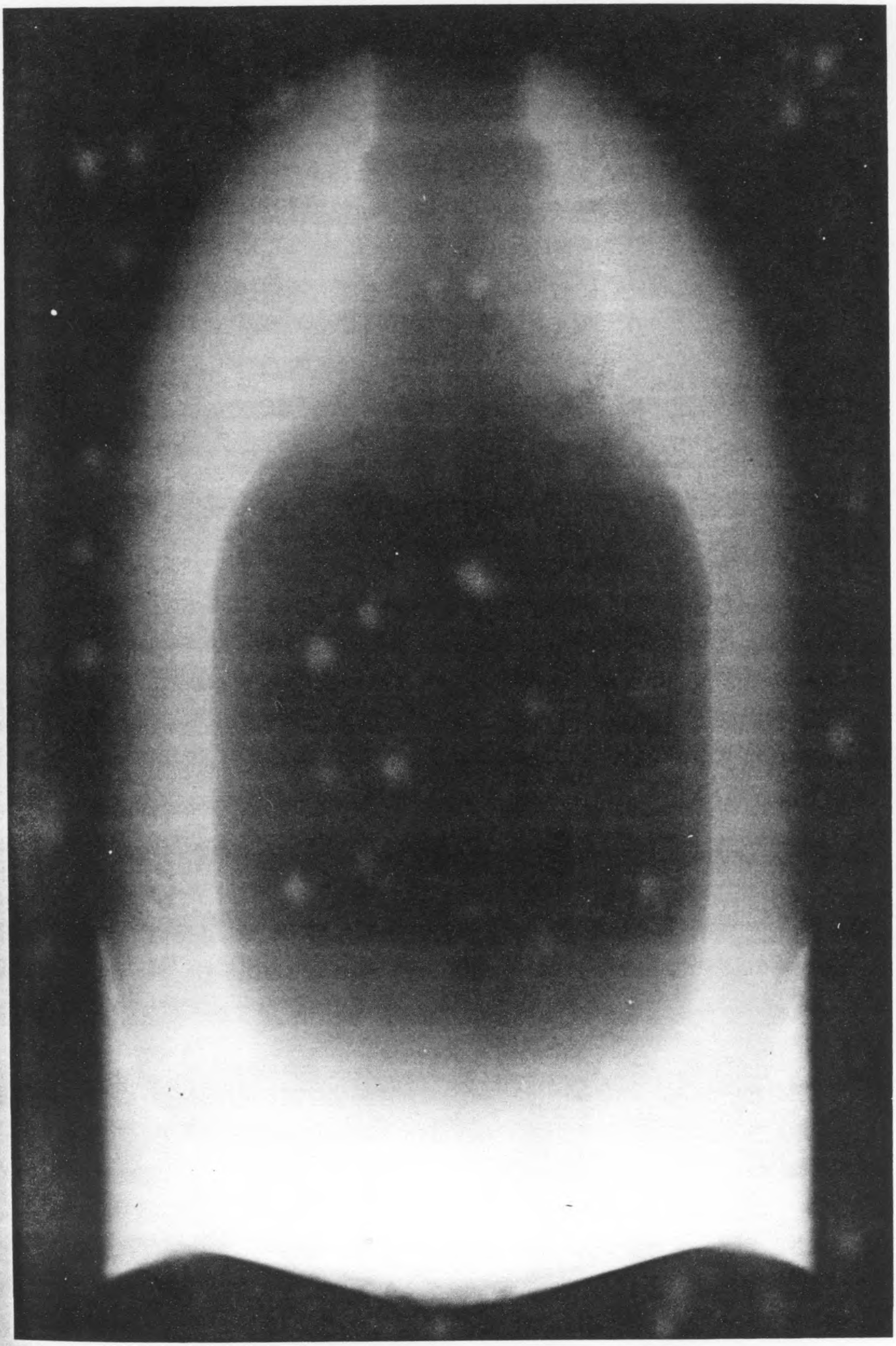


Figure 19. Radiograph of 4.5-Inch Blakely Shell.

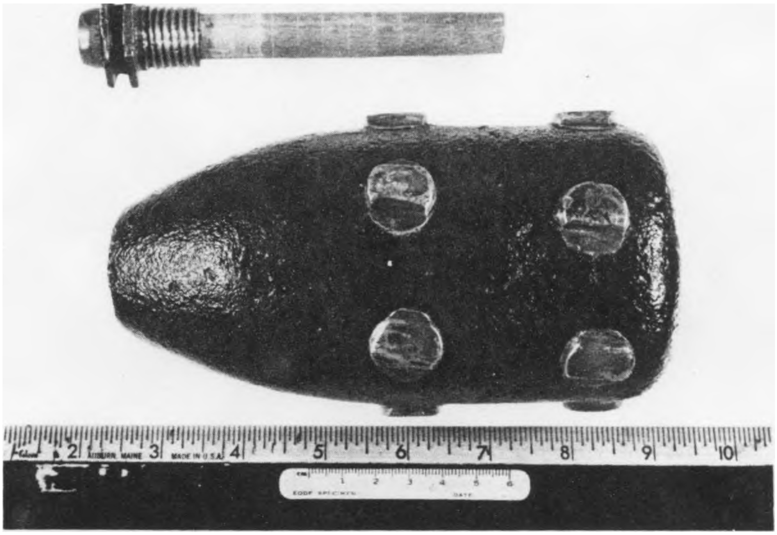


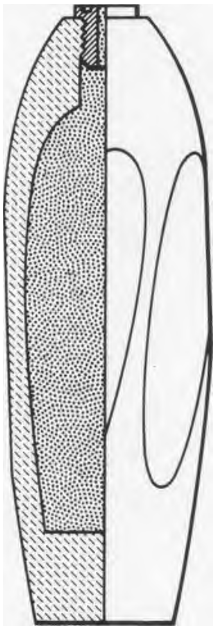
Figure 20. 3.5-Inch Studded Blakely Shell.

The "shunt" or studded-type projectile shown in Figure 20 is a rare find as far as actual battlefield recoveries are concerned. The one shown here was obtained by the author from a collector in Rhode Island. The author knows of only two field recoveries, one in New Iberia, Louisiana, and the other in the Petersburg, Virginia, campaign area. This specimen shows clear evidence of being fired as witnessed by the engraved lead studs.

This Blakely projectile has two rows of hardened lead studs encircling the shell body with each row having six studs. The fuze opening is lead lined and tapped to receive the powder train time fuze shown above the projectile. For further details of the fuze, see Figure 132. This is the only fuze seen to be used in this shell. The fuze still contained the finely pressed black powder when obtained from its original owner. Although recoveries of this type and caliber are rare, records of the Woolwich Arsenal in England reveal its exportation to the South.

Figure 21. Radiograph of 3.5-Inch Studded Blakely Shell.

C. ENGLISH WHITWORTH



Whitworth guns were distinctive because of their hexagonal bore and required a specially designed proj ec- tile of cylindrical shape that was cast and milled to fit the rifling. The shell closely fitted into the bore and the un- usual rifling design imparted a sustaining rotation whi ch offered extreme accuracy at long range. The breach I oad- ing projectile was normally of tinned iron, often being fixed ammunition, consisting of a sheet-iron cartridge case containing the propellant charge, grease wad, and the p ro- jectile itself. However, the breach mechanisms were ude and tended toward frequent breakdowns, being replaced early in 1863 with muzzle loaders which were lighter, shorter, and could be fired more rapidly. The projectiles were manufactured in shot, shell, and case shot. It is appropriate at this time to inform the reader that in cylin ri- cal (conical) shaped projectiles of the rifled variety, the solid shot is more commonly referred to as "bolts."

The common shell, having a rounded nose and a length of more than three times the diameter,was largely employed by the field artillery. Shown in Figure 22 is a 12-pounder case shot with time fuze adapter. Whitworth projectiles came in varying lengths. Bolts for this hexagonal design had either round or flat nose construction. Whitworth projectiles were either fuzed by percussion or time. A grease wad was ordinarily placed between the projectile and powder charge when loading the piece. This served to lubricate the bore which prevented fouling, thus permitting extensive firing without the necessity of sponging out the barrel.

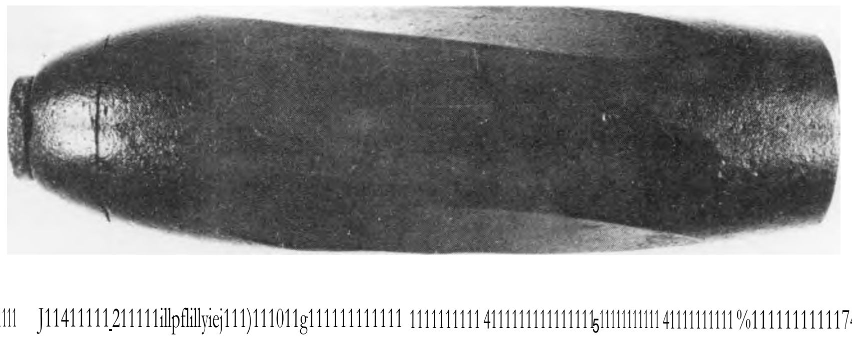


Figure 22. 12 Pdr. Whitworth Case Shot.

The odd shape of the shell employed, created a considerable supply problem as the tighten-big Union blockade reduced imports of English produced ammunition. It was late in the war before Southern arsenals were able to manufacture even small quantities of Whitworth-type projectile s.

The projectile shown in Figure 22 is of unique internal design. While viewing Figure 23, the reader will note a small amount of the case shot missing from the upper part of the shell. The unique feature is the long narrow tube passing through the case shot and matrix down to a steel plate diaphragm and actually extending through the diaphragm. Below the steel diaphragm is the location of the relatively small bursting charge of black powder. In operation, the time fuze adapter, containing its paper time fuze would ignite and flash through the metal tube and down into the bursting charge. Upon detonation, the metal plate pushes the case shot out the front of the projectile. The nose of the projectile has been pressed and staked into position and provides a weak point for rupture as the case shot is propelled forward. This "nose ejection" principle is also employed in the Union Hotchkiss Case shot.

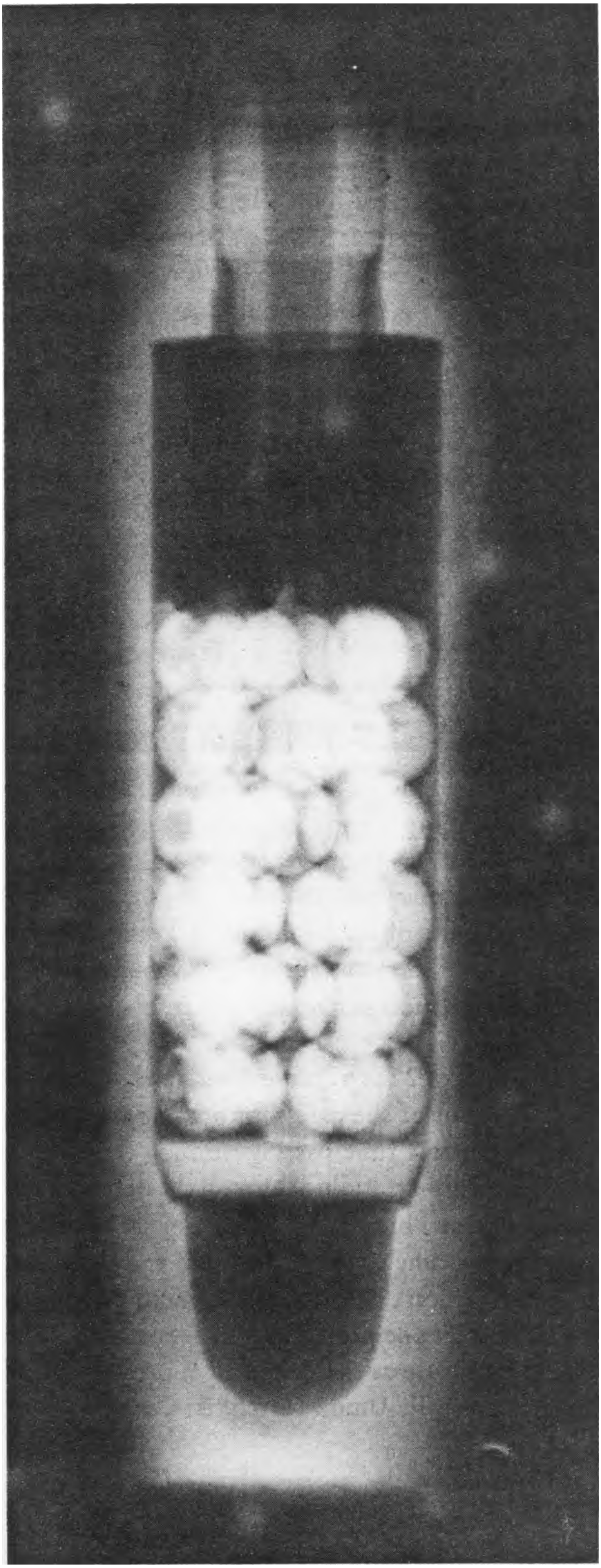


Figure 23. Radiograph of 12 Pdr. Whitworth Case Shot.

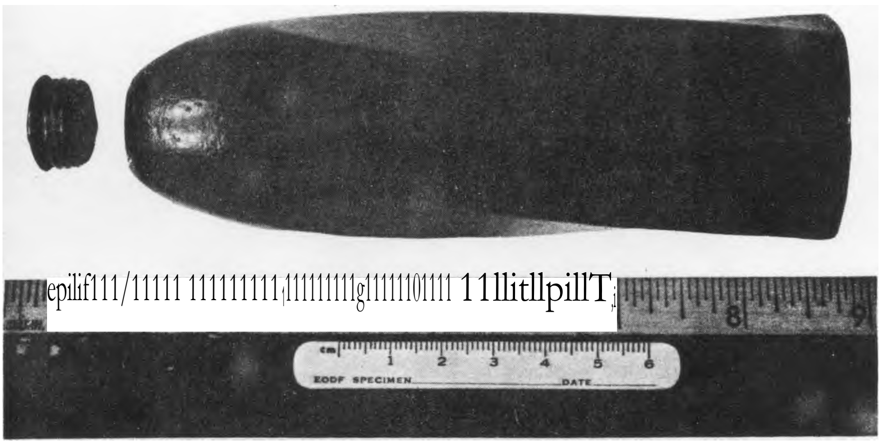


Figure 24. 3 Pdr. Whitworth Shell.

Figure 24 is the small and very rare 3-pounder Whitworth Shell made for the 1.5-inch mountain rifle. Several of these specimens have turned up at Fort Fisher, however the projectile shown here was brought into the U. S. from England in 1970. The author has not seen the fuze intended for this shell but a percussion and time fuze is said to exist. The specimen shown in Figure 24 contains a shipping plug as shown in Figure 139.

Phenomenal range and accuracy was claimed for these small projectiles, more than 9,500 yards; however, the small bursting charge would fragmentate the shell body into only two or three pieces.

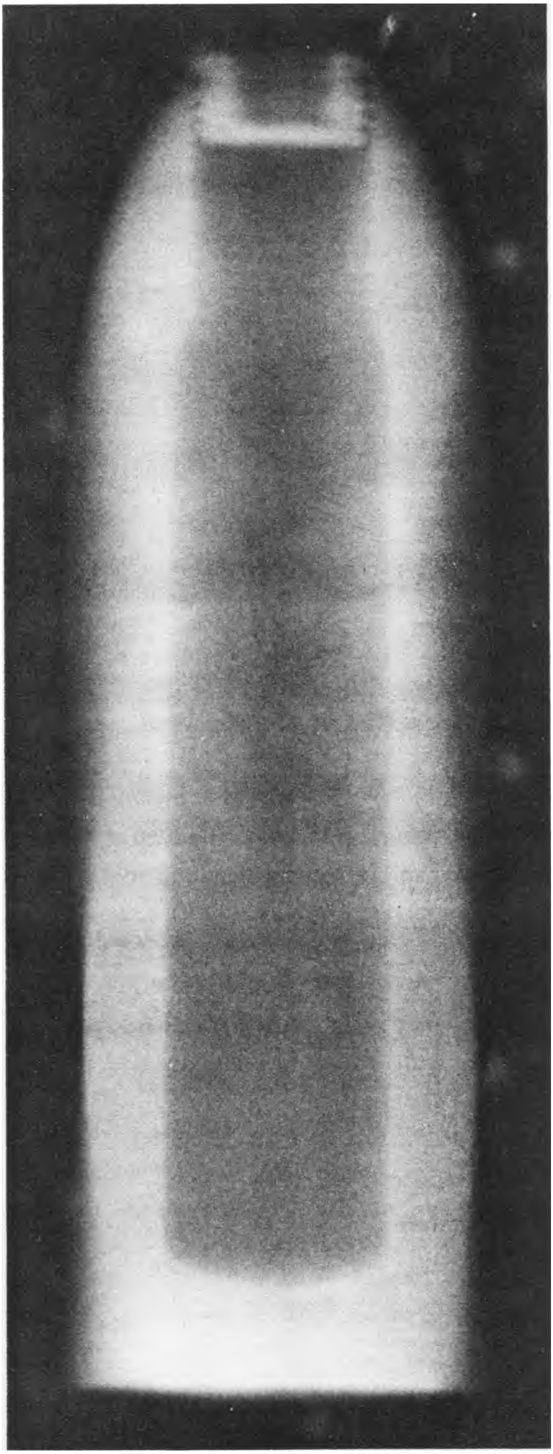
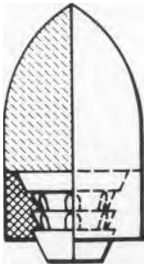


Figure 25. Radiograph of 3 Pdr. Whitworth Shell.

Figure 26. 12 Pdr. Whitworth Bolt (short).

Measuring a bare 5 inches in length, this rare Whitworth Bolt is presented as a sample of bolts that were made for the Whitworth rifle. Although this specimen was brought into the U.S. by the author, it is representative of the Whitworth Bolt. By far the most common rifles of this extremely unusual type were the 12•pounders which measured 3 inches across the corners and 2.75 inches across the flats.

This specimen is English made and was probably less effective than the normal size bolt. Solid shot was far more frequently used in these pieces than in normal field rifles. The range and accuracy made them fine weapons for counter-battery work and for fire at infantry in column. The Traedegar Works in Richmond learned to make projectiles for these guns. Solid shot of this type, made in the South, is common today.



Issued in solid shot and shell, the 3-inch Archer was a popular projectile for the South. The Archer design w another attempt by the South to improve their system f retaining the lead sabot on the projectile during disch from the gun and in flight. This design consisted of a co rugated, tapered base cone encased with the lead sabot. The design of the base taper will vary among the differen models of the Archer, but the one shown in the line draw ing was the most used. Fuzes for the shell configuration were the common wooden adapter for paper time fuzes some specimens have been seen with the Bormann-time fuze. The projectile shown in Figure 27 is the 3-inch bo

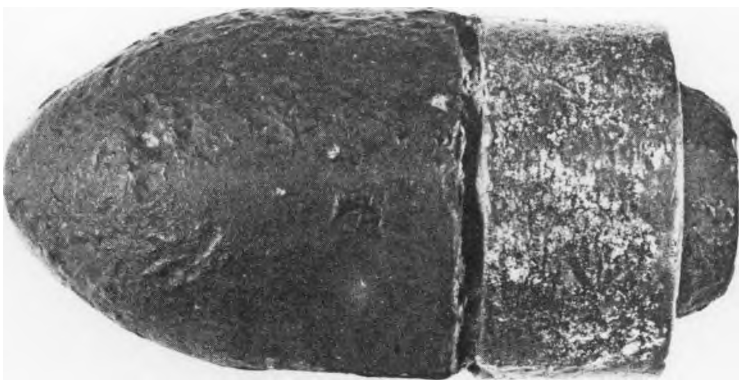


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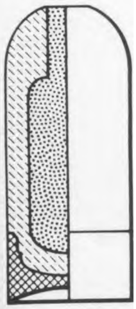
Figure 27. 3-Inch Archer Bolt.

E. BURTON PROJECTILE



The Burton is another lead sabot equipped projectile which resembled the Union Dyer in having a concave lead cup affixed to the base of the projectile. This system had the disadvantage of stripping the sabot either in the bore and losing the spinning action, or at the muzzle, where the lead shredded into advanced friendly troops. Later types overcame this weakness to some degree by first tinning the cast-iron shell and then casting a lead sabot onto it. The Burton was issued in solid shot and shell and fuzed with a zinc fuze adapter for paper time fuzes.

This projectile design is often confused with the Union Dyer, and in larger calibers, with the English Blakely.

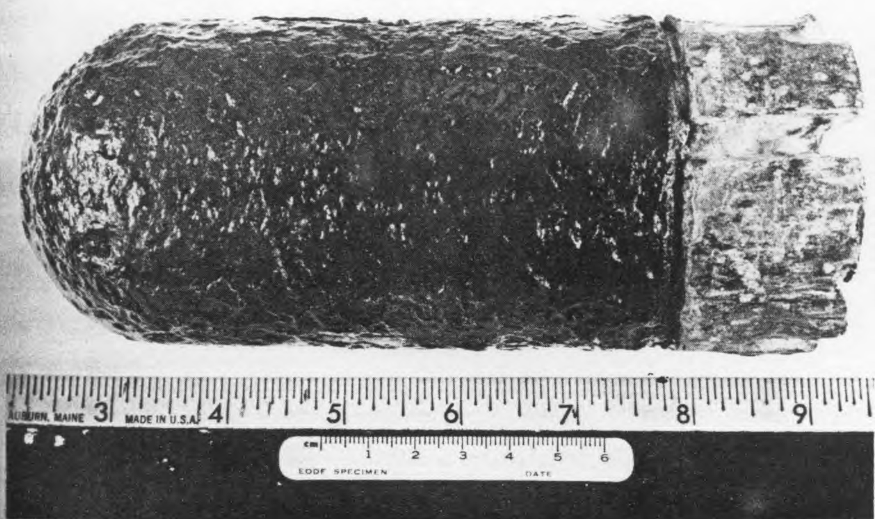


Figure 28. 3-Inch Burton, Case Shot.

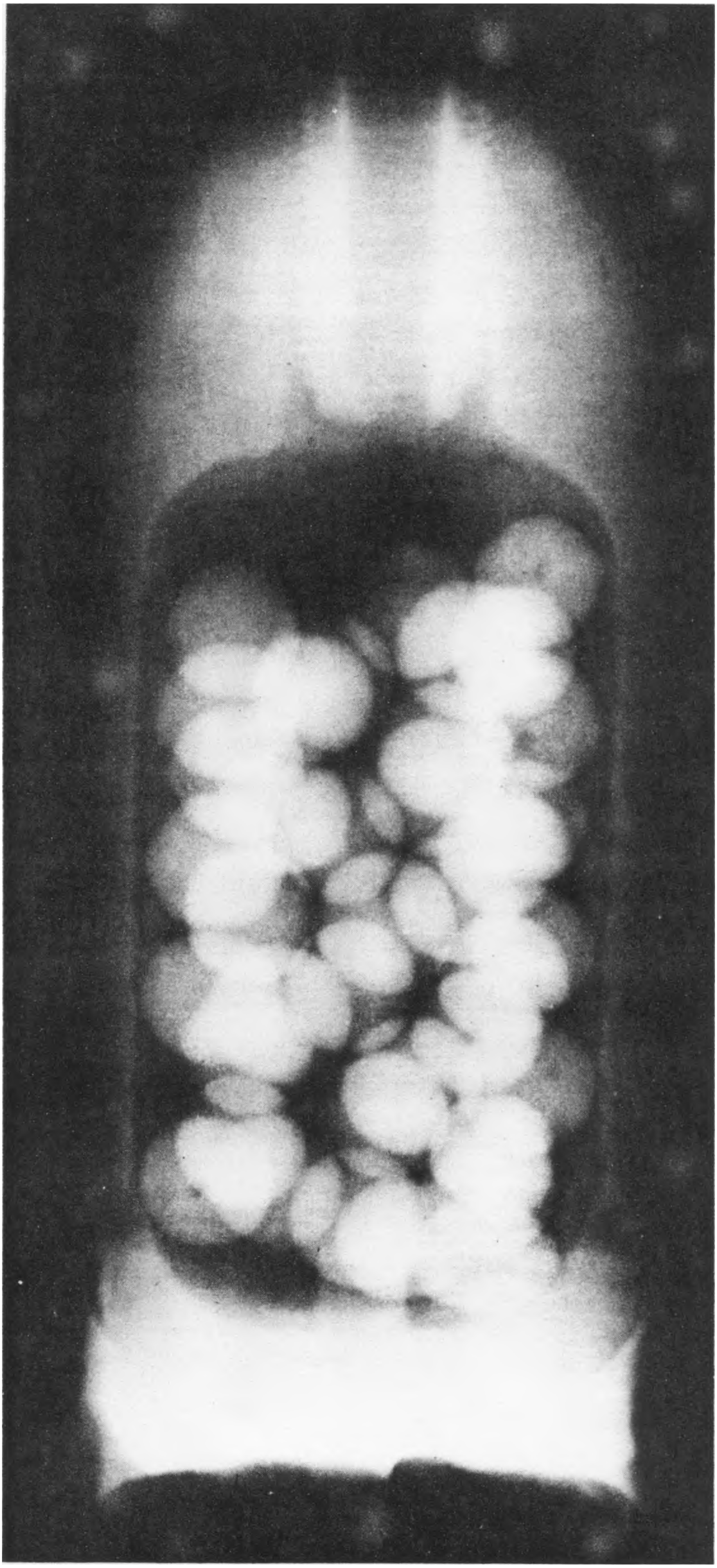
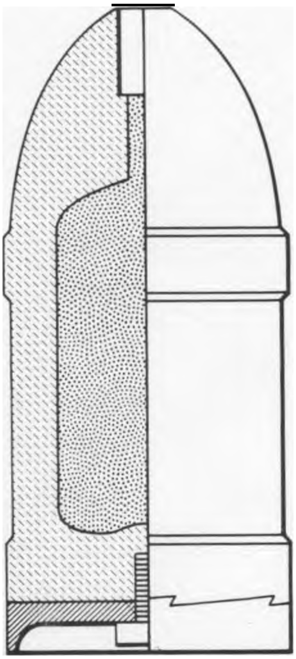


Figure 29. Radiograph of 3-Inch Burton, Case Shot.

F. BROOKE PROJECTILE



The ratchet sabot-type projectiles shown in Figures 30 and 32 were used quite frequently by the Confederate armies. Its inventor, John Mercer Brooke, graduated from the U.S. Naval Academy and served in the Navy until he joined the South in 1861. This type of shell took to the rifling by means of a rotating band attached to the base of the projectile. A threaded bolt secured the copper alloy cup to the projectile base and upon discharge this was forced into a serrated base ramp preventing separate rotation. Although the projectile shown in Figure 30 has a smooth Parrott-shaped body, most styles have two raised bourrelets as shown in Figure 32, a common Confederate practice.

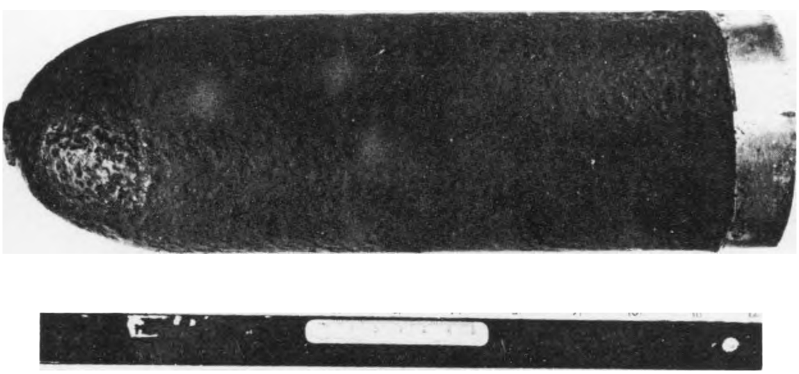


Figure 30. 4.2-Inch Brooke Shell.

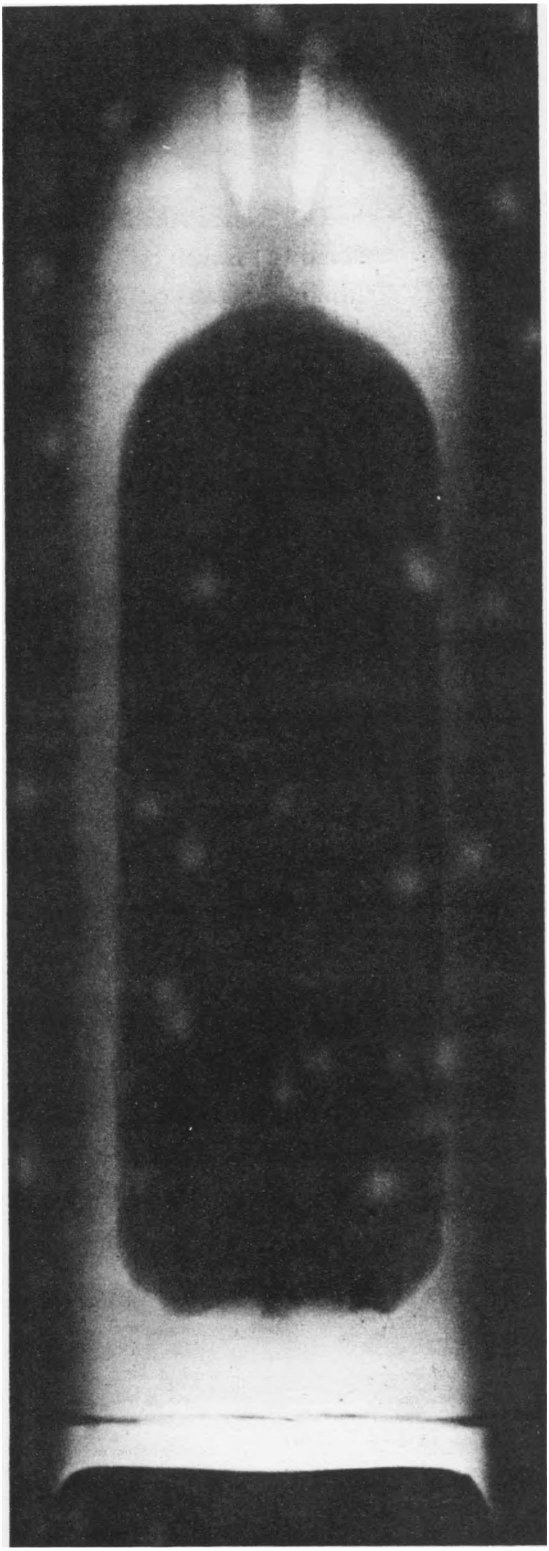


Figure 31. Radiograph of 4.2-Inch Brooke Shell.

Figure 32. 7-Inch Brooke Shell.

This unfired specimen of the Brooke pattern is from the Charleston, South Carolina, area tad clearly represents the commonly used two raised bourrelet system used by the Confederacy.

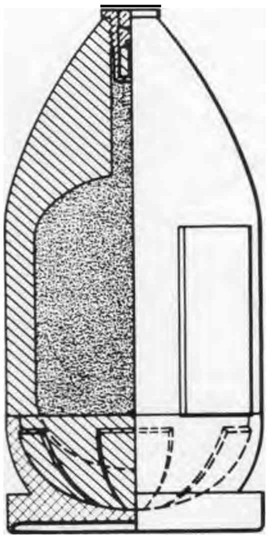
This particular shell was half filled with a incendiary mixture of benzole, crude petroleum, turpentine, and tar bound together with cotton waste. This mixture of flammable materials had solidi ied and was quite difficult to remove. Holes of 1 inch in diameter had to be drilled at different intervals around the lower shell body in order to remove this hardened mix. The upper part of the shell was filled with common black powder and was readily removed.

The time fuze adapter located in the nose differed from the usual two-spanner hole adapter in that it was slotted.

Disposal personnel should be alert for this unusual filler and determine by radiograph if inerting is complete before certification.

Figure 33. Radiograph of 7-Inch Brooke Shell.

G. DAHLGREN PROJECTILE



The Dahlgren projectile is listed in Henry L. Abbott's book "Siege Artillery in the Campaigns Against Richmond" written in 1867 and is shown in Plate VI. It is listed as a Confederate siege and field rifle projectile and is thereby featured in this manual as being of Confederate manufacture. This shell presents much controversy among historians today and some prefer to type it as being of Union manufacture with Southern copies being found. Without serious regard for its origin, this projectile turns up occasionally in the Virginia campaign area.

It is identified by four wide raised ribs cast equal distance around the projectiles midsection, and having a cast lead sabot on the base.

The four raised ribs merely ride the gun barrel and the lead sabot imparts rotation of the projectile.

The Dahlgren shell shown in Figure 34 is normally found filled with black casting sand with the unthreaded fuze opening closed with a copper rivet about 1/2 inch in diameter and 1 inch in length. The 1/2-inch diameter fuze opening will not receive any known fuze of that period. The fuze shown in the line drawing is illustrated in Figures 36 and 37. A close-up view of the fuze can be seen in Figure 37.

Fired Dahlgren shells usually are found with missing sabots indicating that the sabot attach-
*. ment method was very poor. This in-flight sabot loss was an inherent trait of most Civil War projectiles, particular with the South, and is probably the explanation for such a wide variety of projectile patterns.

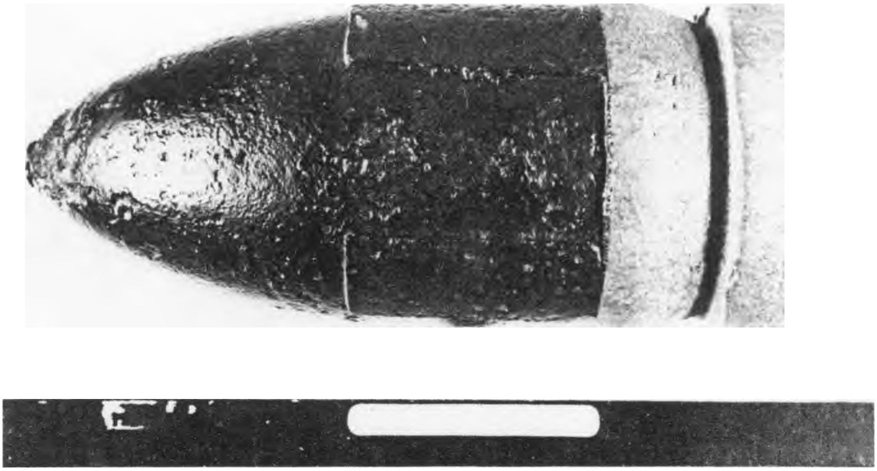


Figure 34. 4.2-Inch Dahlgren Shell.

The Dahlgren shells that are filled with the black casting sand are termed "Blind Shell," and are generally identified by the presence of the copper rivet in the nose. In any case the filler should be removed and identified before certification of inertness is given. The removal of the filler is discussed in Part VI of this manual. Remote drilling procedures should be used even though the black casting sand is suspected.

The 4.2-inch Dahlgren shell is a rarity compared to its smaller counterpart the 3.4-inch shell. The first known fuzed 4.2 inch is shown in Figure 36 along with the 4.2-inch "Blind Shell" for comparison. The percussion fuze of the explosive shell is featured in Figure 37. The radiograph in Figure 37 indicates that drilling from the base provides total access to the filler as well as being the thinnest part of the shell body. The round disk appears to part of the fuze, possibly the rear closure safety plug which is released on setback.

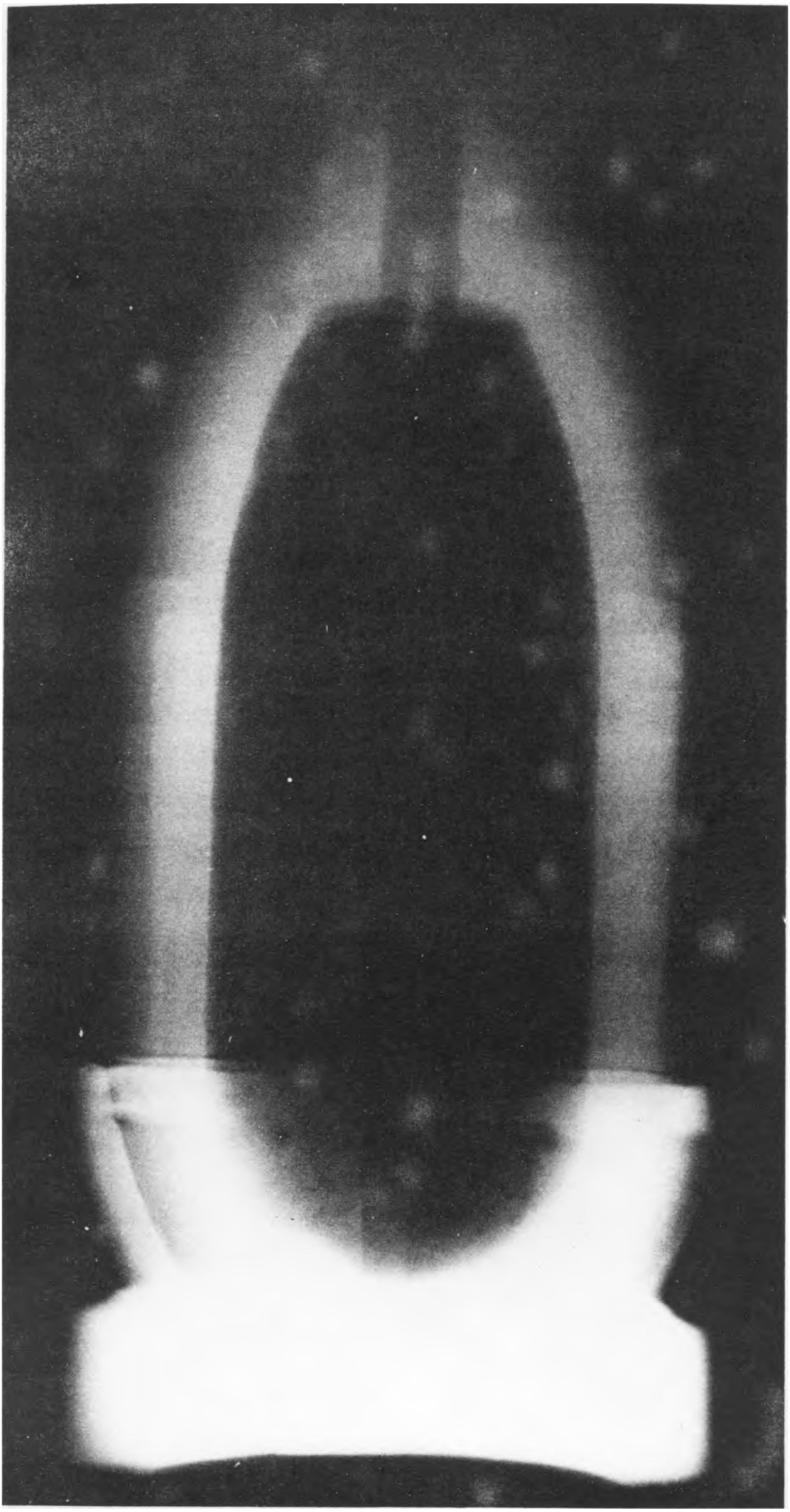


Figure 35. Radiograph of 4.2-Inch Dahlgren Shell (blind).

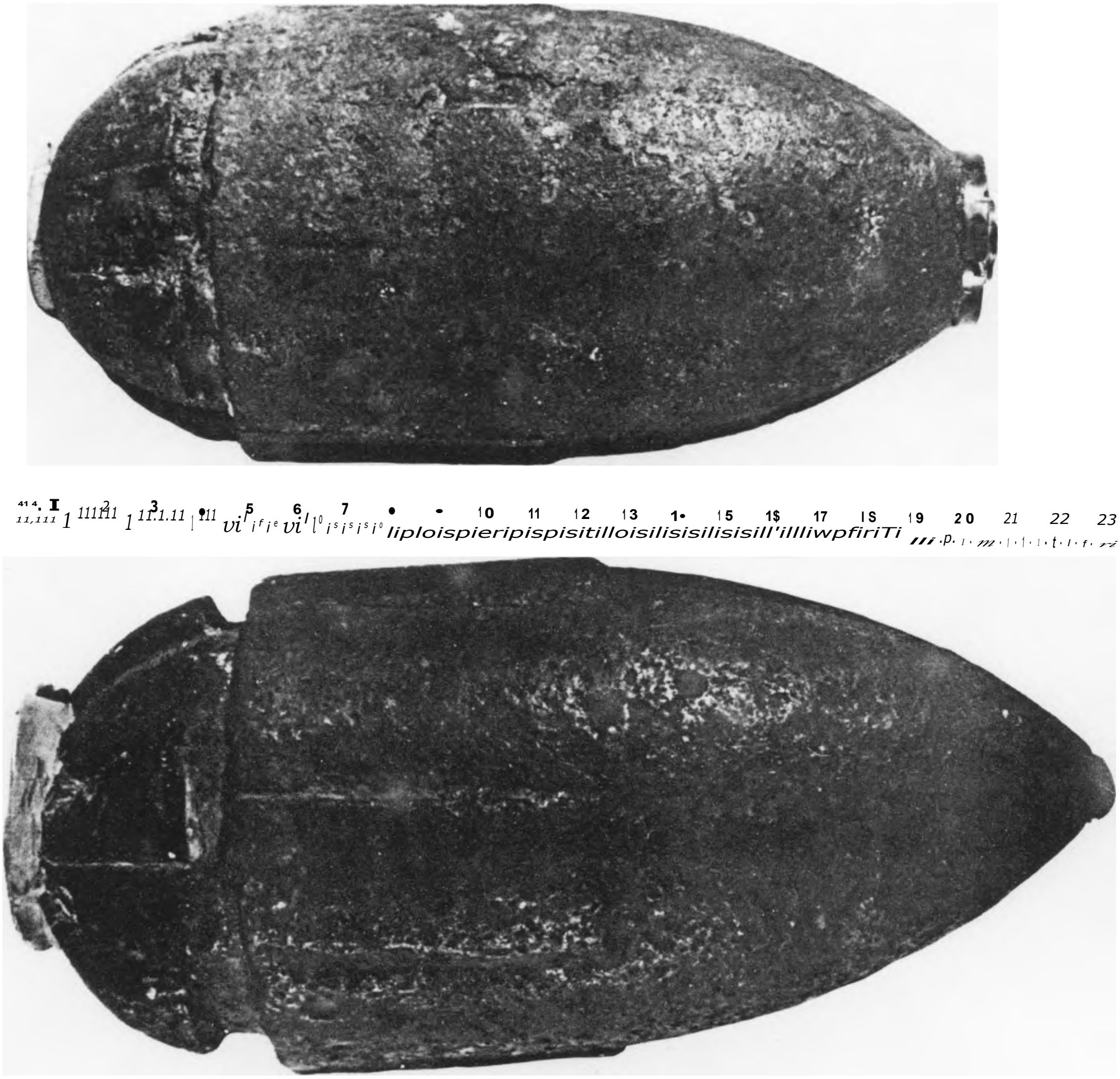
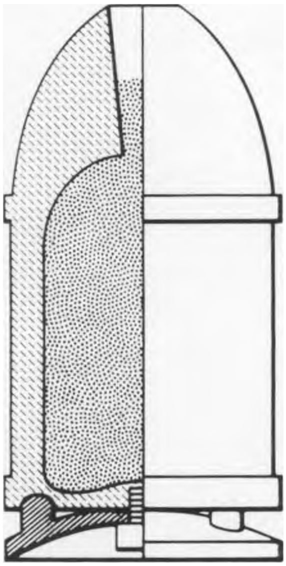


Figure 36. Comparison of 4.2-Inch Explosive and Blind Shell.

Figure 37. Radiograph of 4.2-Inch Dahlgren Shell (explosive).

H. MULLANE PROJECTILE



Many attempts were made to apply the Read cup, discussed in Paragraph I., to projectiles of the larger calibers, but ineffectually, as the wrought iron cup, on which the projectile was cast, broke and failed to give rotation. A series of experiments were made with sabots of various kinds; the preference being finally given to what is known as the Tennessee Cup as shown in the line drawing. This concave disk, of soft bronze, is attached to the base of du shell by a central screw. To prevent turning, the first used were perforated to receive three corresponding projections on the base of the shell. As it was supposed that much gas escaped by these apertures in the disk, the arrangement was reversed, making three cavities in the base of the shell and casting the three projections on the forward part of the disk. In the absence of lead, which was more effectually being used in the small arms of troops, the Tennessee sabot served its purpose. Under certain conditions, the gun - acting as a wedge - was subjected to a severe strain. This along with the small bearing surface which it presented to the bore, the difficulty of adjusting the projections to bear equally, and its liability to become loose and break in firing, were the main objections to its use. These factors later caused its replacement by the superior "ratchet sabot" Brooke design. Figure 38 illustrates the 3-inch Mullane shell which normally used a wooden adapter for paper time fuzes, and Figure 40, its radiograph. The 7-inch bolt for the Mullane is illustrated in Figure 39. Figure 38 represents the early design where the three projections were cast onto the shell body. The bolt and its radiograph shows the improved projections on the disk design. A percussion fuze exists for the larger calibers and is shown in Figure 157.

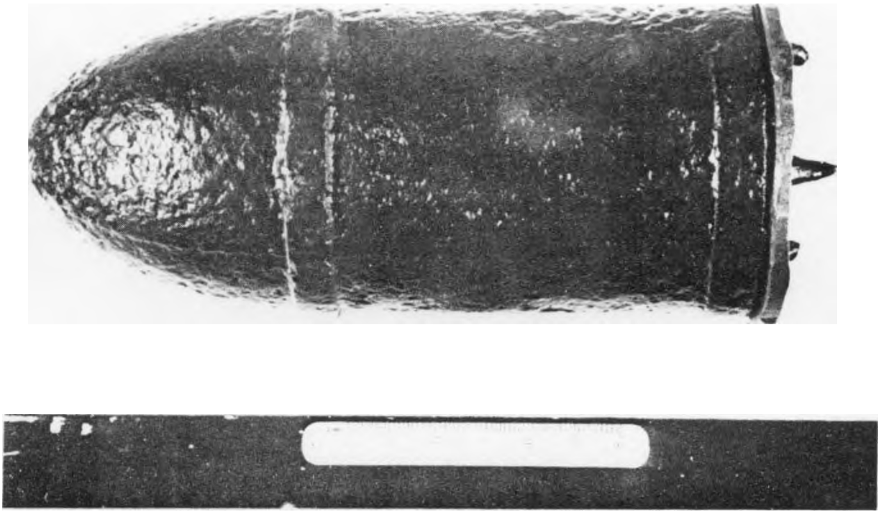


Figure 38. 3-Inch Mullane Shell.

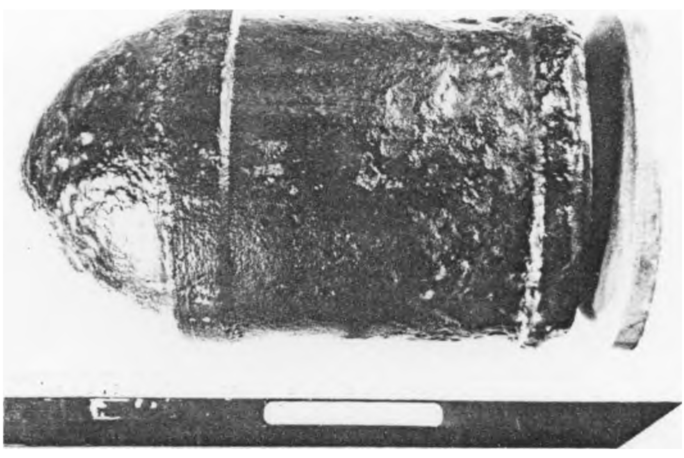


Figure 39. 7-Inch Mullane Bolt.

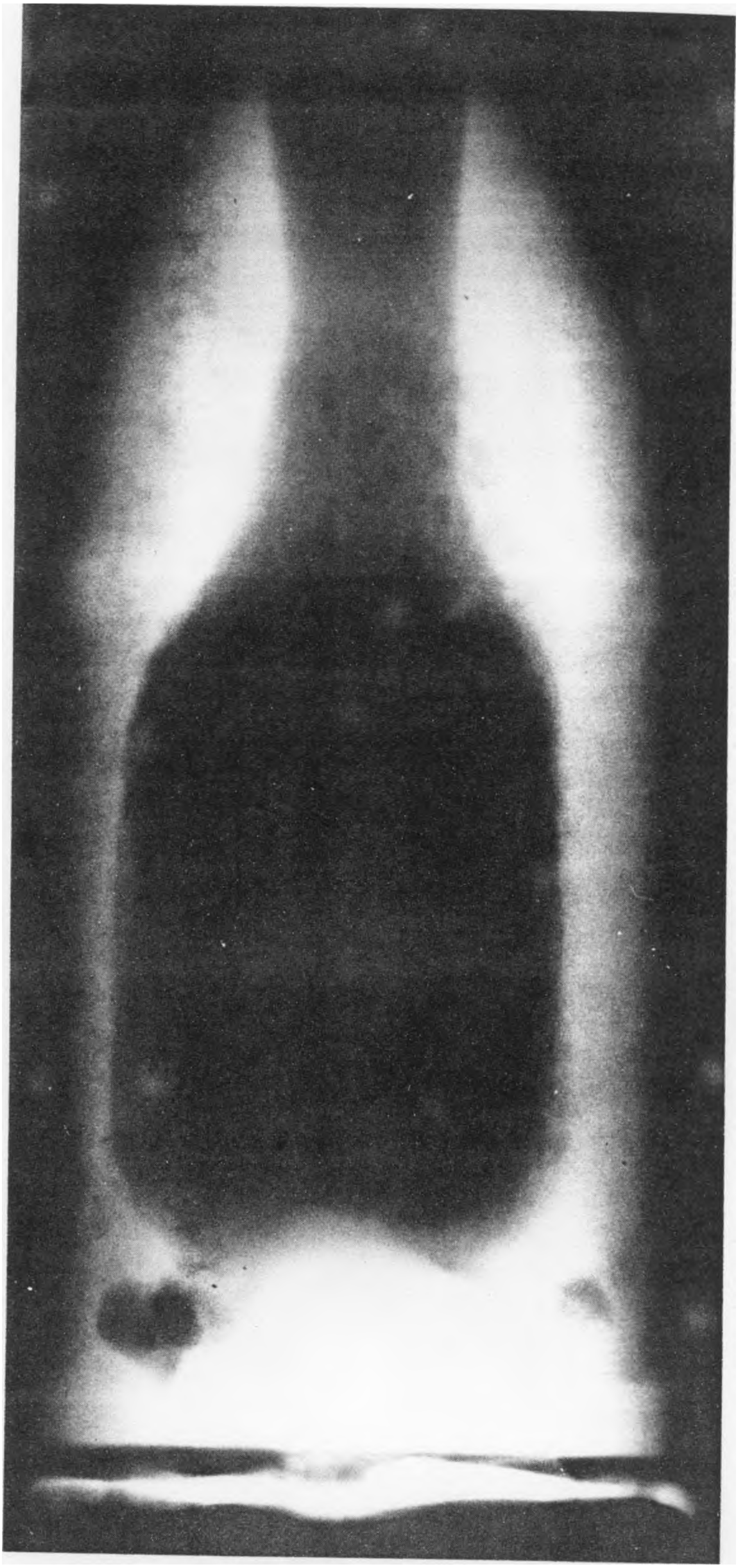


Figure 40. Radiograph of 3-Inch Mullane Shell.

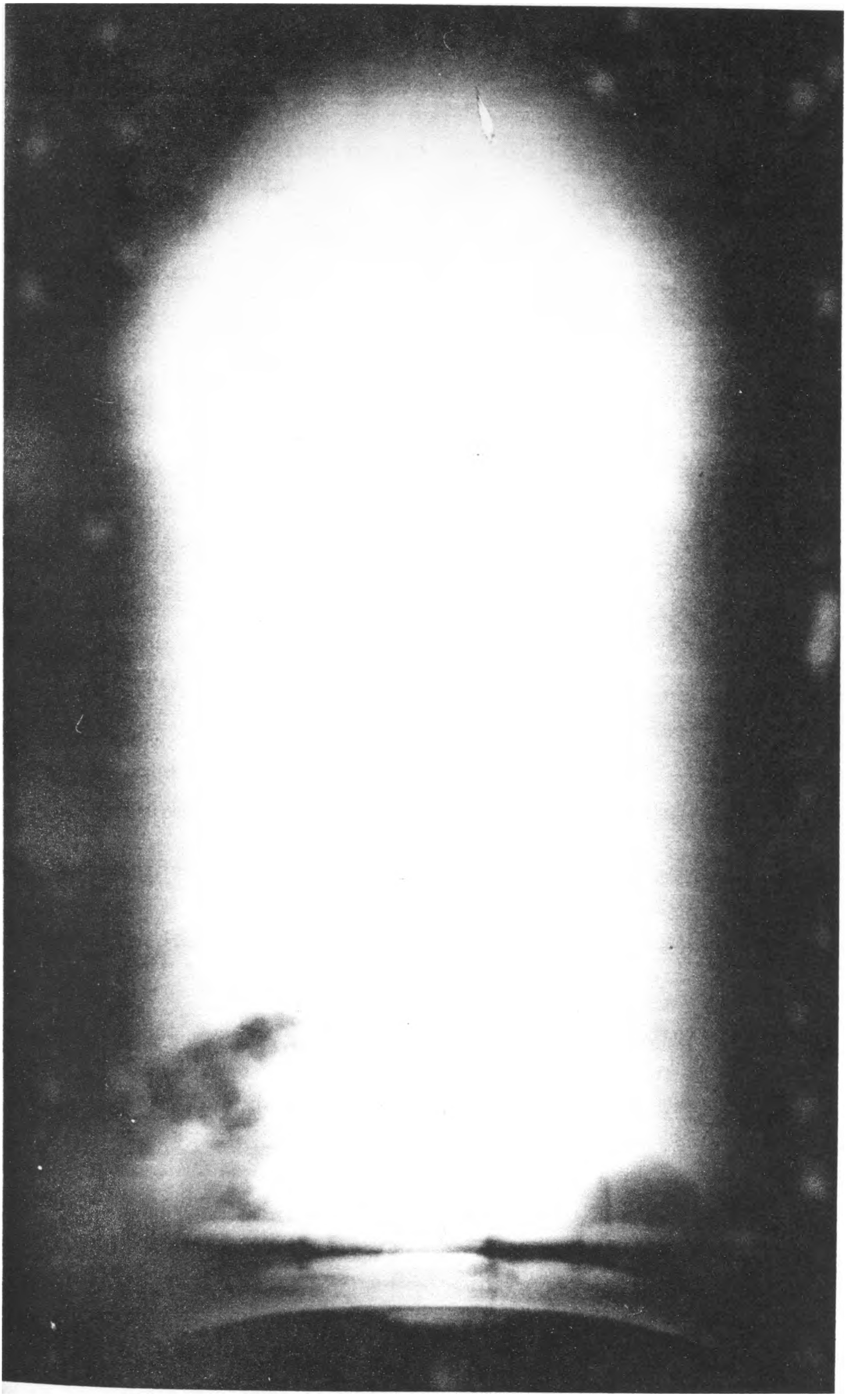
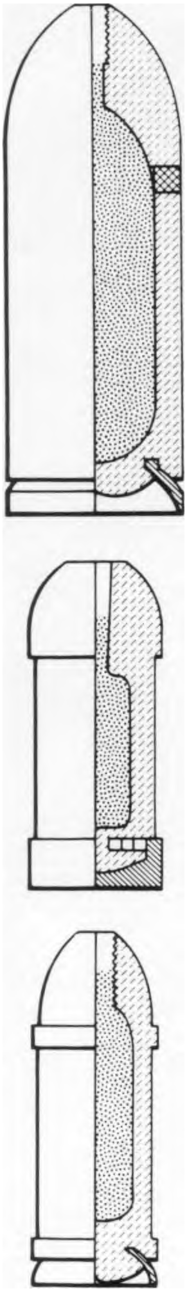


Figure 41. Radiograph of 7-Inch Mullane Bolt (attachment of disk).

I. READ-PARROTT



The Confederate Read and the Union Parrott projectiles were so similar that it is often difficult, (pt possible, to identify field recoveries, one from the other. This was probably occasioned by the close relationship of the two ordnance designers prior to the war. In Unio4 field service the Parrott-type rifled projectile was widely used and considered of top importance, while the Read system was the most common of Confederate made projectiles.

Originally, a wrought iron cup was secured by hot or cold forging to the base, or by actually having the shell body cast upon the wrought iron cup. Powder gas pressure forced the rim of the cup outward and into the bore of the gun at discharge. This was later redesigned as a brass ring and applied particularly to the 20-pounder Parrott rifle. Finally, a ring of brass was pressured into a serrated groove at the base of the projectile in a like manner to the Union. This system had no place for the ring to expand, nor did the band project below the bottom of the cast-iron shell body. Apparently, the pressure entering into the narrow space between the brass ring and the projectile proper was sufficient to expand the ring into the bore. Ordnance reports of the period indicate that this system was extremely effective, although the rings were usually spread slightly with a cold chisel prior to firing. This made them more certain to expand from the gas pressure and upset into the rifling.

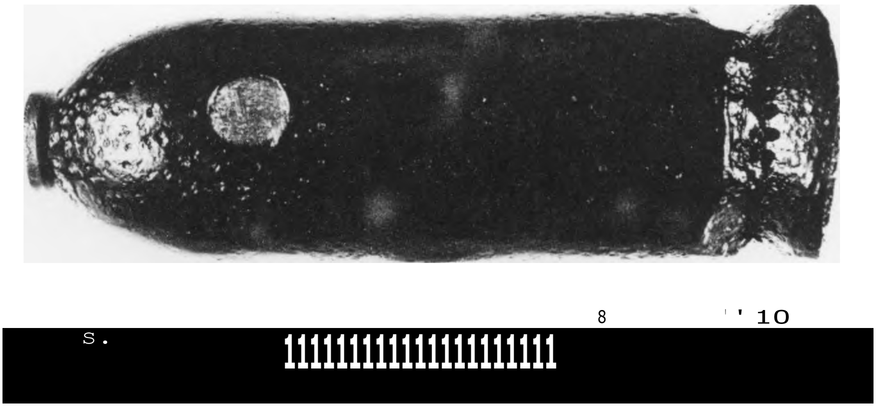


Figure 42. 3-Inch Read-Parrott Case Shot.

A major disadvantage to the Read system was the adverse chipping of the shell body base by the wrought iron cup. This base chipping is illustrated in Figure 42. The above illustration also shows the common method of filling the shell body with case shot through the side hole which is later filled with a lead plug. The above specimen is fitted with the copper adapter for time fuze. The McEvoy fuze igniter used to insure ignition of time fuzes in rifled projectiles was commonly used in conjunction with this copper adapter and is shown in Figure 142.

The Confederate Read projectile differed from the Union Parrott system in some designs through the use of two bourrelets on the shell body as shown in Figure 49. Often Confederate shells were lathe finished while the North procedure was done by forcing the shell through a die for proper sizing. The Parrott percussion fuze and the presence of the zinc time fuze adapter used by the North can often be used to determine the shell's origin. Captured fuzes were used by both armies to further confuse the issue.

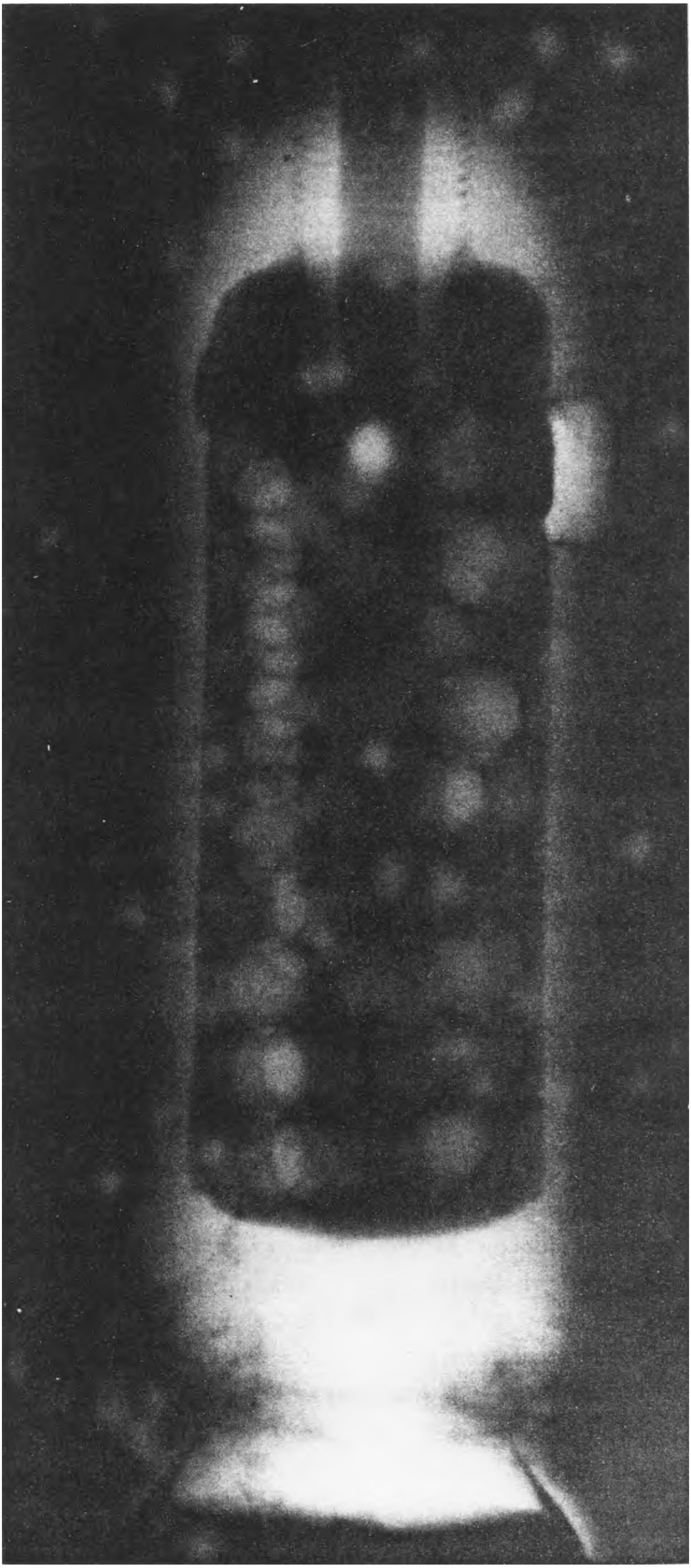


Figure 43. Radiograph of 3-Inch Read-Parrott Case Shot.

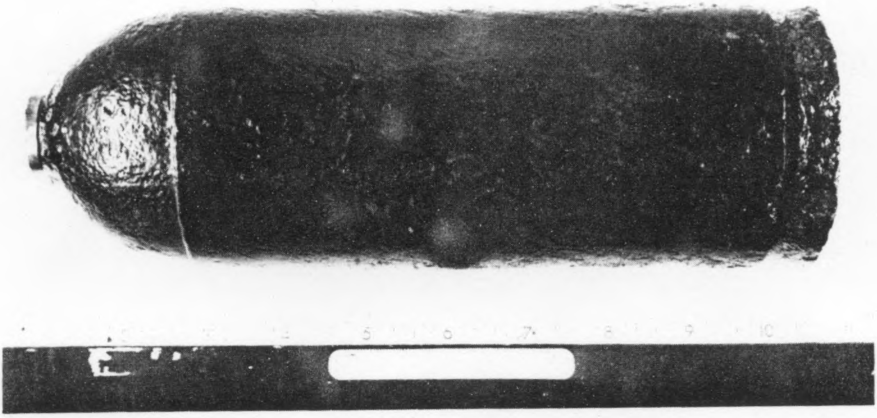


Figure 44. 3.3-Inch Read-Parrott Shell.

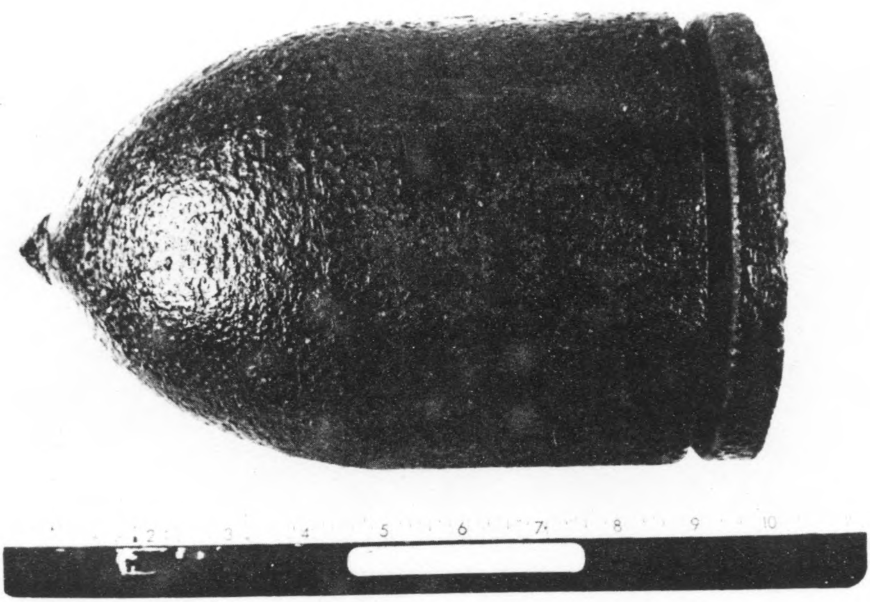


Figure 45. 6-Inch Read-Parrott Shell.

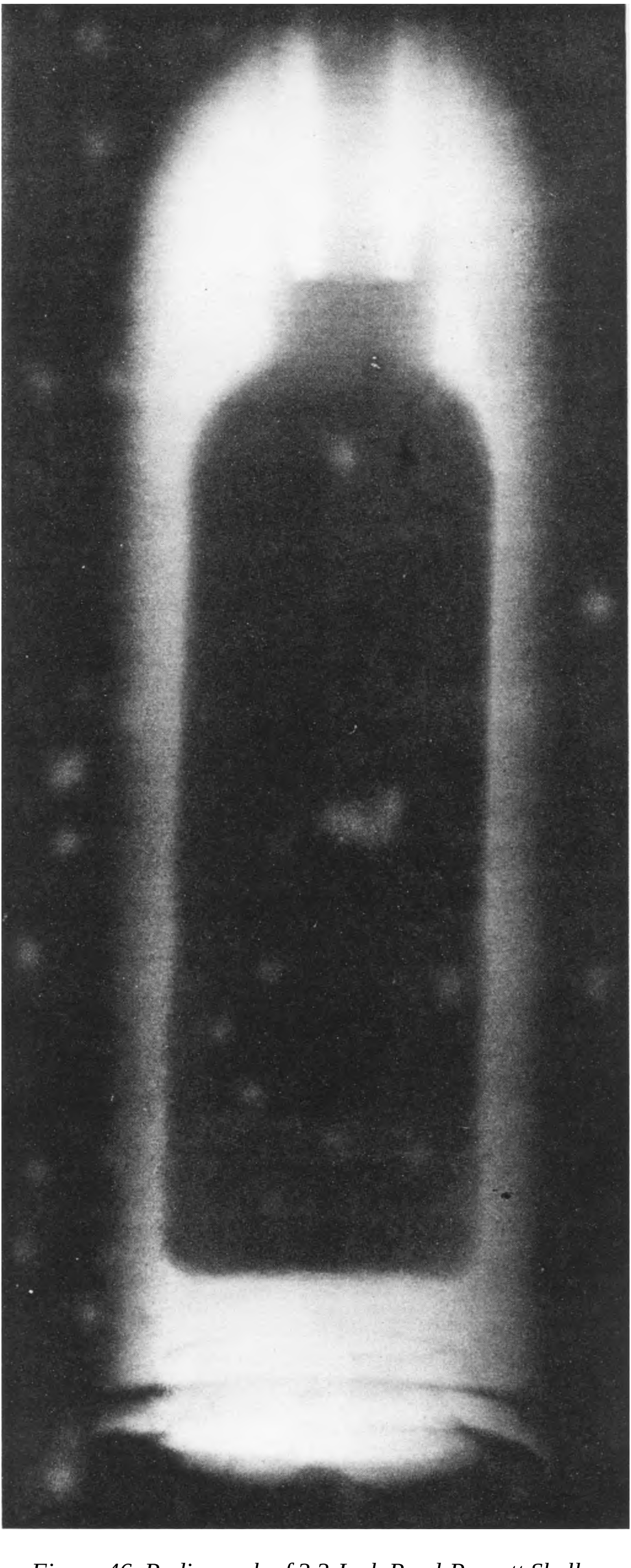


Figure 46. Radiograph of 3.3-Inch Read-Parrott Shell.

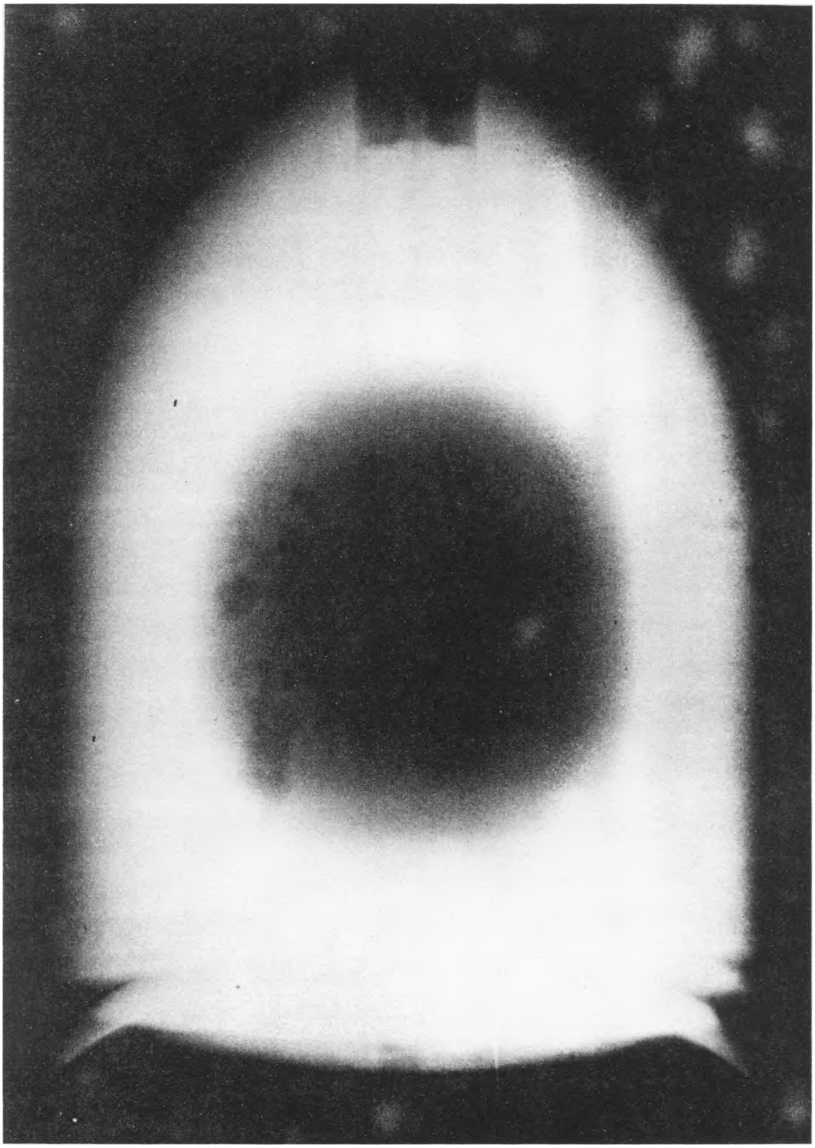


Figure 47. Radiograph of 6-Inch Read-Parrott Shell.

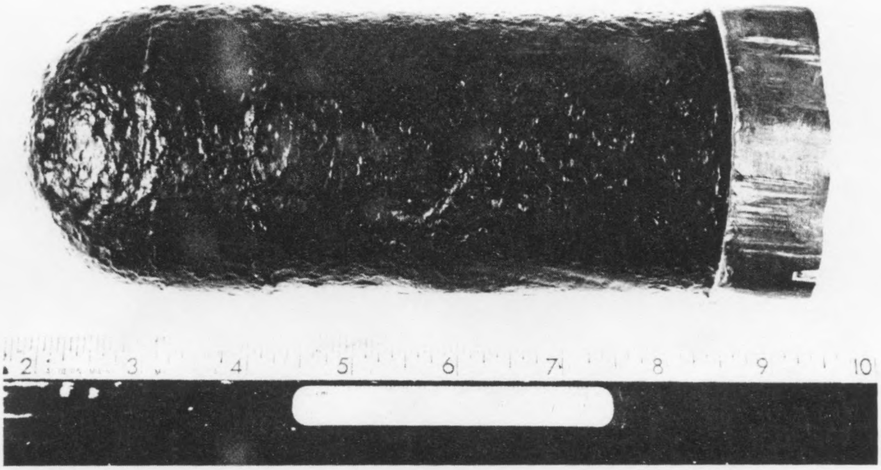


Figure 48. 3-Inch Read-Parrott Shell.

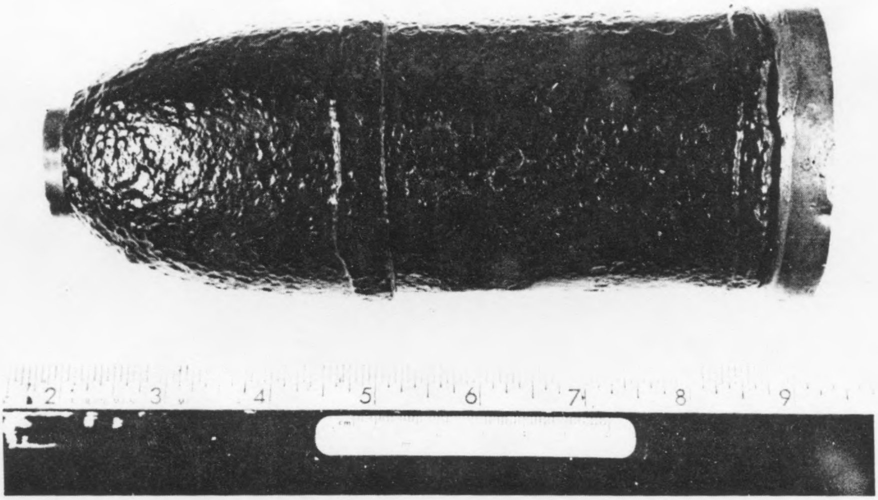
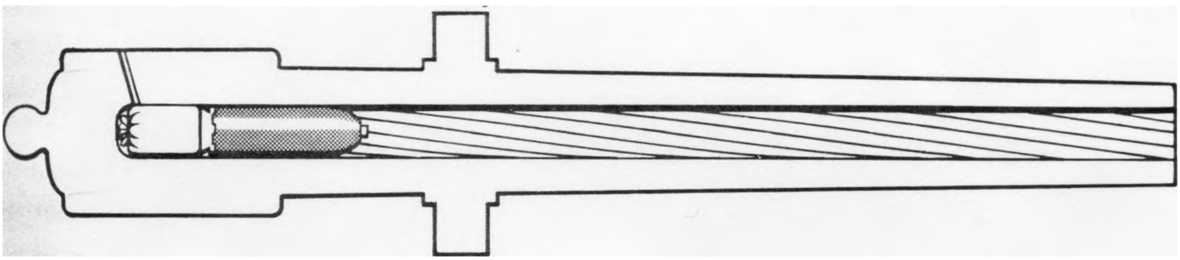


Figure 49. 3-Inch Read-Parrott Shell.

Figure 50. Radiograph of 3-Inch Read-Parrott Shell (Figure 48).

Figure 51. Radiograph of 3-Inch Read-Parrott Shell (Figure 49).

PART III

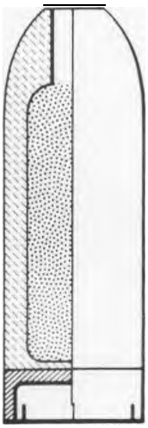


UNION RIFLED PROJECTILES

PART III

UNION RIFLED PROJECTILES

A. ABSTERDAM



The Absterdam projectile was employed by Union artillery to some extent. However, there is little mention of it in text books of the period, while the rareness of field recovery indicates either a sparing use or a highly successful shell that resulted in few duds. Ordnance Bureau listings of the time carry the Absterdam shell in 3, 4.2, and 4.5-inch sizes. Possibly the higher cost restricted their general use. An early type Absterdam shell resembled the Dyer system in its hollow base, leaden cup design; being easily distinguished by six saw cuts equidistant around the base cup and extending to the cavity bottom. These slits aided in the expansion of the sabot into the rifling. The early shells also carried two lead bands or bourrelets set into serrated grooves. Figure 52 shows the later model resembling the Parrott type **and** relying on a brass sabot for rotation. The 3-inch model has been seen in case shot and shell, **and fuzed** with a brass adapter for paper time fuzes. The adapter is shown in Figure 137. Percussion fuzes exist, but none were available for photographs.

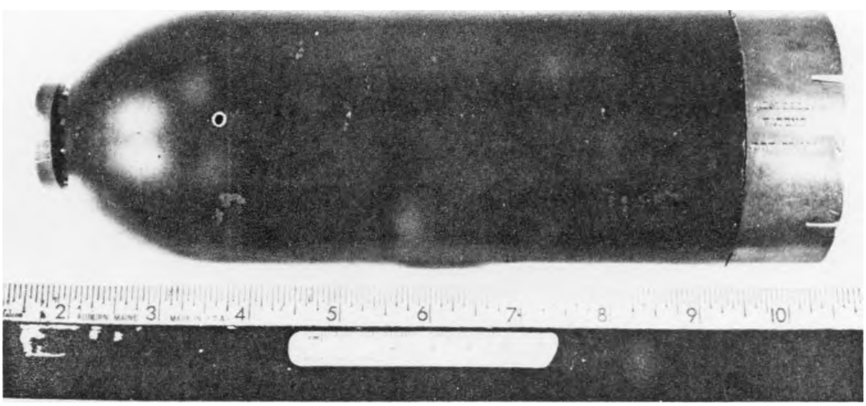


Figure 52. 3-Inch Absterdam Shell.

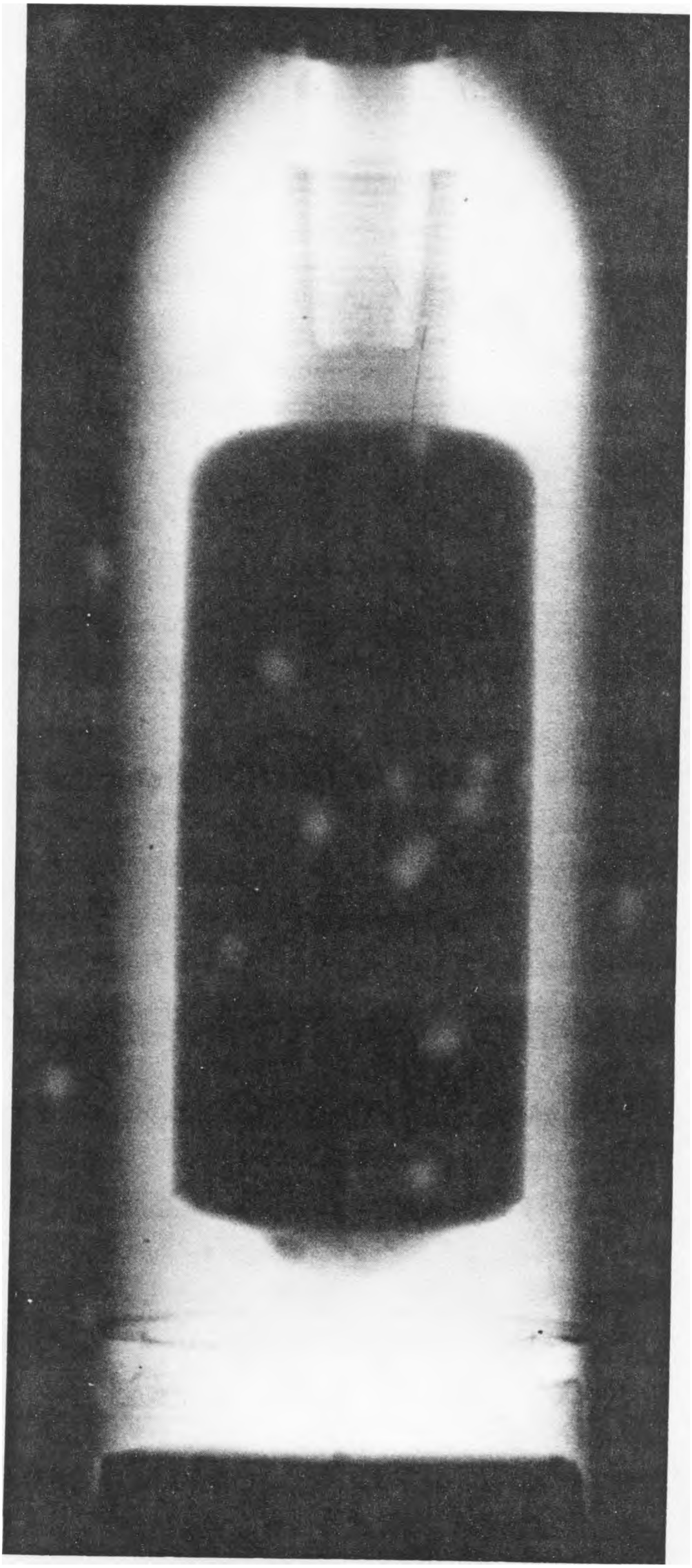
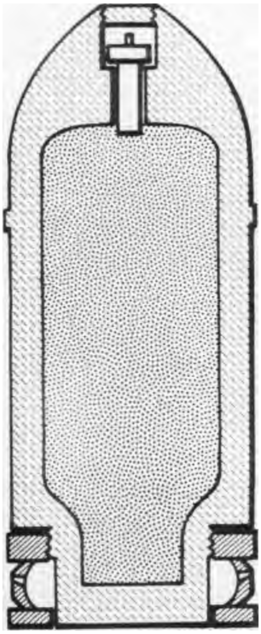


Figure 53. Radiograph of 3-Inch Absterdam Shell.

B. COCHRAN



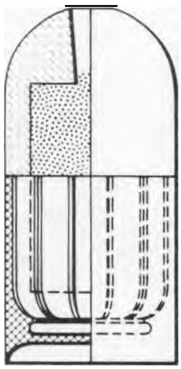
Invented by John W. Cochran, the patent was issued on September 25, 1860. Field recoveries have been limited to two known specimens. The Cochran is presented in the event future recoveries are made. Primarily it is shown to establish its identity for EOD personnel. The shell body is of cast iron having a forward bourrelet of iron. The rear bourrelet is provided by the leading edge of the sabot. Fuzing is percussion and almost identical to the James fuze. The rear portion of the shell body is reduced in diameter with the forward part being threaded to receive the sabot. The sabot is made of brass and consists of two brass rings joined together by a thin brass sleeve. The sleeve is perforated by a series of 1/16-inch holes around its circumference. In operation, the rear ring is driven forward by the propellant gases and compresses the brass sleeve outward into the rifling. Simultaneously, grease is forced out of the numerous holes of the sleeve to lubricate the bore. Figure 55 reveals different shell construction from that described in the patent papers, however the design of the sabot is Cochran.

The patent describes the plunger of the fuze as being retained by a spring to prevent accidental functioning of the fuze should the projectile be dropped. This specimen is lacking this safety feature.

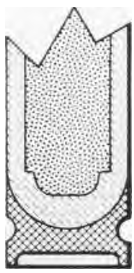
The original patent claims an idea to have the explosive filler placed in a separate container that may be placed into the projectile just prior to firing. This separate loading system is presently under experiment by the U.S. Navy.

Figure 54. 6-Inch Cochran Shell.

Figure 55. Radiograph of 6-Inch Cochran Shell.



Lead saboted Dyer projectiles were perhaps the first missiles to be fired from rifle guns in the Union field service. Early Parrott pieces were tested with these prior to the Civil War. The system was also available throughout the ensuing hostilities but was employed in lesser quantities than the more popular Hotchkiss, James, Parrott, and Schenkl, known as the Union Artillery Big Four. Produced as shells, bolts, case shot, and cannister, the Dyer projectile varied in size up to a 12 inch with the 3 and 4.5 inch being the more common. Fuzing was generally with the wooden time fuze adapter. In some models Hotchkiss percussion nose fuzes were said to have been used.



The projectile was constructed of a cast-iron body having a soft metal expanding cup attached to its base. The cup was composed of an alloy of lead, tin, and copper and was cast onto the tinned base of the projectile. A corrugated cap of tinned sheet iron was sometimes used with the 3-inch model to catch and direct a portion of the discharge flame toward the nose inserted time f e, thus insuring ignition. Other models carried longitudinal ribs cast on the shell body and a much longer lead sabot extending to at least half the length of the projectile. Some models of the type having the cast on ribs have been seen to have wire wrapping cast into the lead sabot in a further attempt to retain the lead b and to the shell body during bore travel and inflight. The Taylor zinc adapters for paper time fuzes have been seen in several late model Dyers. This unusual adapter and its corrugated cap to direct the discharge flame is featured in Figure 134.

[redacted]

Figure 56. 2.4-Inch Dyer Bolt.

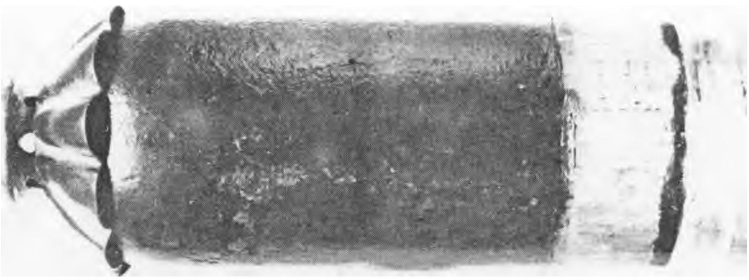


Figure 57. 3-Inch Dyer Shell.

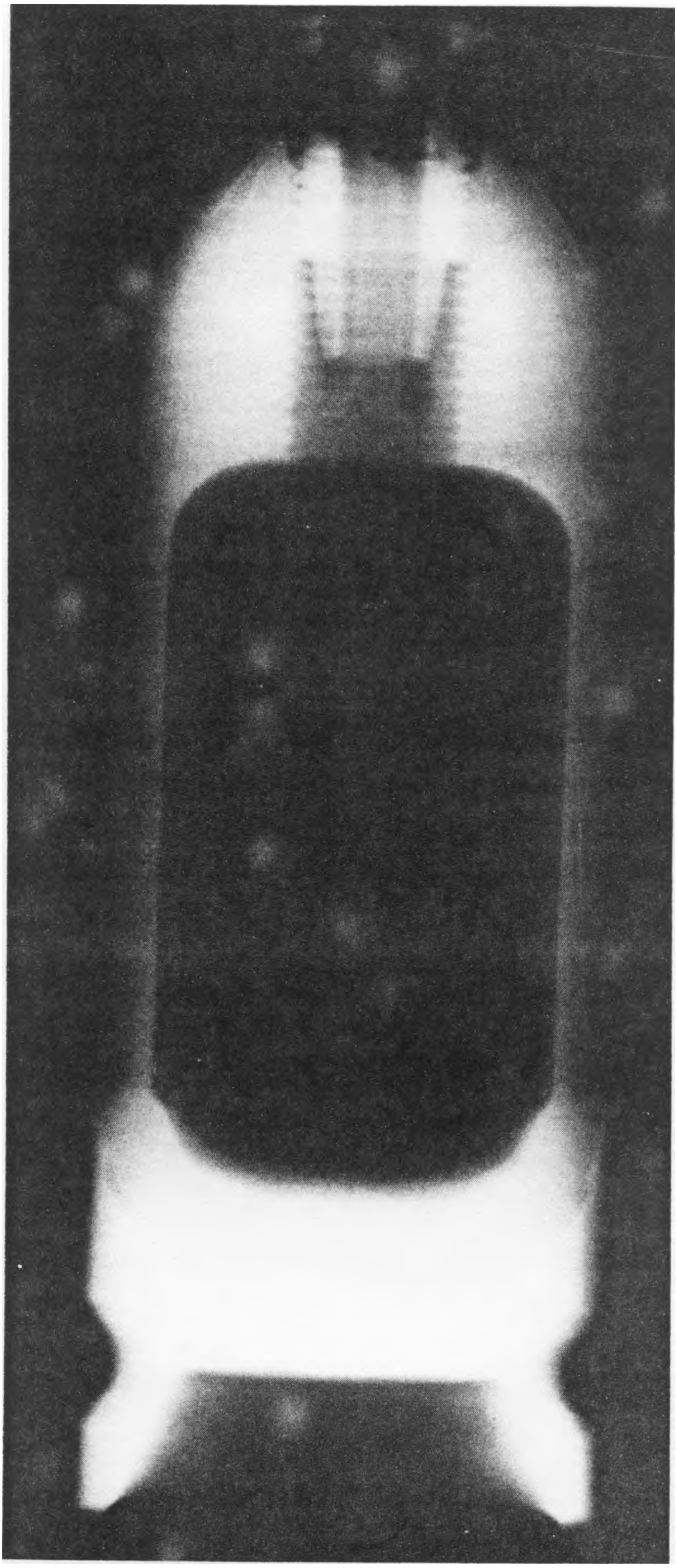


Figure 58. Radiograph of 3-Inch Dyer Shell.

Figure 59. 3-Inch Dyer Case Shot (fragment).

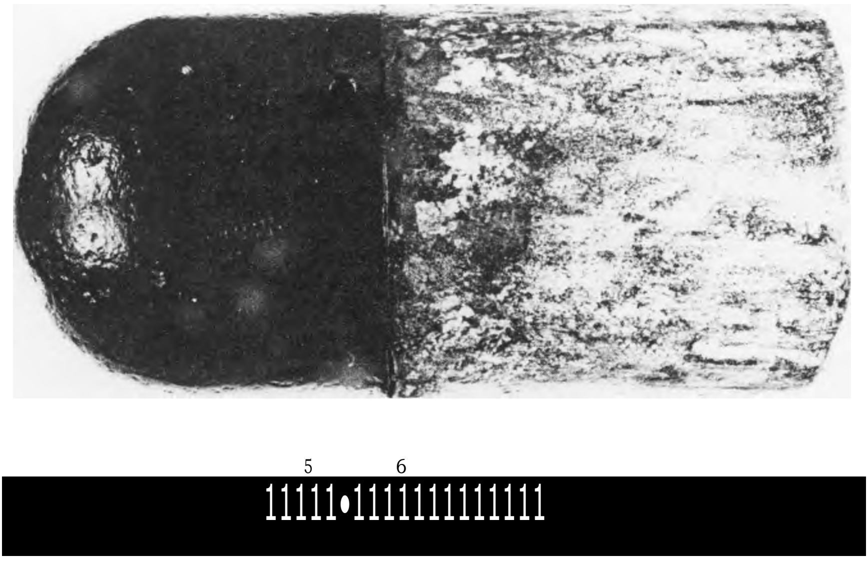


Figure 60. 4.25-Inch Dyer Case Shot.

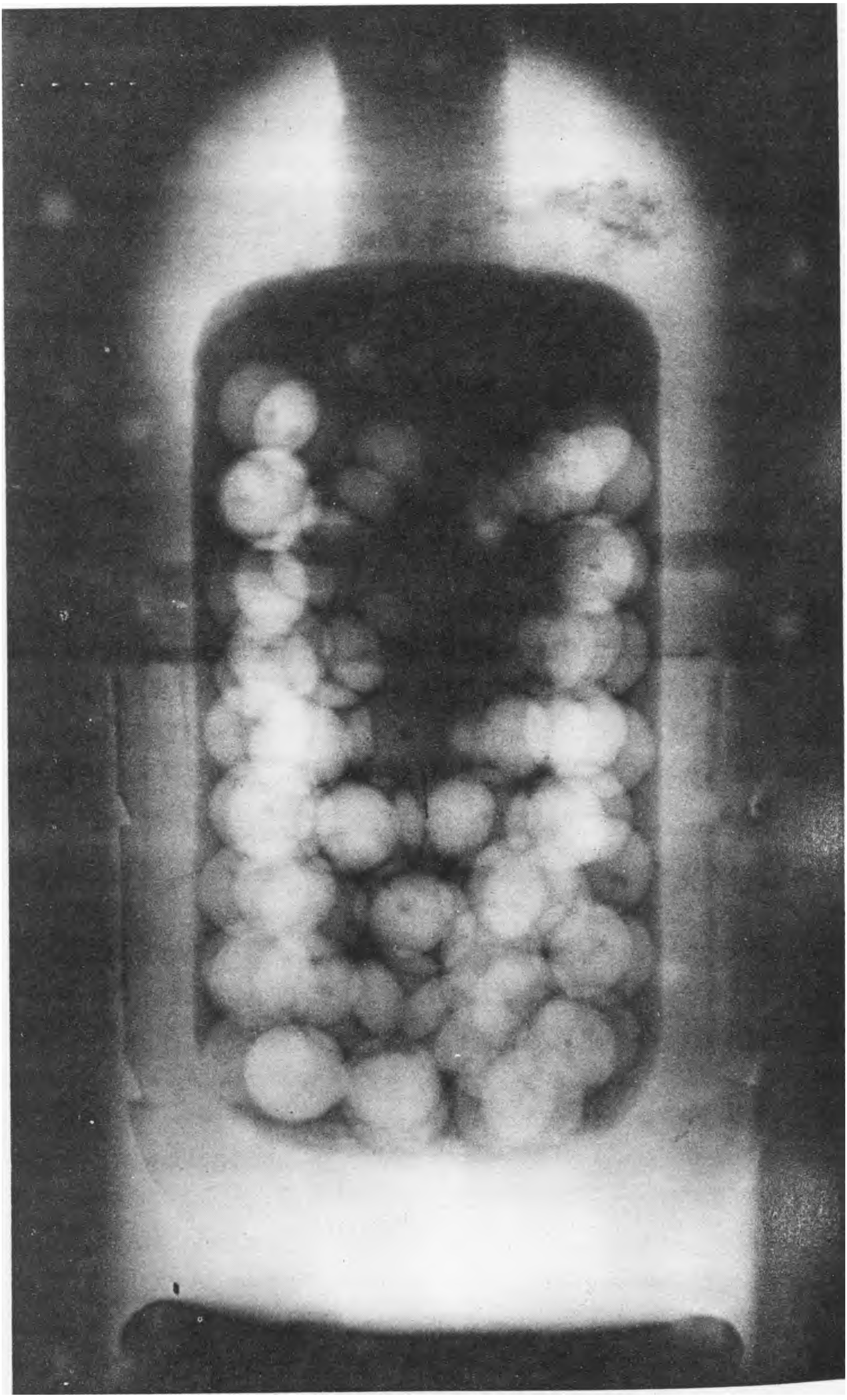
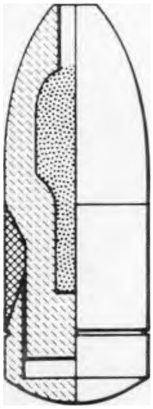


Figure 61. Radiograph of 4.25-Inch Dyer Case Shot.

D. HOTCHKISS



Some historians list the Hotchkiss-type projectile as exceeding the Parrott in rounds fired on the battle field. Certainly they were widely used throughout the war years being available in all standard field service sizes. The smallest was 5 3/4 inches in length with a diameter of 2.6 inches and the largest about 24-inches long having a diameter of 12 inches. Weight varied from 9 to approximately 600 pounds. Records indicate the projectile to have been mass produced in bolt, case shot, and shell.

The projectile consisted of three pieces; two of cast iron and one of lead. The front section contained the explosive or case shot and was cast with a tail section to fit the cast-iron base cup. The two pieces were then assembled together with a bit of jute to keep them in position and a lead ring was cast around, binding the sections together. The lead sabot was further covered with greased canvas for lubrication purposes. Discharge forces jammed the tail section tightly over the front casting and expanded the soft lead ring into the gun rifling. The sudden sealing of the gun bore often prevented the nose time fuze from igniting, thus later models were cast with longitudinal grooves which permitted the passage of discharge flames. Hotchkiss first demonstrated his rifled projectile in 1855, but failed to arouse U.S. Ordnance Department interest. In 1859, Mexico purchased shells in quantity as did Japan in 1860. At the outbreak of the Civil War a large Union order was received causing the construction of a modern factory in New York. In some of the case shot type of projectiles, a sheet metal tube connected the zinc time fuze adapter to the bursting charge. Extending through the cast case shot, this metal tube passed through an iron plate at the rear of the forward shell body section. Below the iron plate can be found the bursting charge. See Figure 69.

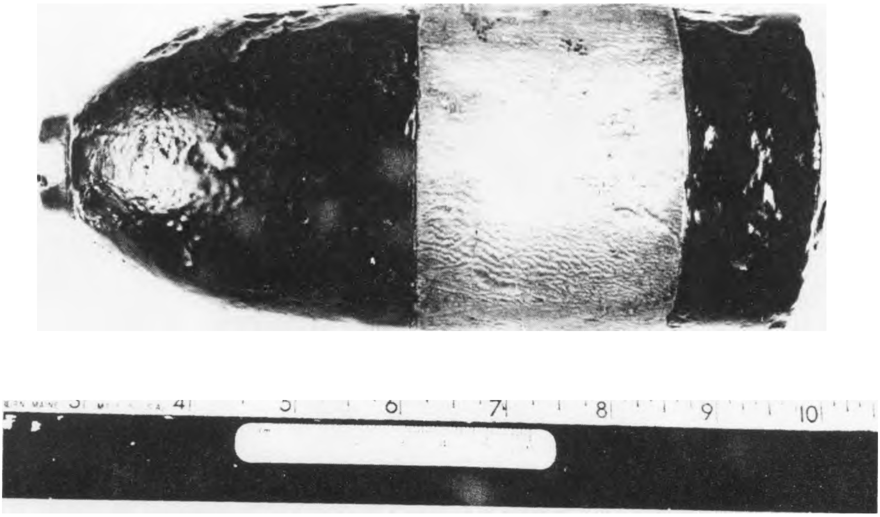


Figure 62. 3.25-Inch Hotchkiss Shell.

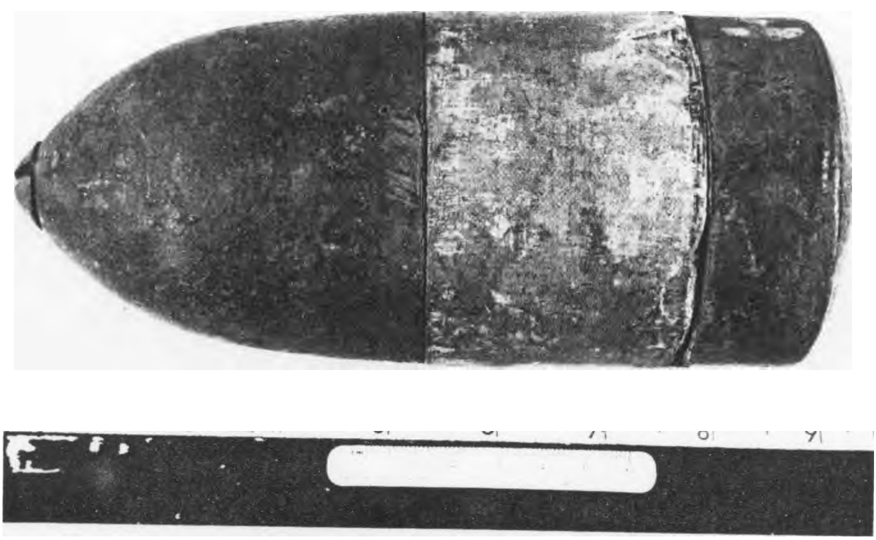


Figure 63. 3.4-Inch Hotchkiss Shell.

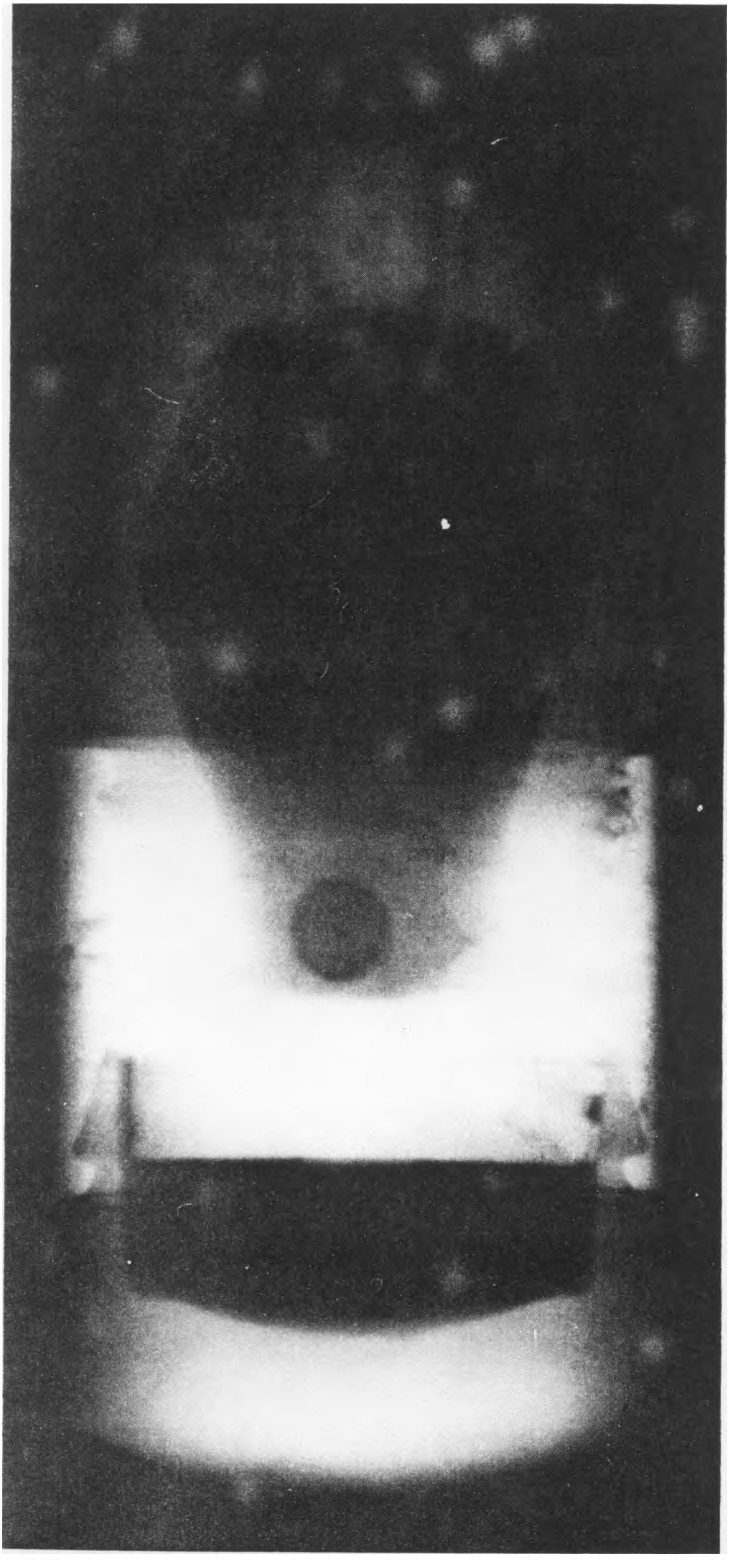


Figure 64. Radiograph of 3.25-Inch Hotchkiss Shell.

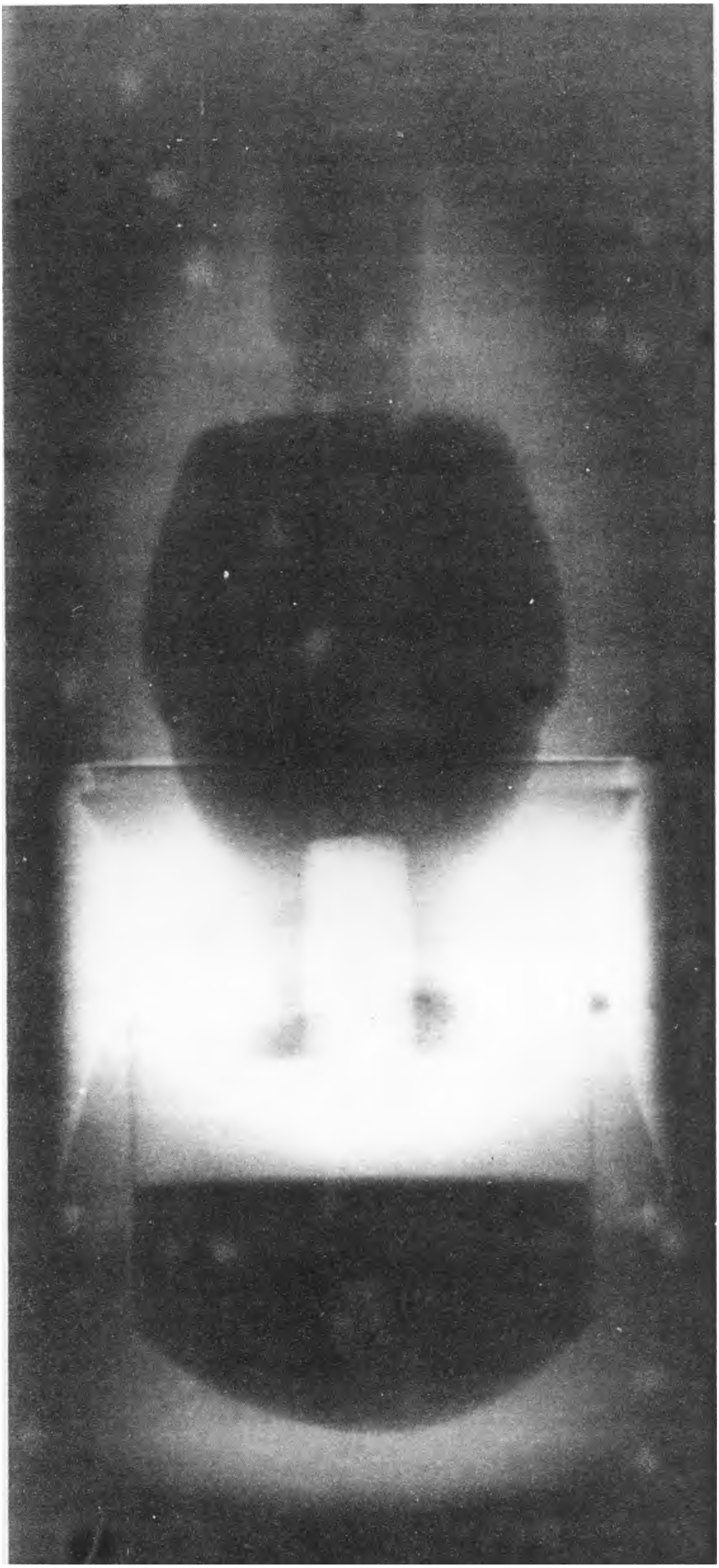


Figure 65. Radiograph of 3.4-Inch Hotchkiss Shell.

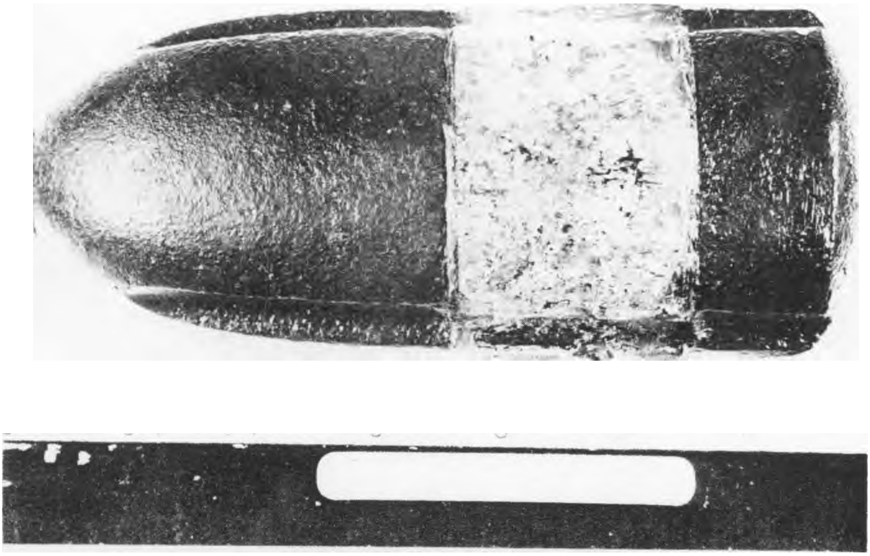


Figure 66. 3-Inch Hotchkiss Shell.

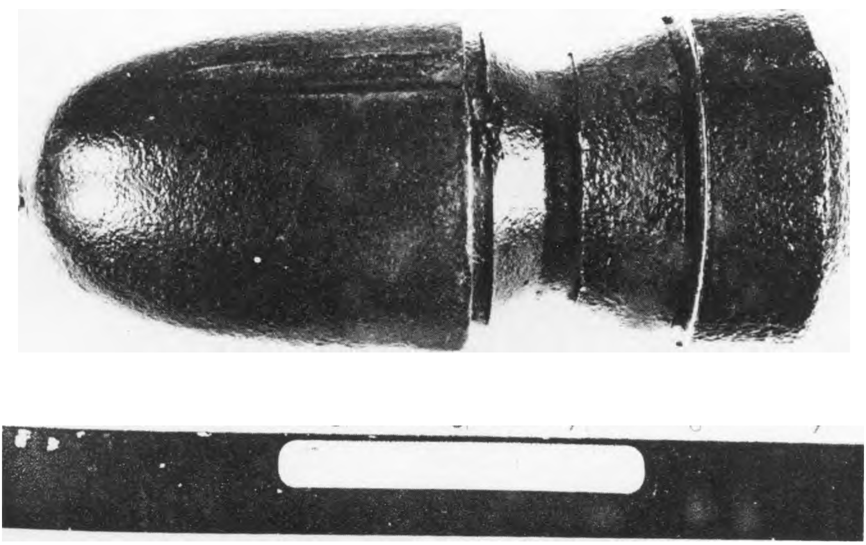


Figure 67. 3-Inch Hotchkiss Case Shot.

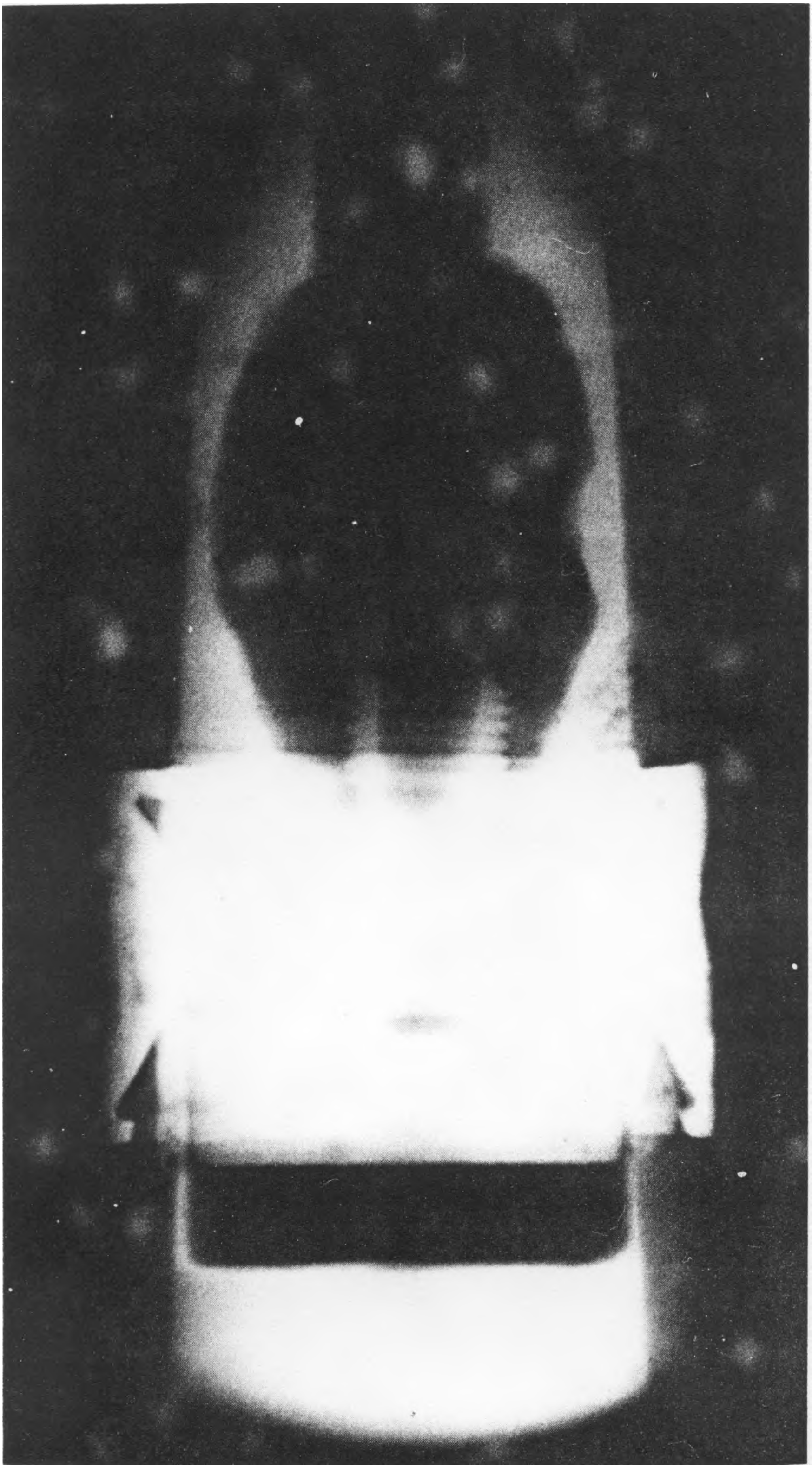


Figure 68. Radiograph of 3-Inch Hotchkiss Shell.

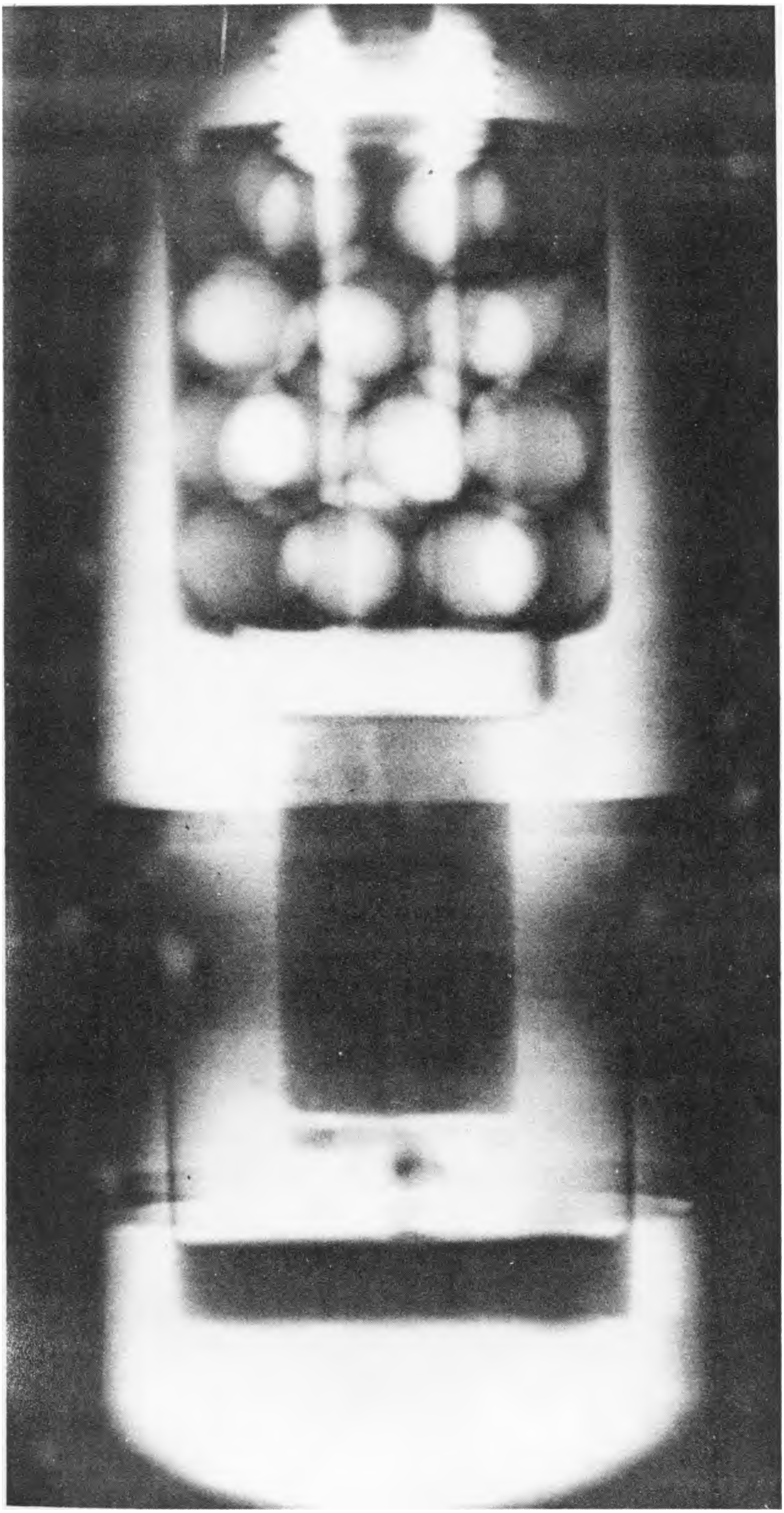


Figure 69. Radiograph of 3-Inch Hotchkiss Case Shot.

Figure 70. 2.67-Inch Hotchkiss Case Shot (flat nose).

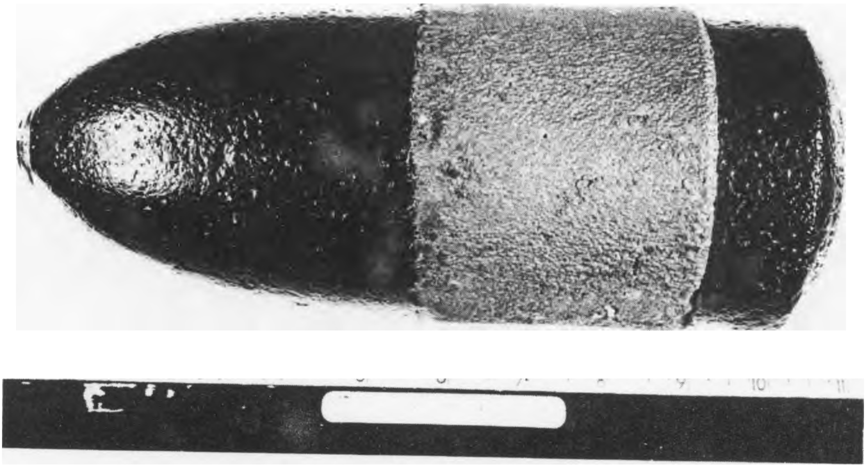


Figure 71. 4-Inch Hotchkiss Shell.

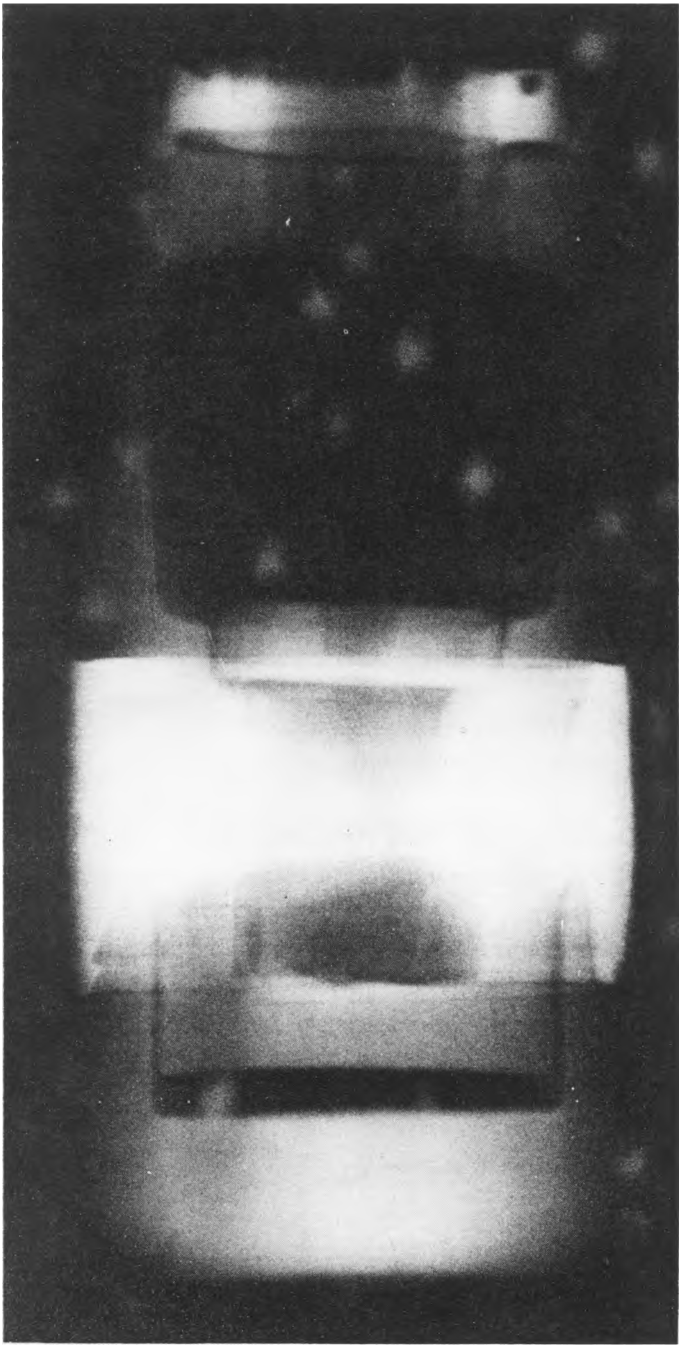


Figure 72. Radiograph of 2.67-Inch Hotchkiss Case Shot (flat nose).

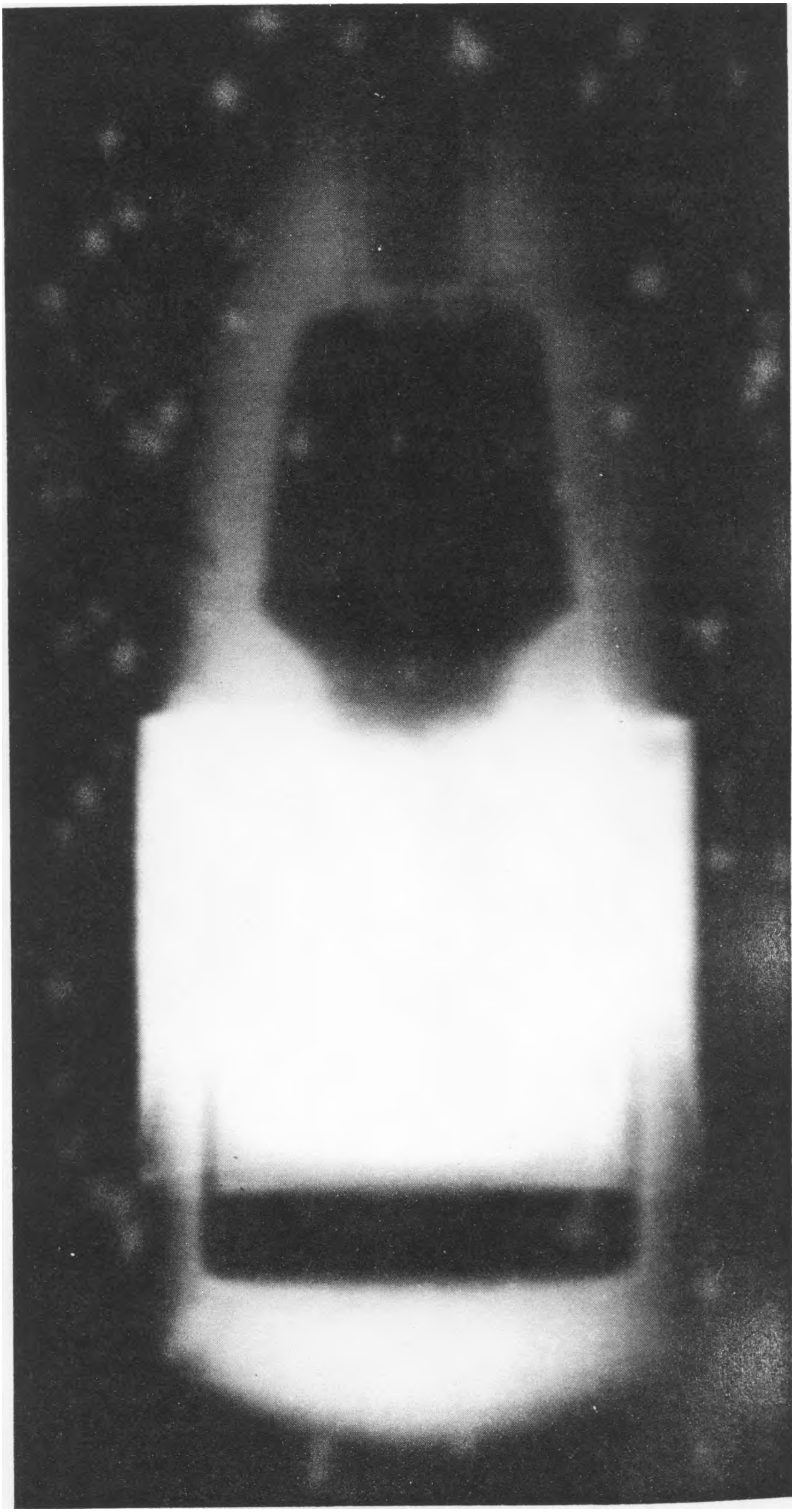
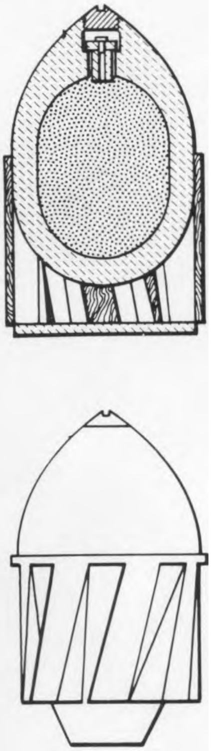


Figure 73. Radiograph of 4-Inch Hotchkiss Shell.

E. JAMES



The James system of projectiles ranked third in total rounds expended by rifled Union field pieces. The inventor, who was later killed by one of his own fuzes, also worked out a method of rifling bronze smoothbore field guns and cast-iron coast artillery pieces, for which his projectiles were especially designed. Employing an oiled canvas over the sheet lead sabot, action on the gun bore was sufficiently mild so as not to endanger the gun that had been weakened by the rifling process. Expansion was caused by gas pressure at discharge entering the hollow base, passing through the eight radial openings, and bearing on the outer lead and canvas sabot. This sabot usually blew off the shell upon leaving the bore.

Fuzing was of the precussion type, especially constructed by James, and consisted of a brass or steel threaded end cap enclosing a free sliding hollow steel plunger with a musket cap mounted on the forward end. Upon impact, the plunger went forward striking the musket cap against the threaded end cap, referred to as the anvil. This action caused a flash down through the plunger, detonating the black powder bursting charge.

A later James design eliminated the base cavity and radial openings by furrowing the shell side with longitudinal grooves which increased in depth toward the rear. Gas pressure entering these, expanded the outer covering into the bore rifling. The canvas wrapper was well greased for easy muzzle loading and for ease in cleaning and lubricating the gun. James manufactured a complete range of field, siege, and seacoast service projectiles, varying from a 6-pounder shell to the 65-pound, 8-inch caliber solid shot. Recoveries are still common in Southern battlefields.

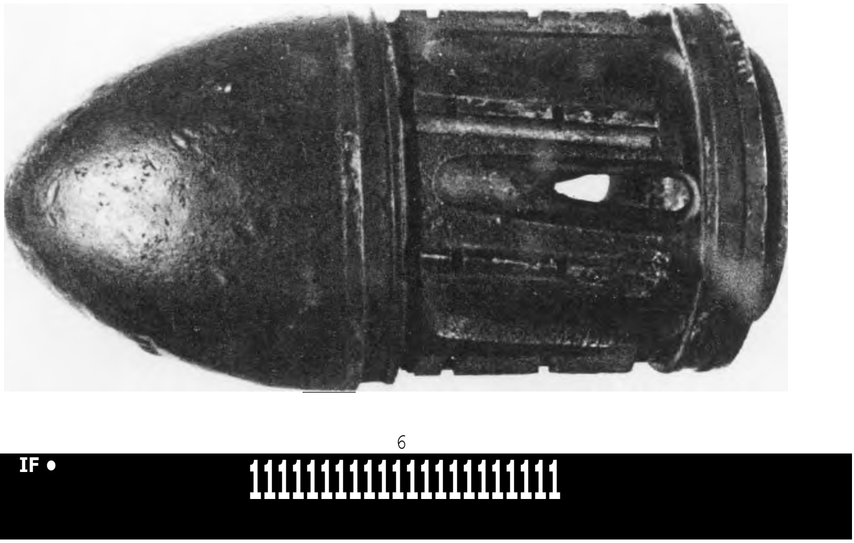


Figure 74. 3.75-Inch James Shell (early model).

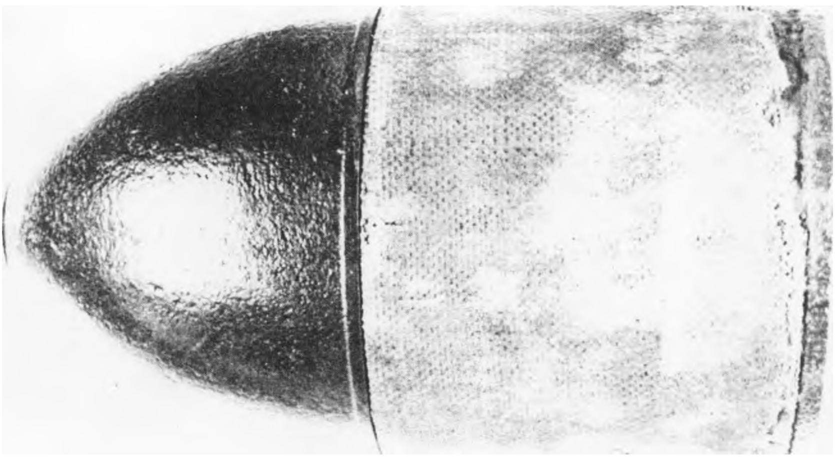


Figure 75. 3.62-Inch James Case Shot (improved model).

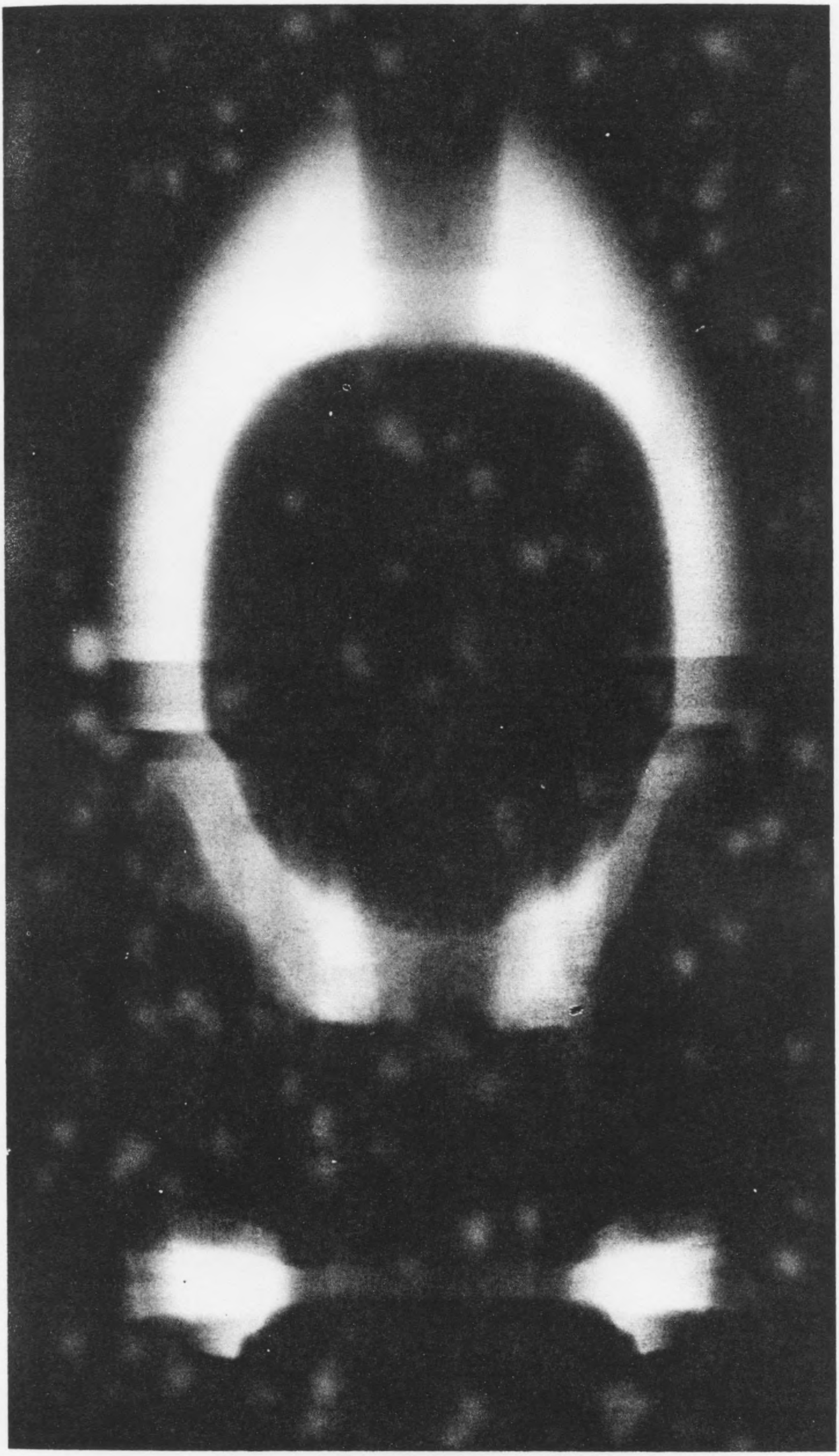


Figure 76. Radiograph of 3.75-Inch James Shell (early model).

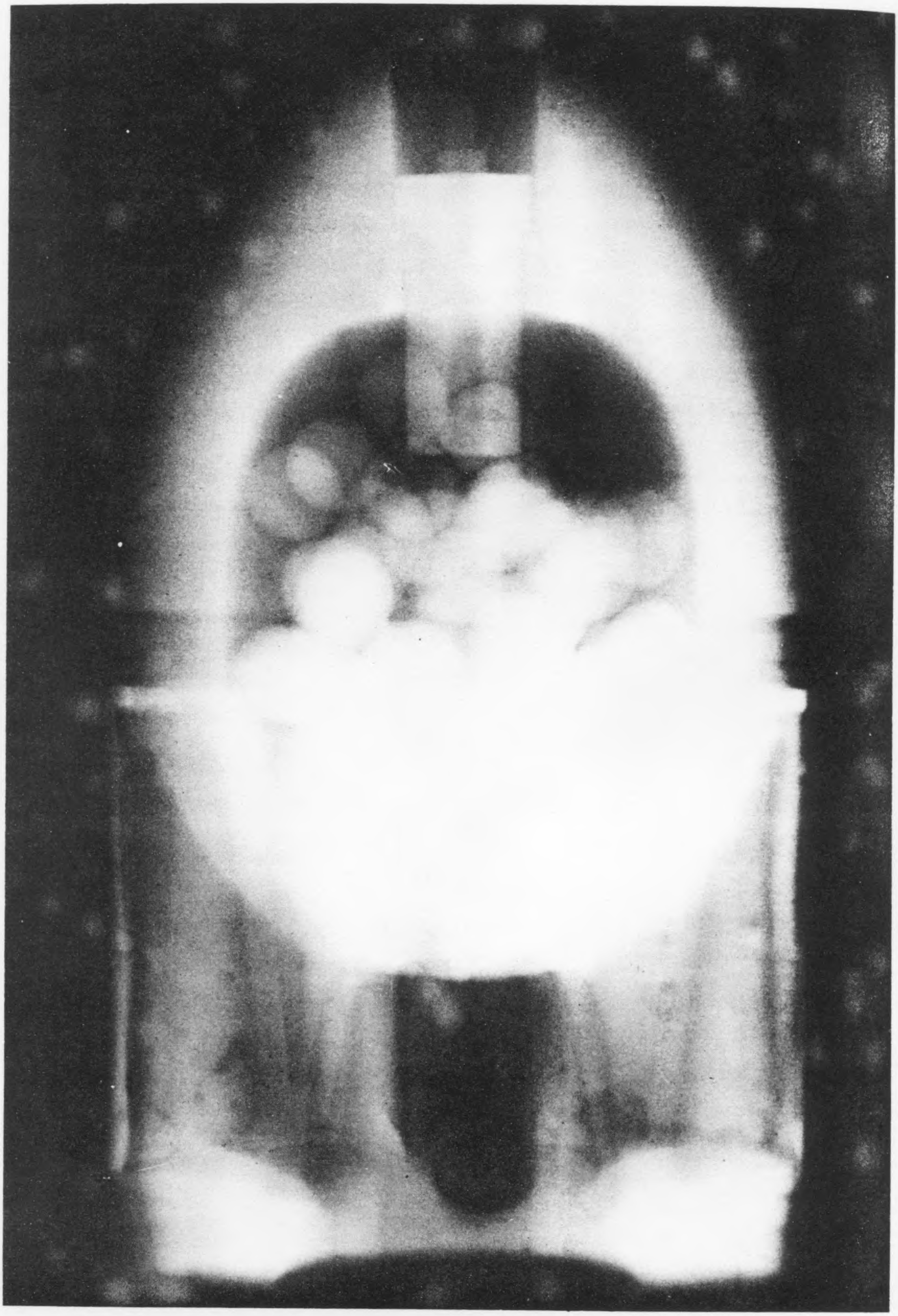
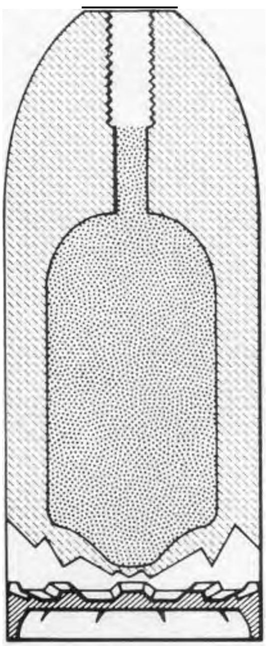
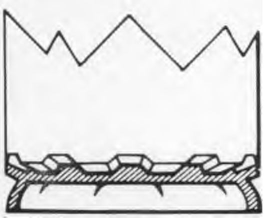


Figure 77. Radiograph of 3.62-Inch James Case Shot (improved model).

F. PARROTT





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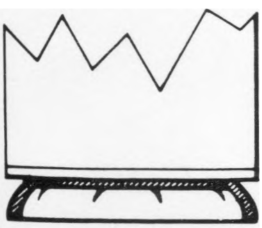


***

The Union Ordnance Department used only a few basic types of rifle ammunition to any extent throughout the war. Of these the Parrott systems were the most important. Similar to the Confederate Read projectiles, the two types are often confused when field recovered. Perhaps the three most commonly employed Parrott designs are shown in the line drawings at left. The projectile was issued in bolt, case shot, and shell and was composed of a cast-iron body-having a large powder cavity and equipped with a threaded nose fuze well. A brass ring cast into a rabbet was formed around its base. At discharge the flame pressed against the bottom of the ring and underneath it, so as to cause expansion into the grooves of the gun. To prevent the ring from turning in the rabbet, the latter was recessed at several points of its circumference. These projectiles were fuzed with zinc or brass time fuze adapters, Bormann-time fuzes, and the Parrott percussion fuzes. Some models have been found with wrought iron sabots. Shells containing a bolt screwed into the base should be suspected to contain the incendiary mixture. Case shot type having brass or iron sabots and employing the zinc time fuze adapter should be assumed to have its bursting charge located in the rear of the cavity in a small tin cylinder which is linked to the fuze adapter by a metal tube. Figure 92 gives radiographic proof of this innovation and Figure 93 is a line drawing interpretation of the radiograph. The location of the bursting charge should point out the need of breaching all projectiles from the base rather than the normal side breaching that is familiar to most EOD teams.

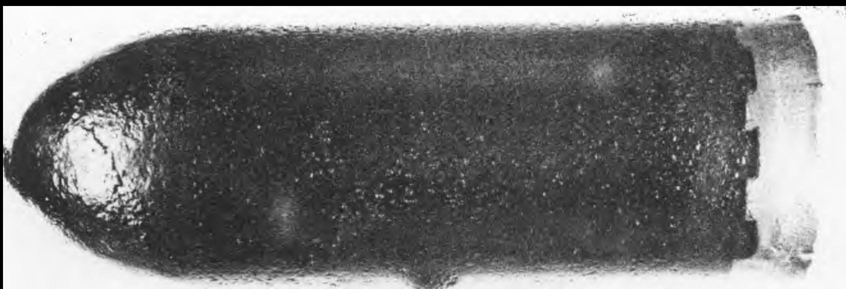


Figure 78. 4.2-Inch Parrott Shell (*).

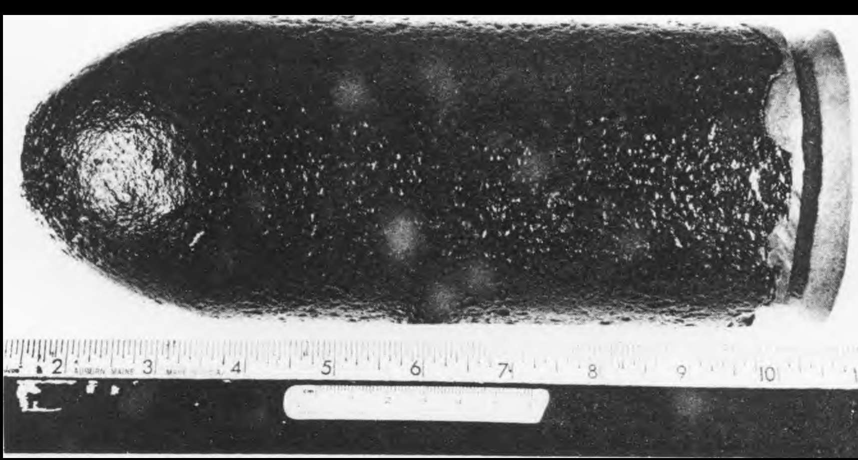


Figure 79. 3.5-Inch Parrott Case Shot (**).

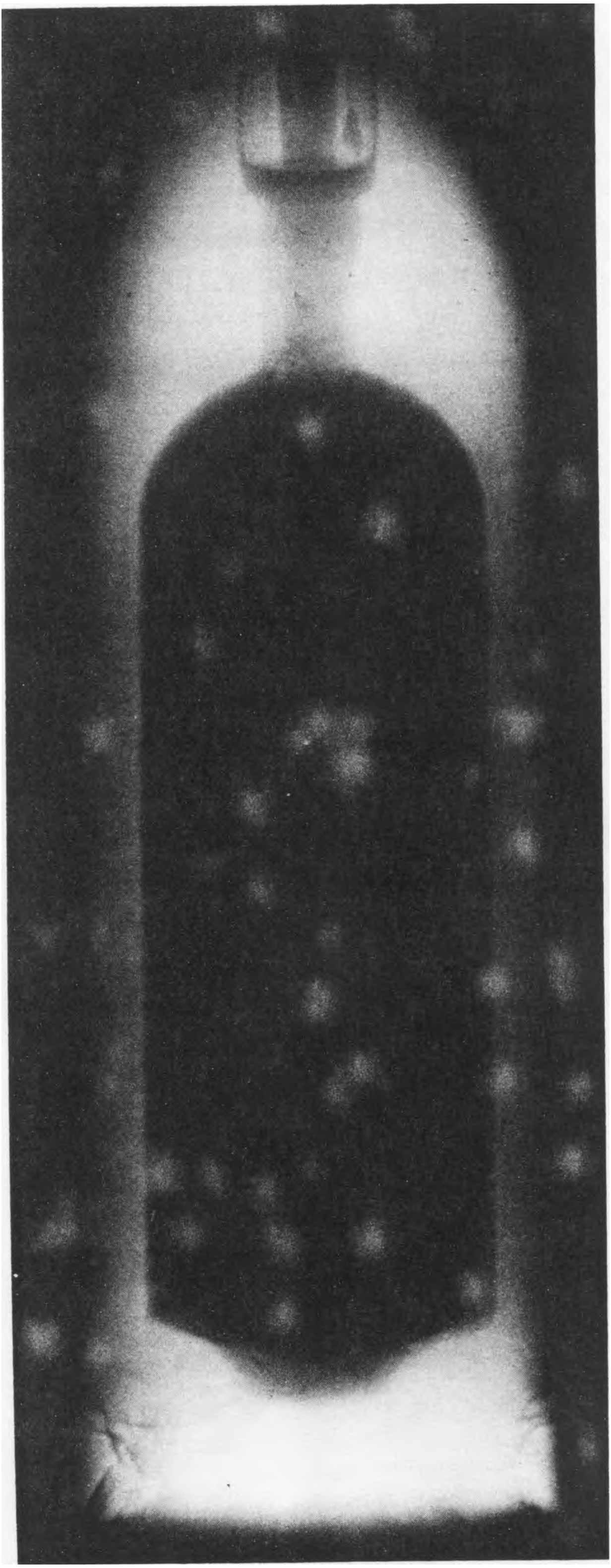


Figure 80. Radiograph of 4.2-Inch Parrott Shell (*).

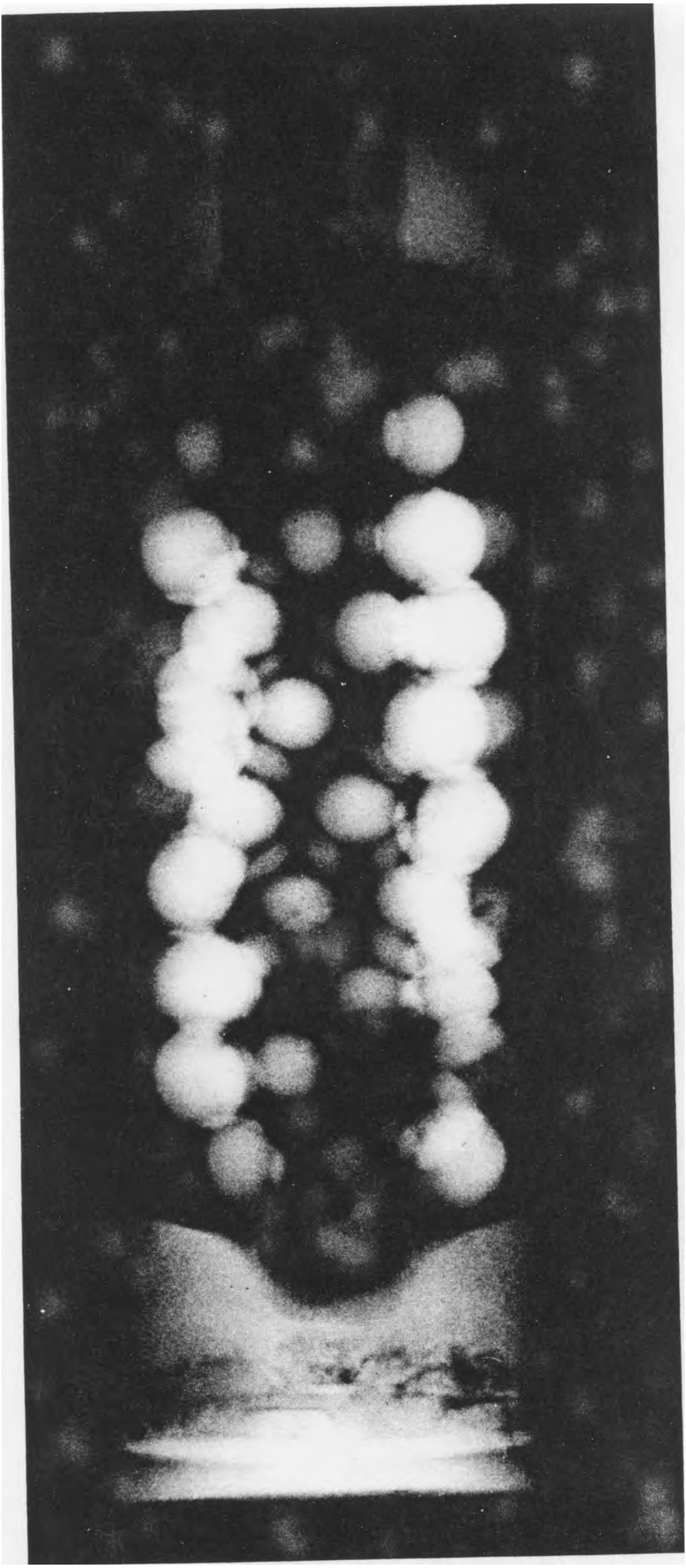


Figure 81. Radiograph of 3.5-Inch Parrott Case Shot (**).

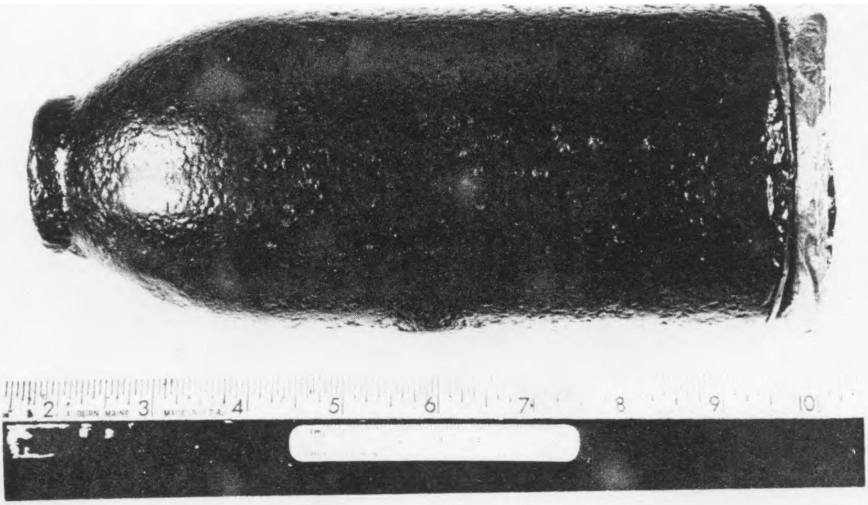


Figure 82. 3.5-Inch Parrott Bolt (***).

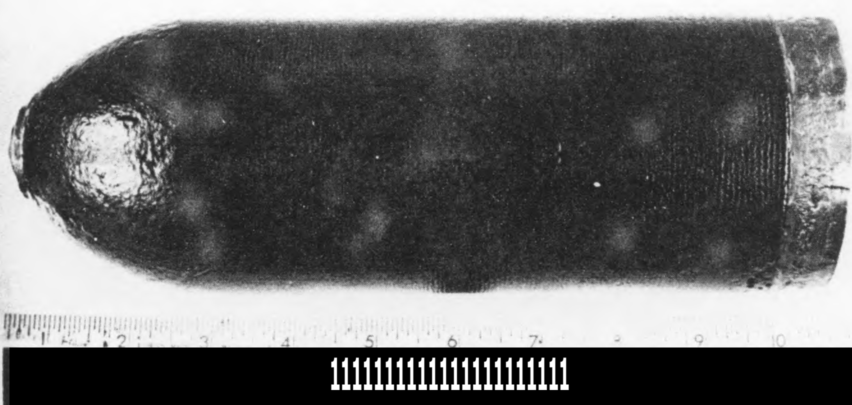


Figure 83. 3.5-Inch Parrott Shell.

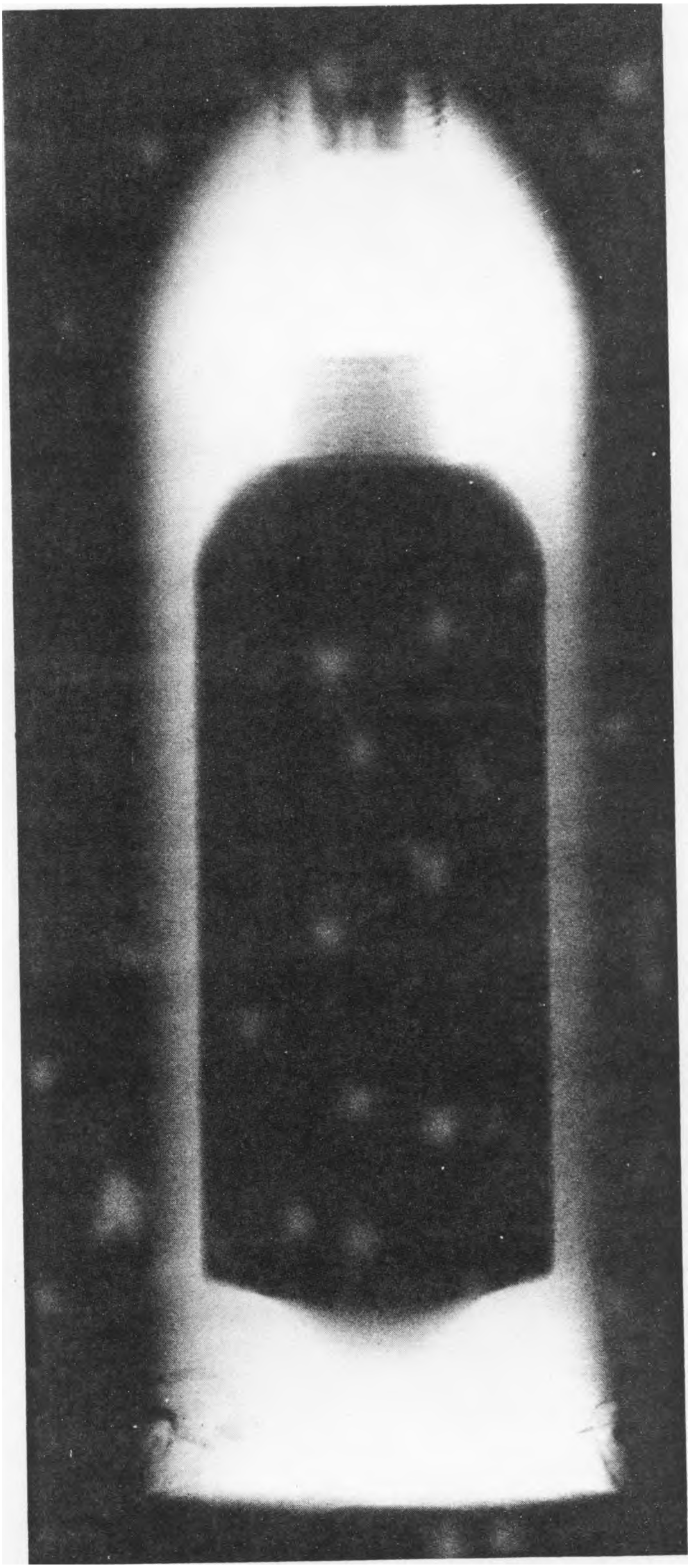


Figure 84. Radiograph of 3.5-Inch Parrott Shell.

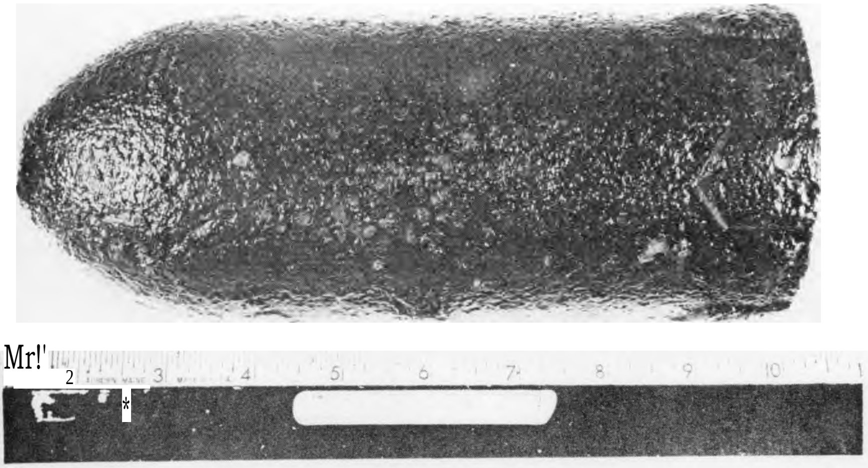


Figure 85. 3.5-Inch Parrott Shell (pre-engraved sabot).

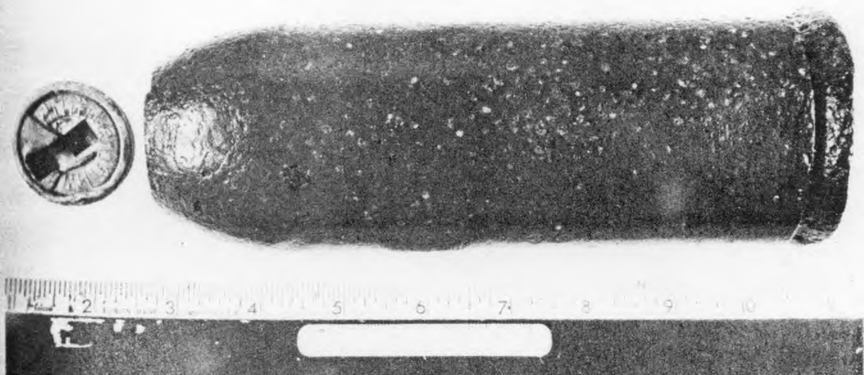


Figure 86. 3-Inch Parrott Case Shot (Bormann fuzed).

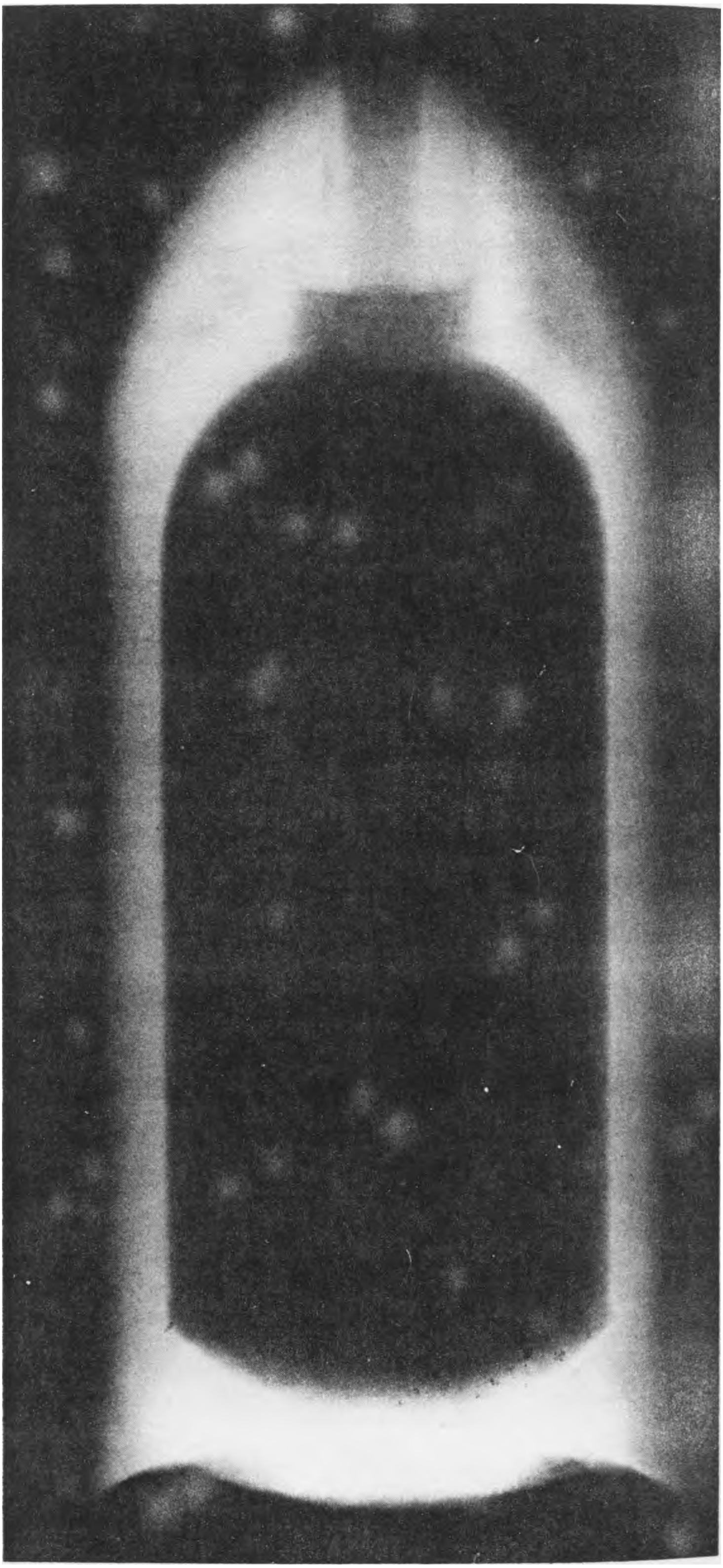


Figure 87. Radiograph of 3.5-Inch Parrott Shell (pre-engraved sabot).

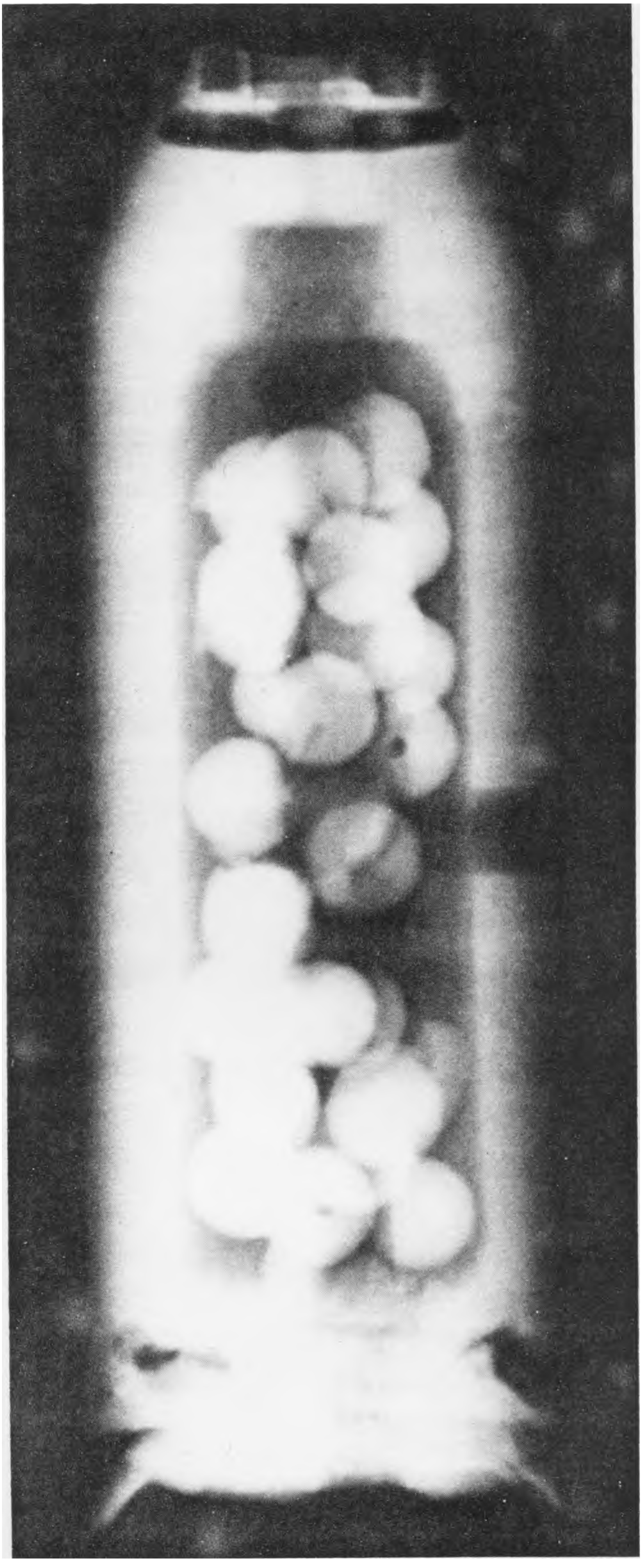


Figure 88. Radiograph of 3-Inch Parrott Case Shot (Bormann fuzed).

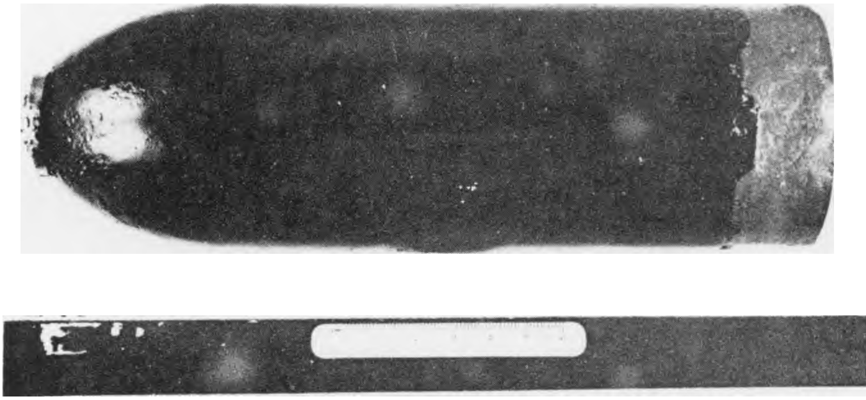


Figure 89. 3-Inch Parrott Shell (percussion fuzed).

Figure 90. 3-Inch Parrott Case Shot (canned burster).

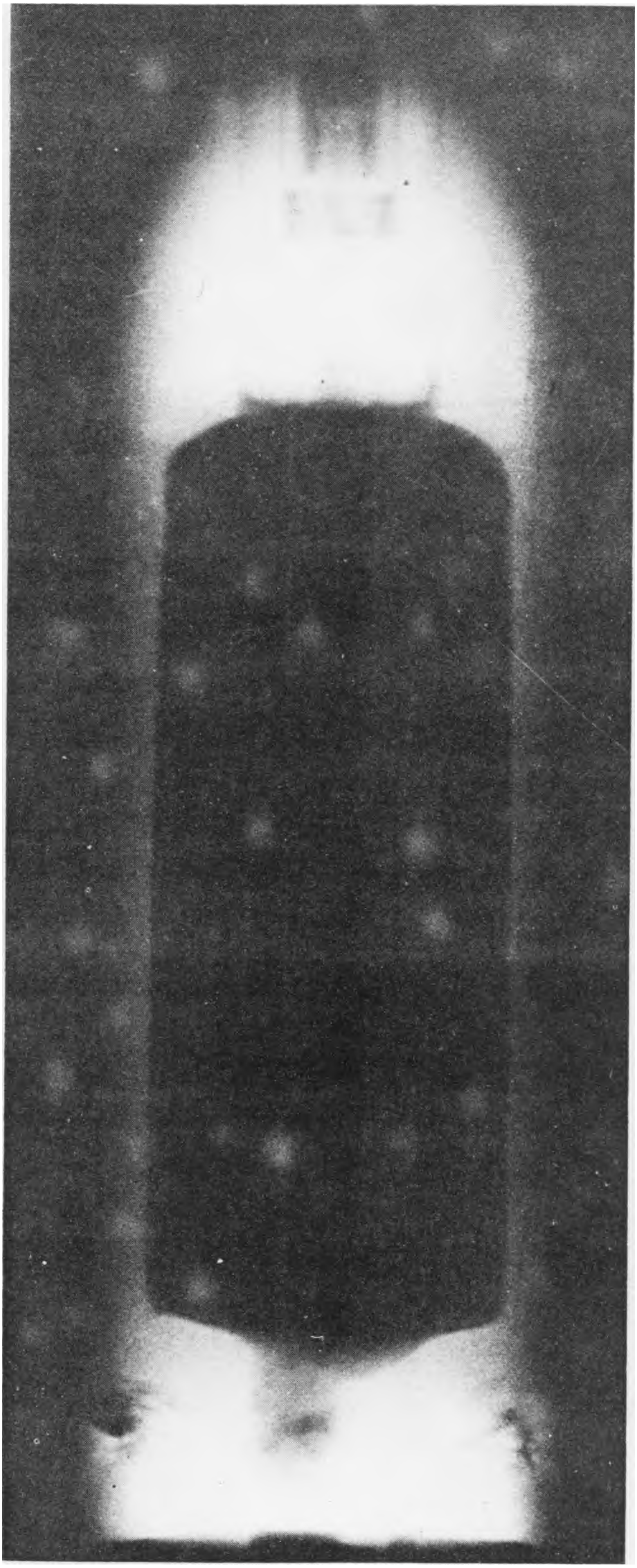


Figure 91. Radiograph of 3-Inch Parrot Shell (percussion fuzed).

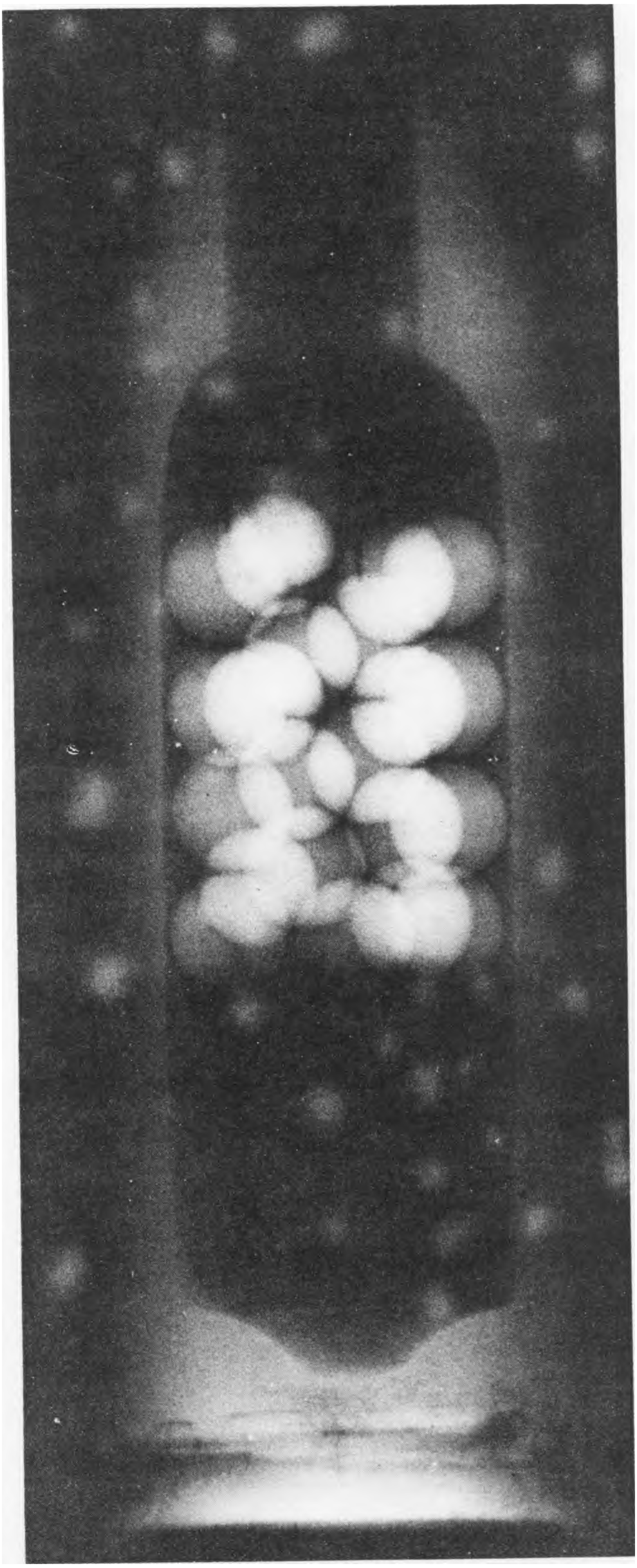
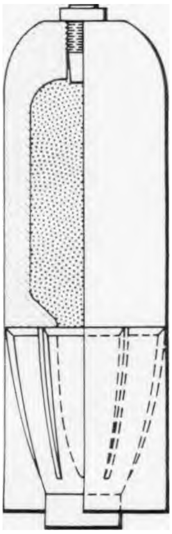


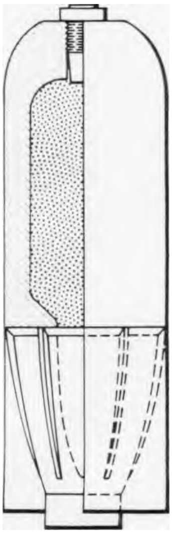
Figure 92. Radiograph of 3-Inch Parrott Case Shot (canned burster).



The cone-like shape and absence of a sabot after firing, affords easy field recovery identification of the Schenkl projectile. It was constructed of a cast-iron body, the posterior end of which was sharply tapered and had raised ribs cast onto the shell body. The expanding portion was a paper-mache sabot which was forced up the inclined surface of the shell base by the explosion of the propelling charge, thus engaging the bore rifling. On leaving the gun muzzle the paper-mache wad, unlike lead sabots that often fragmented at the muzzle endangering friendly troops in the foreground, was blown almost to dust.

Schenkl projectiles were extremely reliable if kept dry, however, the paper-mache would swell from moisture and after drying often failed to take the rifling properly or could not be placed down the muzzle at all. In an attempt to counter this swelling, a thin zinc sleeve was placed over the sabot. A patent was issued to Frederika Schenkl, wife of the shell's inventor, and in January 1865, to aid in the compression of the sabot into the rifling, a soft metal band was placed at the top and bottom of the pressure condensed paper sabot along with a metal disk affixed to the base of the sabot.

Schenkl projectiles were fuzed with the percussion fuze shown in Figure 154 or the combination fuze shown in Figure 163. Although highly reliable, these two fuzes had their share of ,iuds. The inventor made use of the force of setback to arm his fuzes and the force of impact or time to detonate the fuze. This author feels that the fuze dud rate was caused by the absence of an anticreep spring between the fuze plunger and the anvil. On the projectile's terminal dive to the target, the force of creep would allow the plunger to come to rest against the anvil and preclude the impact required to initiate the cap.



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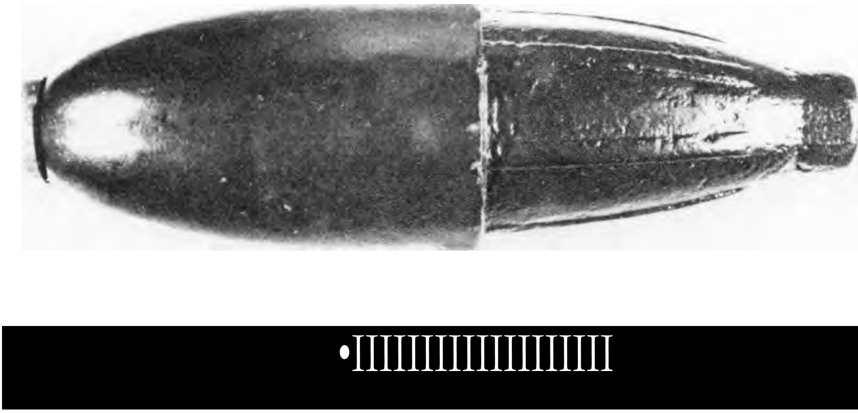


Figure 94. 3-Inch Schenkl Shell.

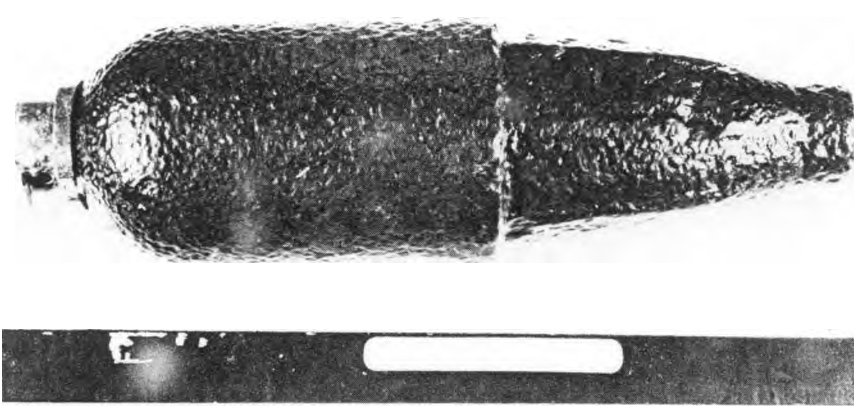


Figure 95. 3-Inch Schenkl Case Shot.

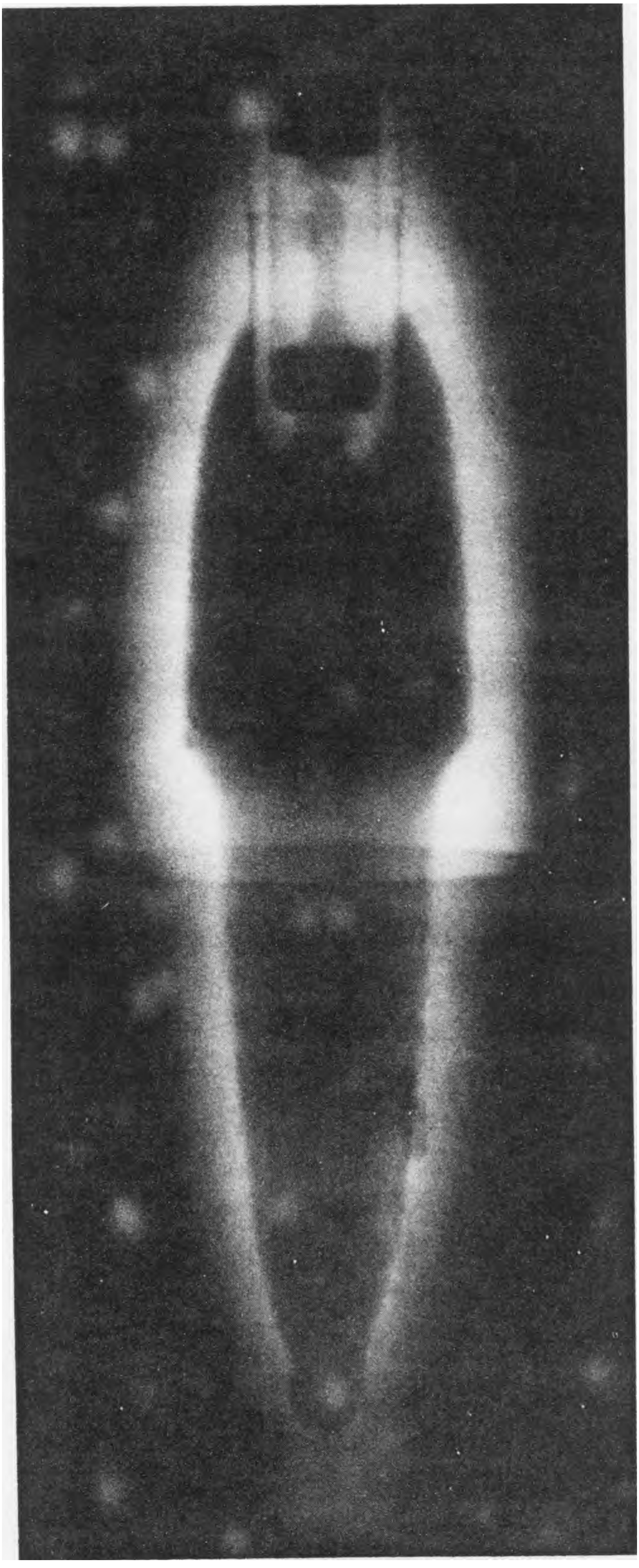


Figure 96. Radiograph of 3-Inch Schenkl Shell.

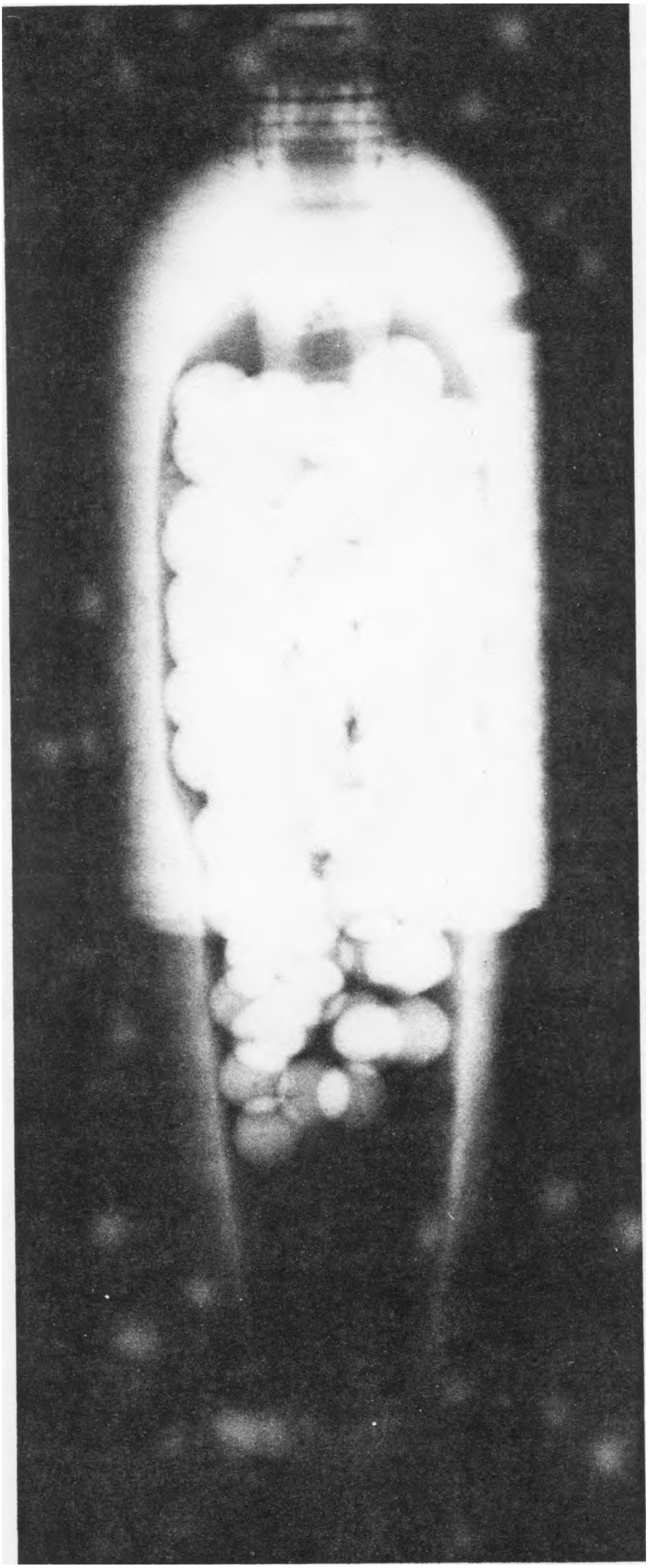


Figure 97. Radiograph of 3-Inch Schenkl Case Shot.

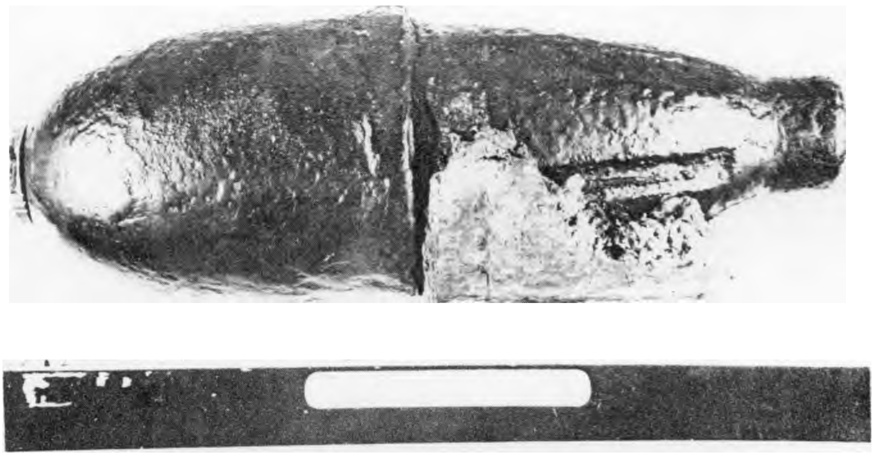


Figure 98. 3.25-Inch Schenkl Shell.

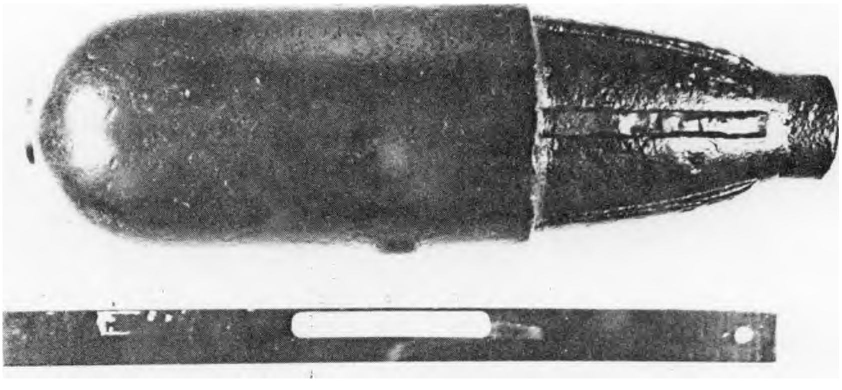


Figure 99. 4-Inch Schenkl Shell.

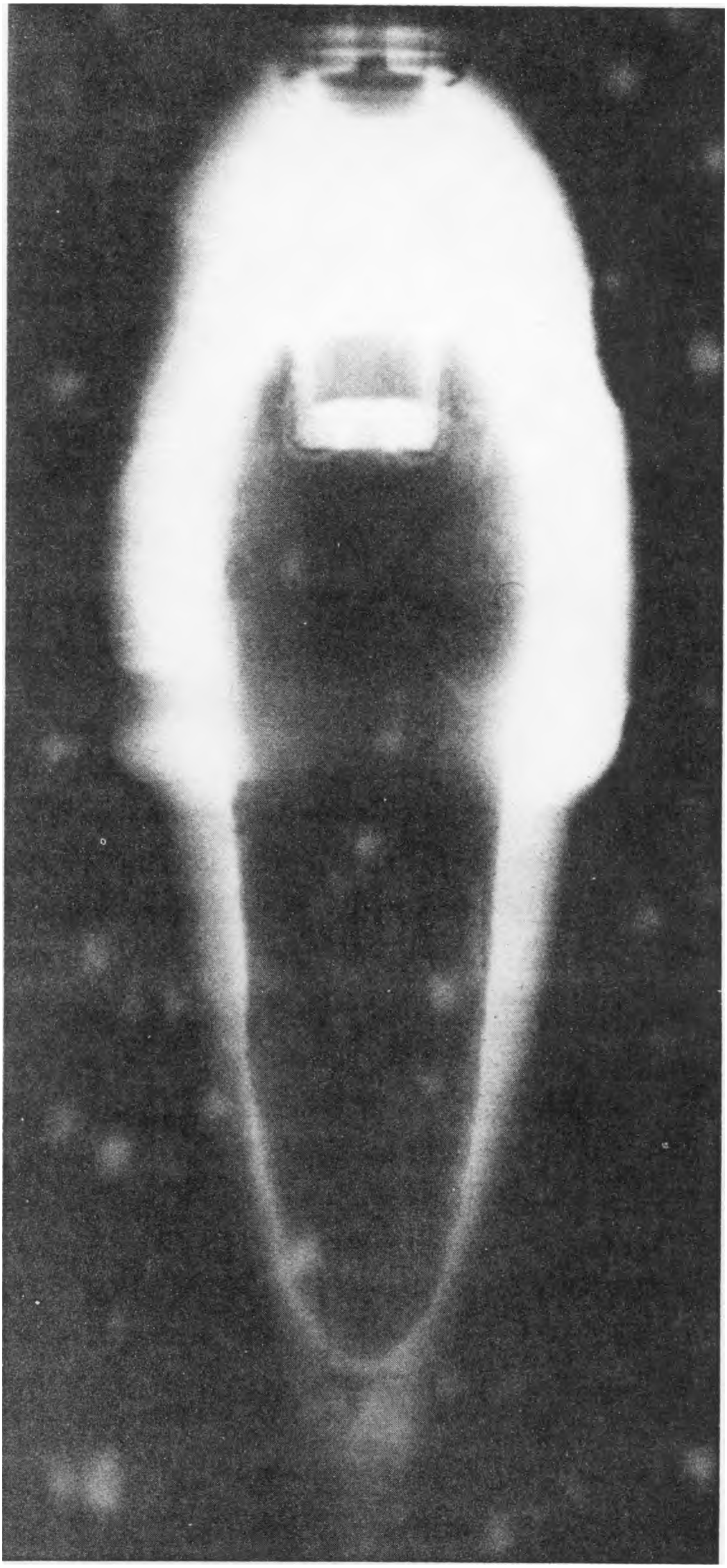


Figure 100. Radiograph of 3.25-Inch Schenkl Shell.

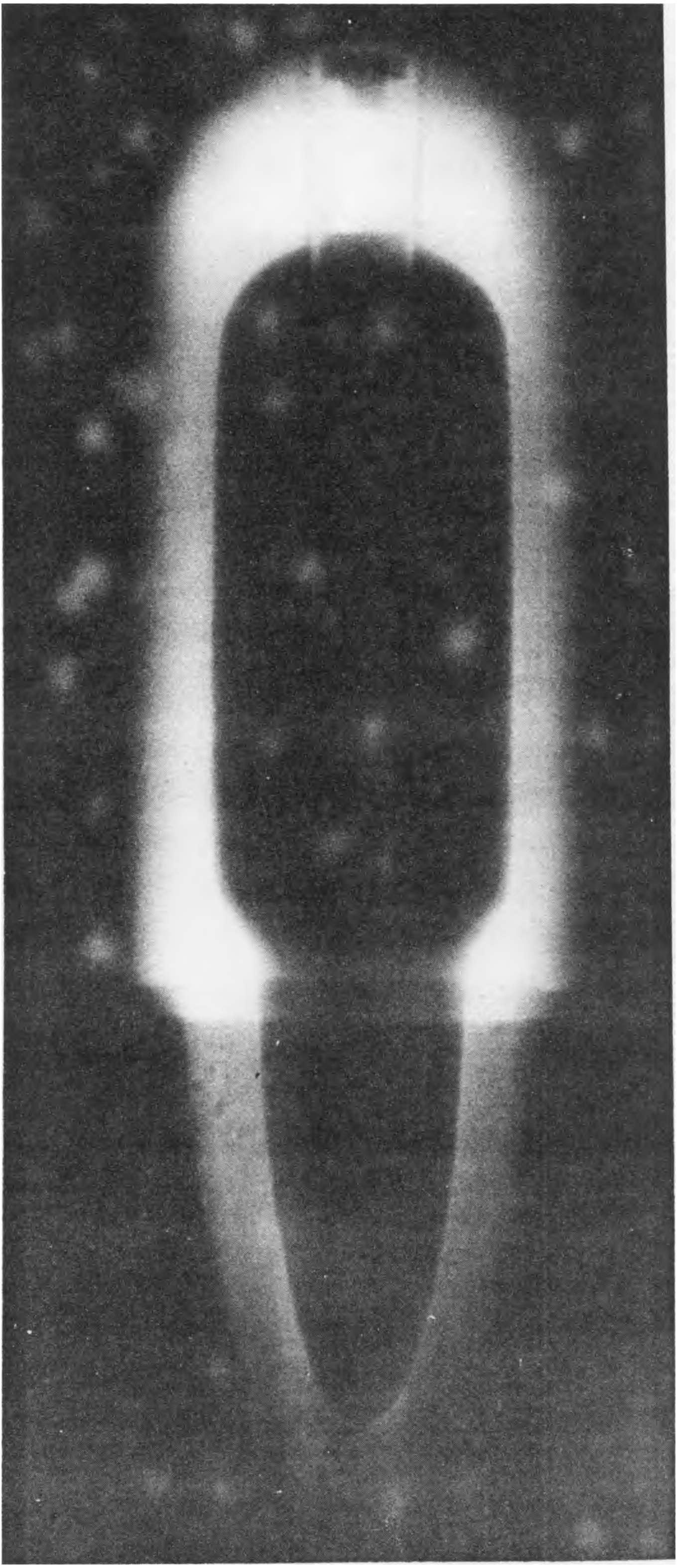


Figure 101. Radiograph of 4-Inch Schenkl Shell.

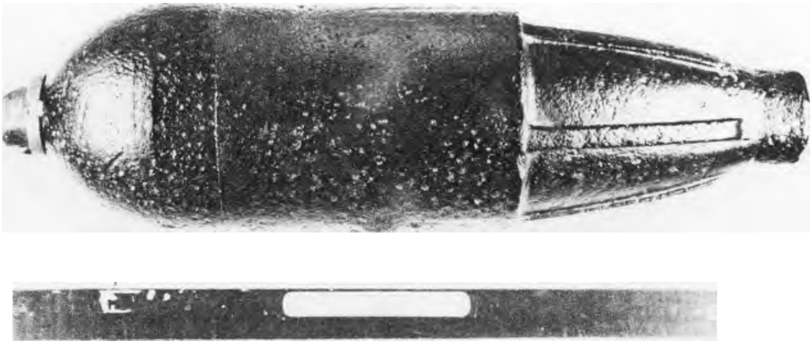


Figure 102. 4-Inch Schenkl Case Shot.

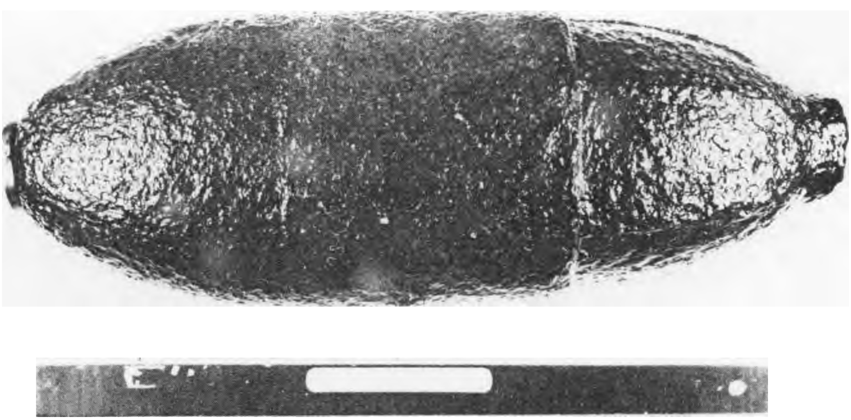


Figure 103. 5-Inch Naval Schenkl Shell.

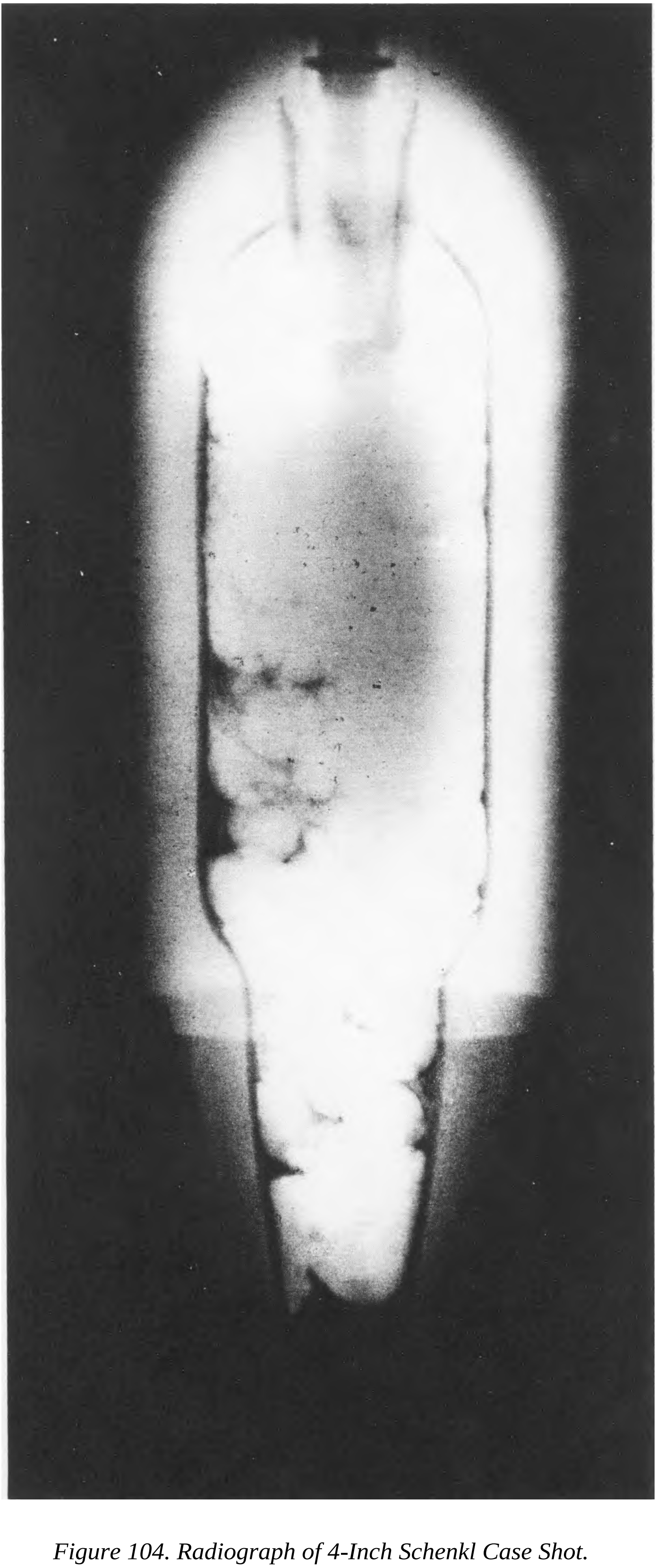


Figure 104. Radiograph of 4-Inch Schenkl Case Shot.

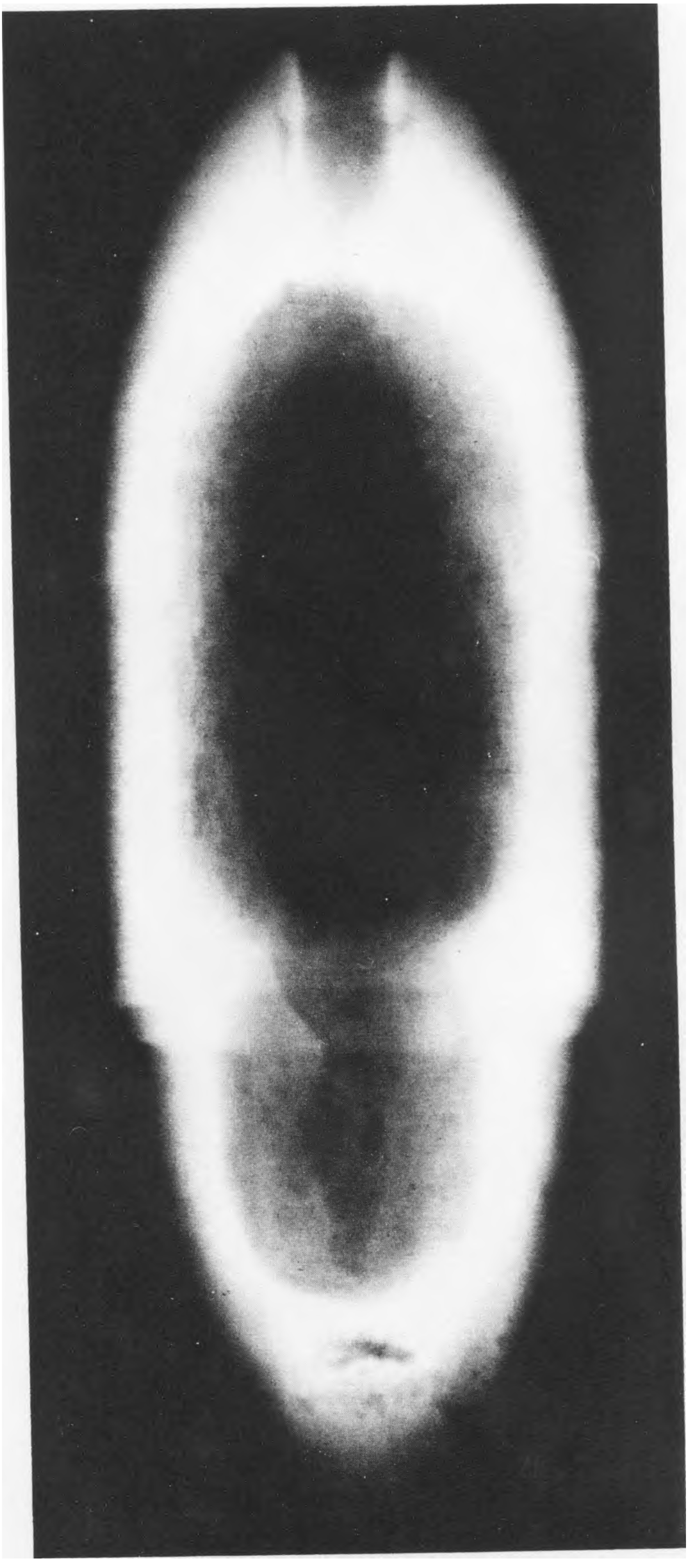


Figure 105. Radiograph of 5-Inch Naval Schenkl Shell.

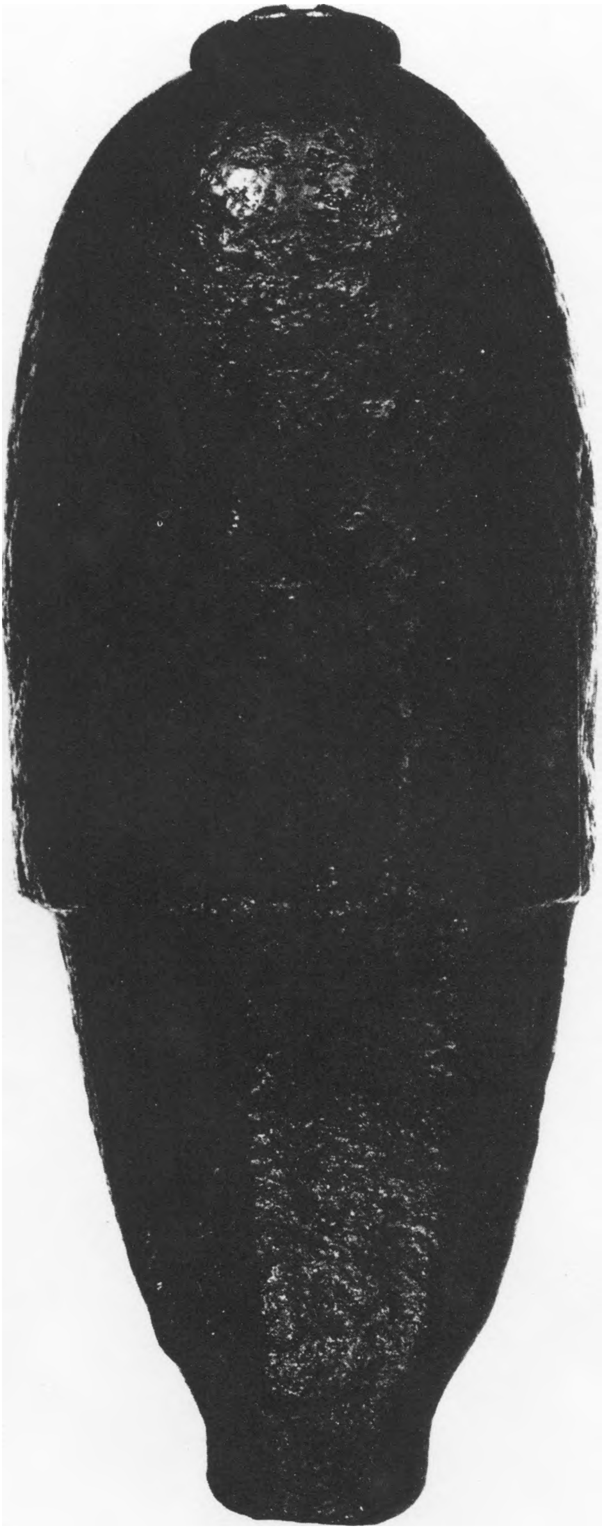


Figure 106. 6.4-Inch Schenkl Case Shot.

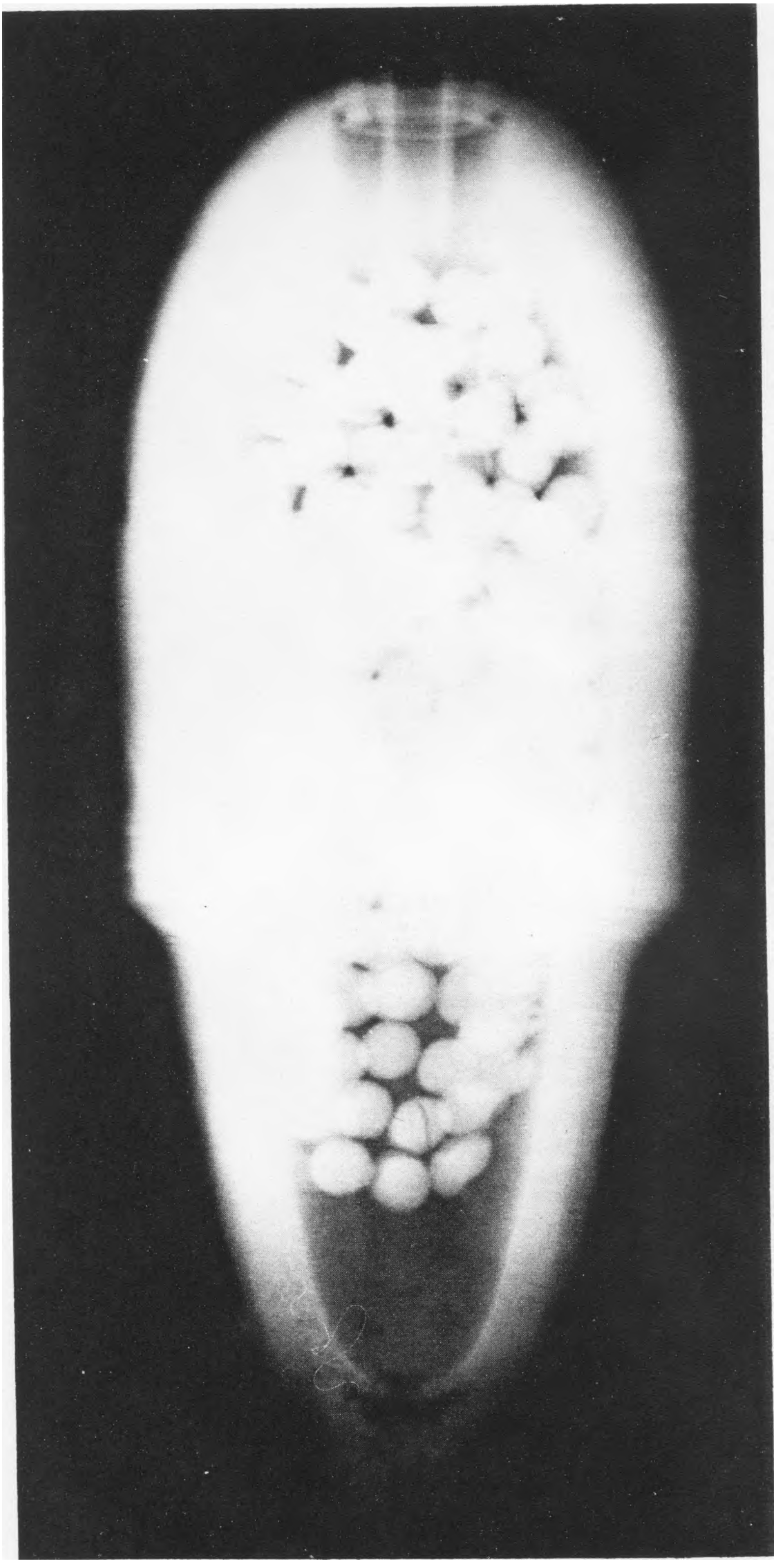
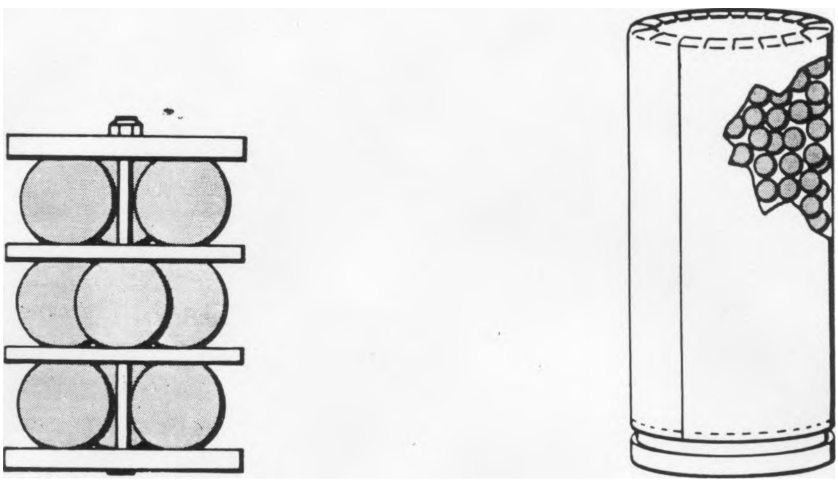


Figure 107. Radiograph of 6.4-Inch Schenkl Case Shot.

PART IV



MISCELLANEOUS PROJECTILES

PART IV

MISCELLANEOUS PROJECTILES

A. CANNISTER SHOT

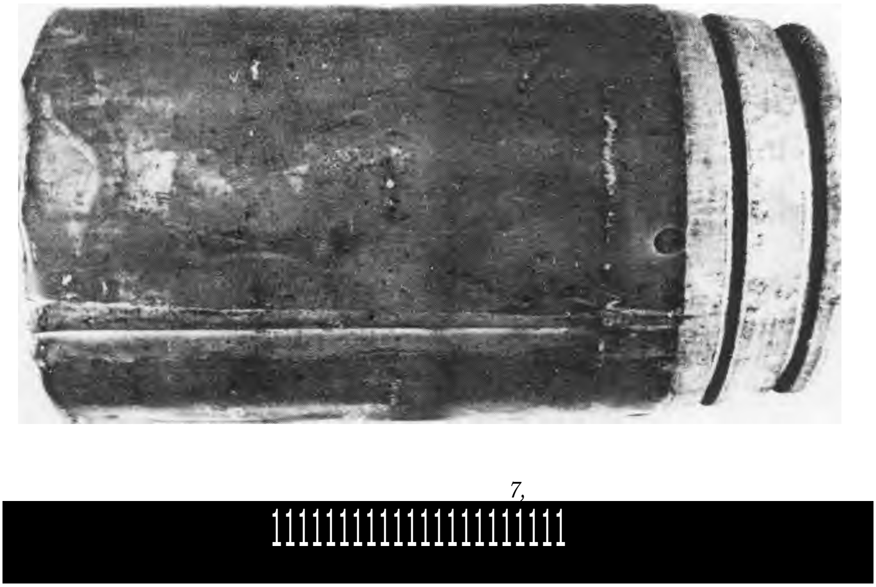


Figure 108. 4.25-Inch Cannister (Union).

Cannister shot for a gun contained 27 small cast-iron balls arranged in four layers, the top of six and the remainder seven. Howitzer cannister was larger as it held 48 balls in four layers of 12 each. Although cannister was often referred to a grape shot by both belligerents, it differed in being loosely packed in a sheet tin cylinder and the balls were of smaller size. Sawdust was used to separate and pack the voids in among the balls. A wire handle was attached to the thin top plate for handling ease. Cannister was usually fired from smoothbore guns and can be likened to a huge shot gun, for the container was broken by the shock of discharge and the enclosed projectiles scattered into a sheaf or cone pattern after rupture. In the later war years, cannister firing artillery was often in line with the infantry. Union cannister normally contained lead balls. The steel plates enclosing each end were called culots. Refer to Figure 117 for issued sizes.

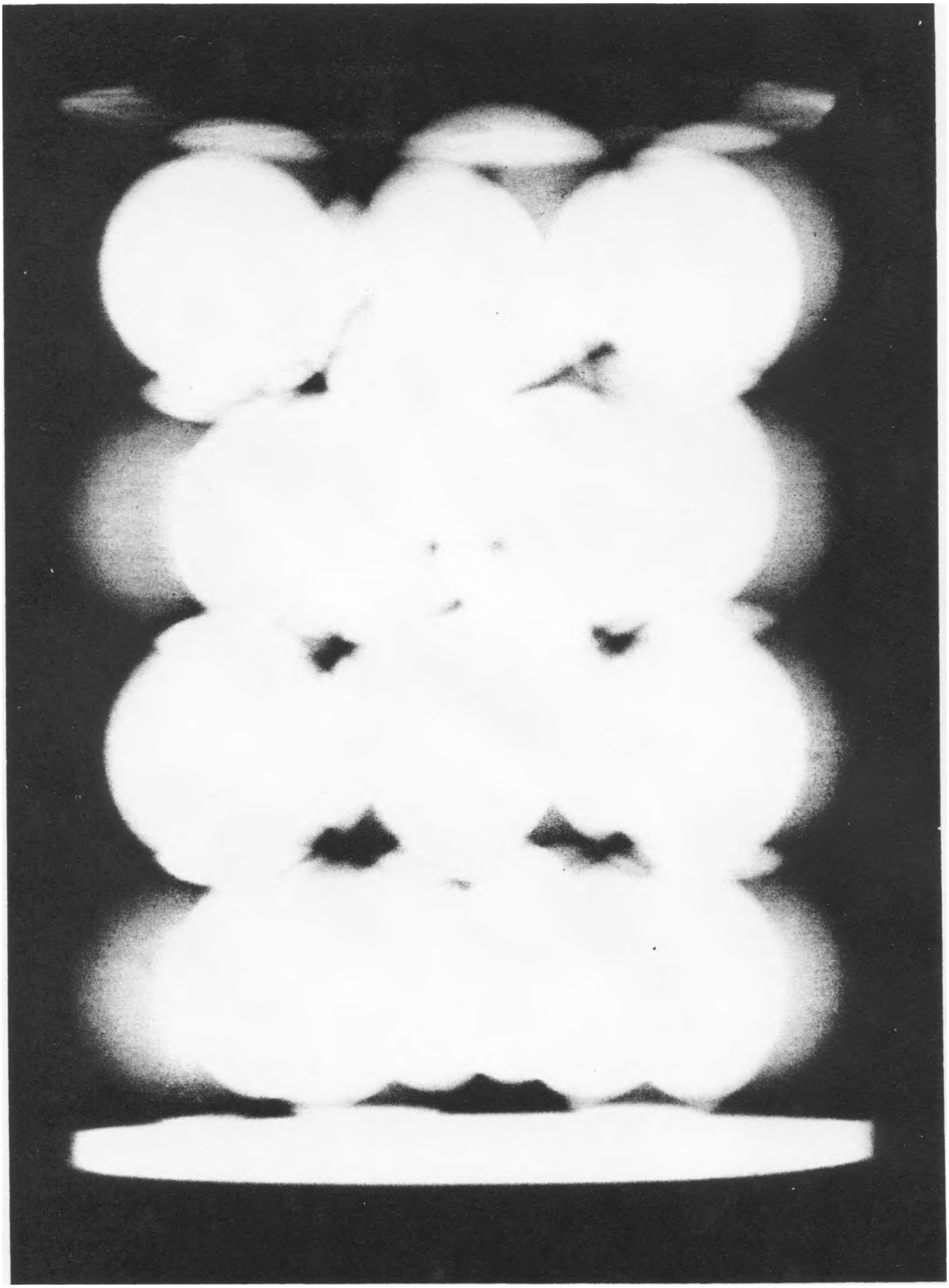


Figure 109. Radiograph of 4.25-Inch Cannister (Union).

Figure 110. 2.5-Inch Cannister (side view).

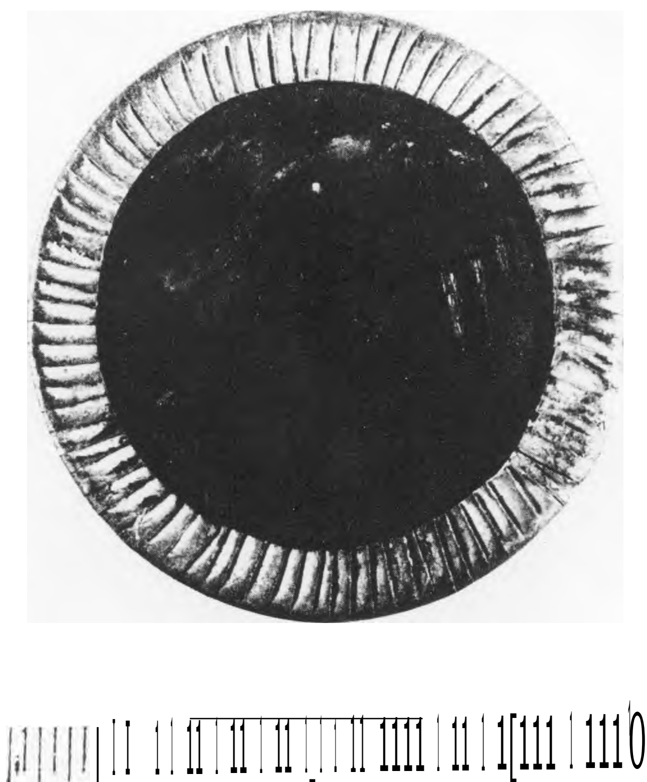


Figure 111. 2.5-Inch Cannister (nose view).

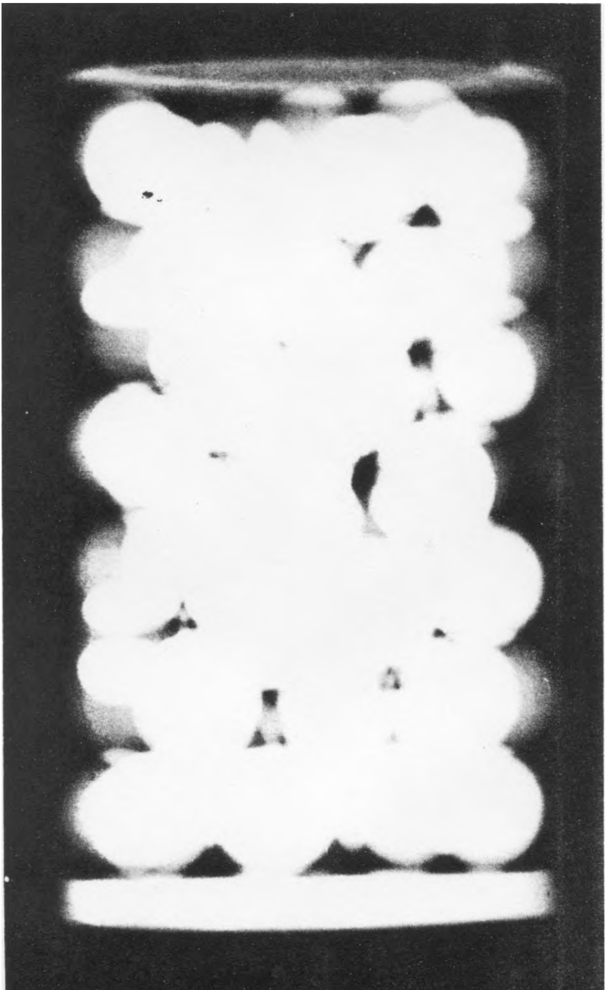


Figure 112. Radiograph of 2.5-Inch Cannister.

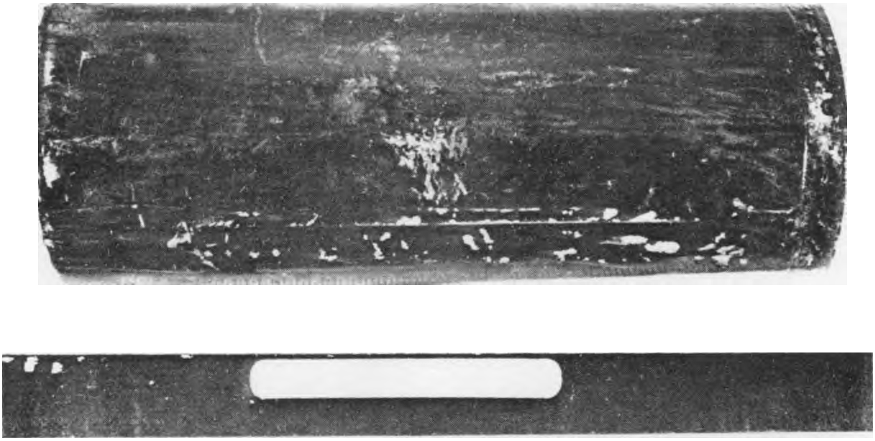


Figure 113. 3-Inch Hotchkiss Cannister (side view).

Figure 114. 3-Inch Hotchkiss Cannister (base view).

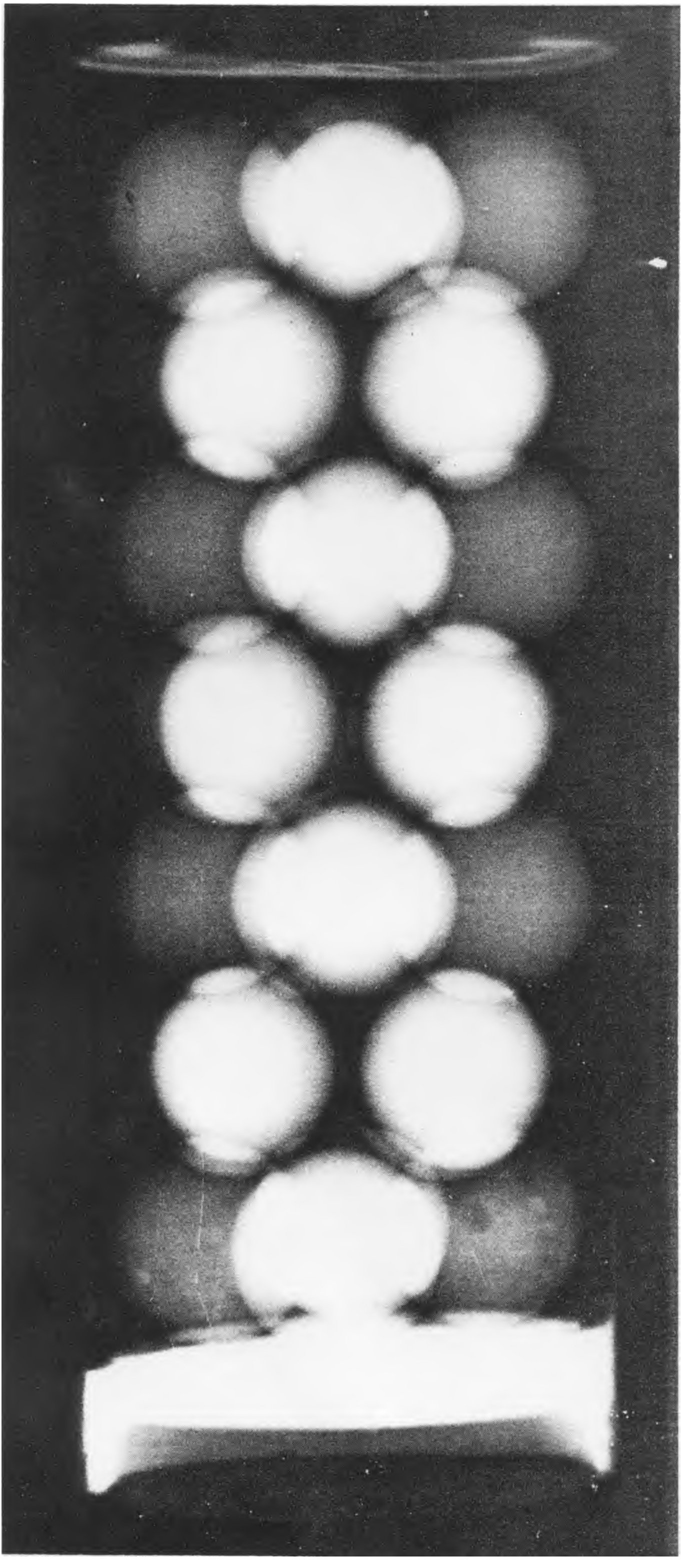


Figure 115. Radiograph of 3-Inch Hotchkiss Cannister.

B. GRAPE SHOT

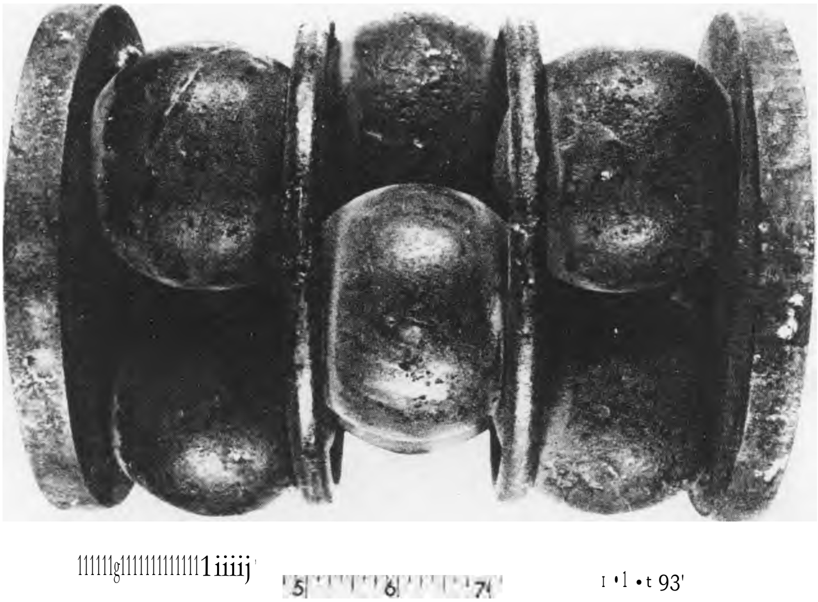


Figure 116. 5.6-Inch Grape Shot.

The true nine ball, three-layer grape shot was needlessly large for effective use against lines of attacking infantry, thus it found small favor in the field. Killing velocity was over 400 yards but the pattern at that distance was small. The shot separated upon leaving the gun muzzle and carried no bursting charge. Refer to Figure 117 for the issued sizes.

A complete assembly was called a "stand of grape" and consisted of nine balls ranging from 2.06 inches to 3.58 inches in diameter held together in the middle by two cast-iron rings or hoops with the ends enclosed with two cast-iron plates and the entire assembly held together by a threaded bolt and nut. Designed strictly for smoothbore guns, the above "stand" was made for the 24-pounder.

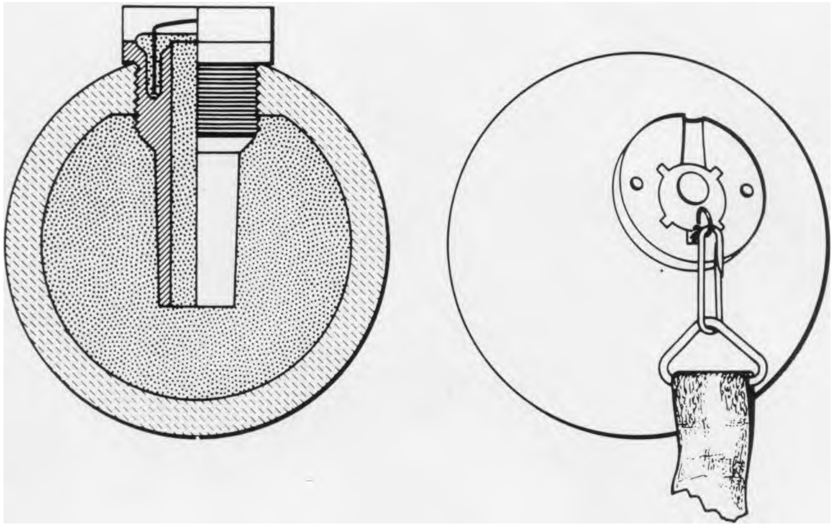


Figure 118. 6-Pound Adams Grenade (line drawing).

A line drawing of the Adams grenade is presented as actual hardware was unavailable at the time of publication of this guide. Invented by John S. Adams in January 1865, field recoveries of the grenade are rare. The grenade body was made up from a 6-pounder ball with the adaption of the Adams fuze. The fuze consisted of a fuze body containing a 5-second paper time fuze. A friction sensitive primer mix was placed atop of the paper time fuze with a friction wire imbedded therein. Attached to the friction wire was a spring hook and an 18-inch leather strap. The top of the Adams fuze was protected by a waterproof paper cap which was removed prior to throwing. The small hole in the center of the fuze provided an escape port for burning gases.

In operation the leather strap and hook were attached to the friction wire and the paper protective cap was removed. With the strap attached to the thrower's wrist, the friction wire was pulled through the primer mix when the ball was thrown. Ignition of the primer mix ignited the time fuze.

Figure 119. Hanes Grenade.

Sometimes referred to as the "Excelsior Grenade," the Hanes grenade was constructed of cast iron. It consisted of a spherical shell capable of being screwed together at the middle. Contained within these two hemispheres was a 2 5/8-inch diameter ball filled with black powder. At various and uniform points around this inner ball's exterior were 14 to 16 nipples or teats over which musket caps were placed just prior to using.

In operation the inner ball was filled with black powder and set aside for the user. Just prior to being thrown, the musket caps were pressed onto their mounting teats and the ball was carefully placed inside the two outer hemispheres which were then screwed together. Upon impact with the target one or more of the caps were crushed between the inner and outer case thus exploding the grenade. This grenade is rarely encountered today, and its use in combat during the War is questionable owing to its inherent lack of safety features.

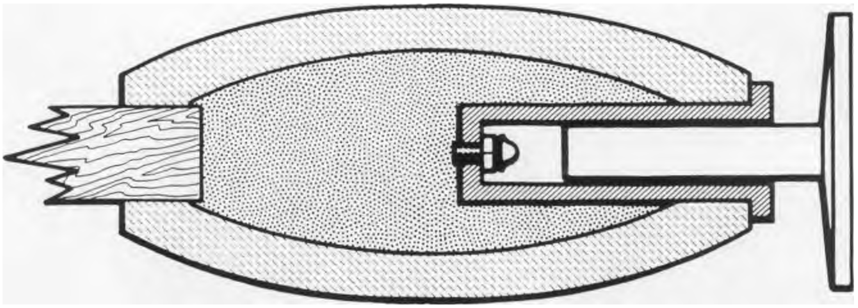


Figure 120. 3-Pound Ketchum Grenade.

Patented by W. F. Ketchum in August 1861, this was the most popular grenade of the War. Issued in 1-, 3-, and 5-pound sizes, the Ketchum was a cast-iron double conical oval form that was hand thrown and stabilized by an 8-inch wooden stick having four fins of pasteboard. Its fuzing was a simple protruding striker assembly having a small leaf spring to retain the striker from falling out of the fuze body. Directly below the striker was placed a common musket cap upon its nipple. In operation, the cap was placed on its nipple with a hollow stick and only then was the powder poured in the opposite end. A stowage plug was used to plug the filler hole until the fins were installed. The striker was inserted just prior to throwing. On impact the striker crushed the cap which communicated a flash to the powder charge.

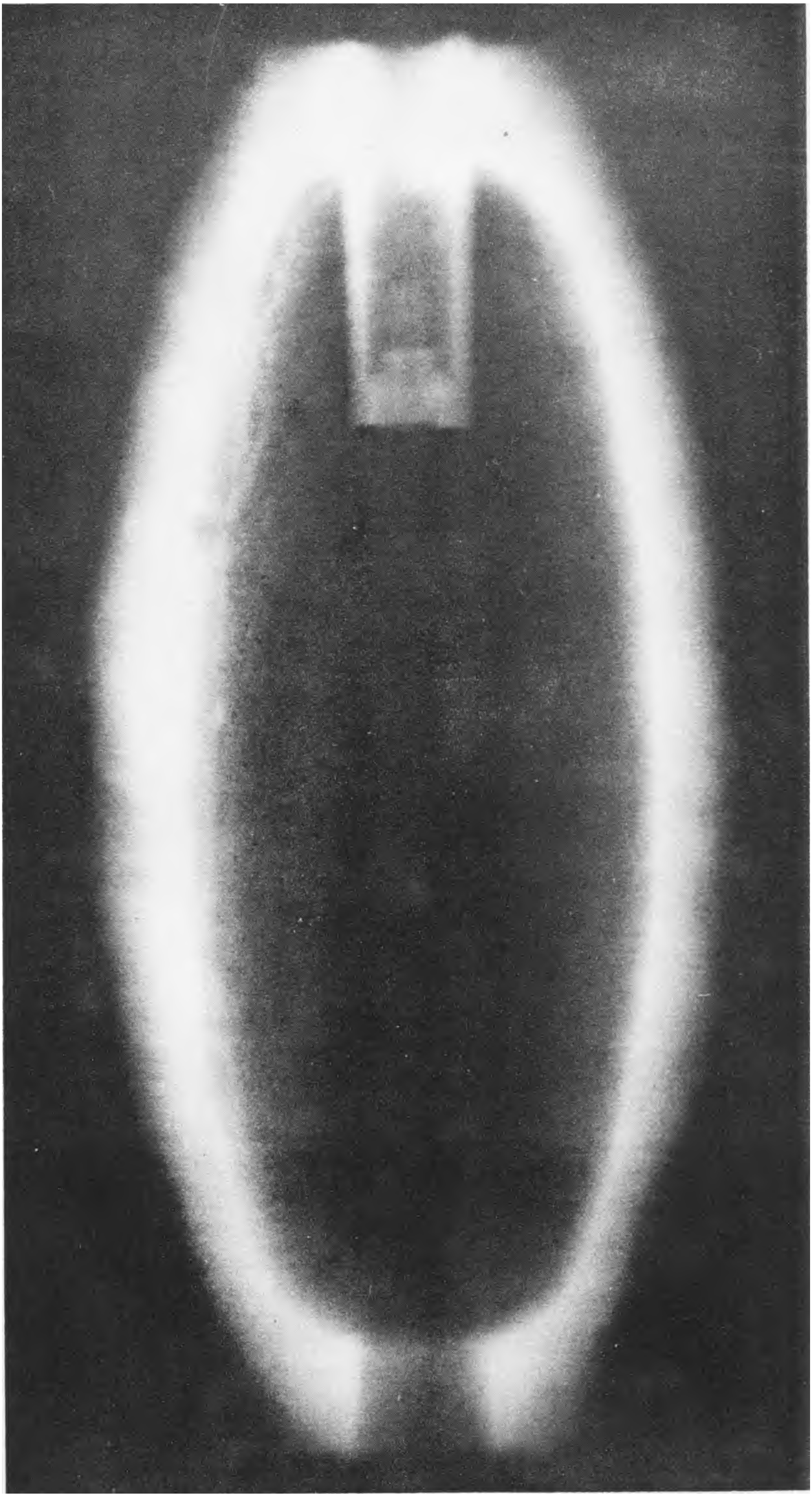


Figure 121. Radiograph of 3-Pound Ketchum Grenade.

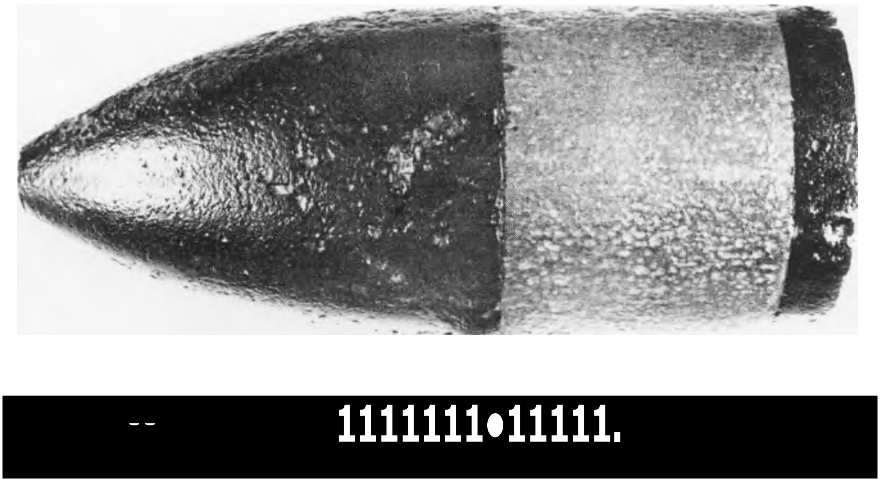


Figure 122. 3.4-Inch Read Shell (tentative ID).

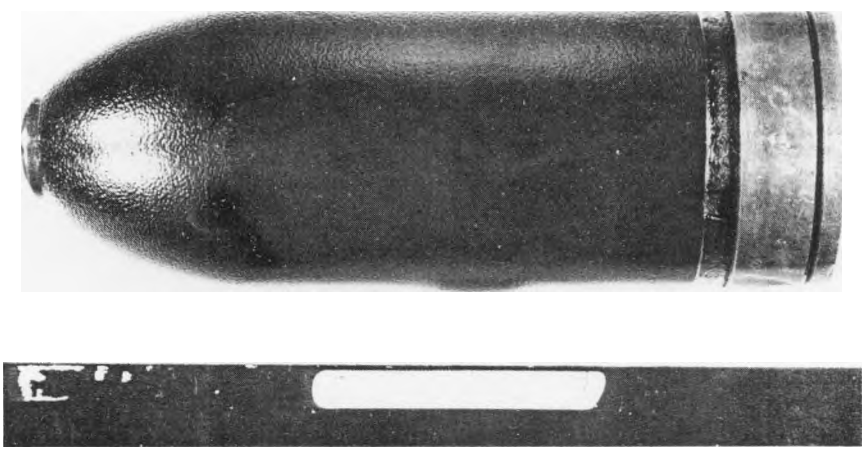


Figure 123. 3-Inch Stafford Shell.

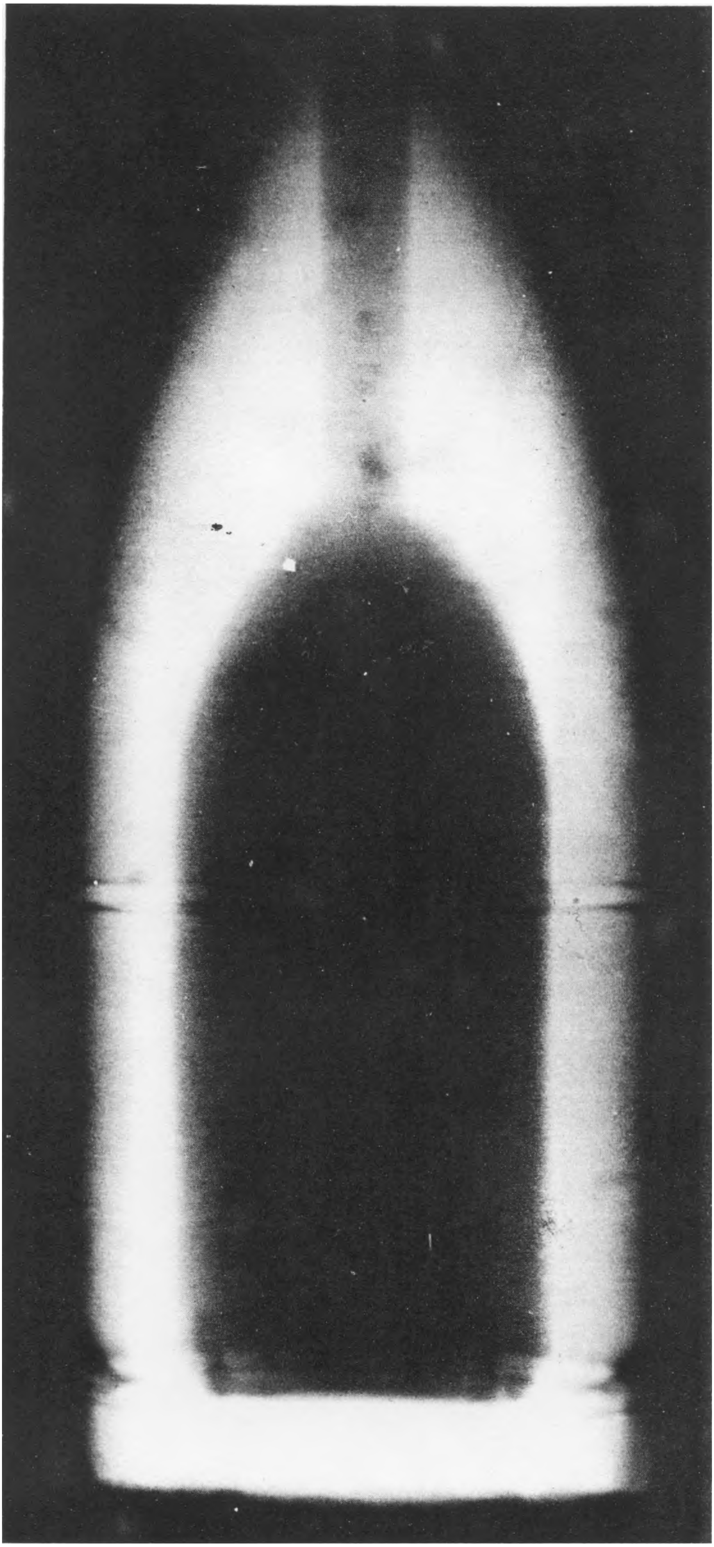


Figure 124. Radiograph of 3.4-Inch Read Shell (tentative ID).

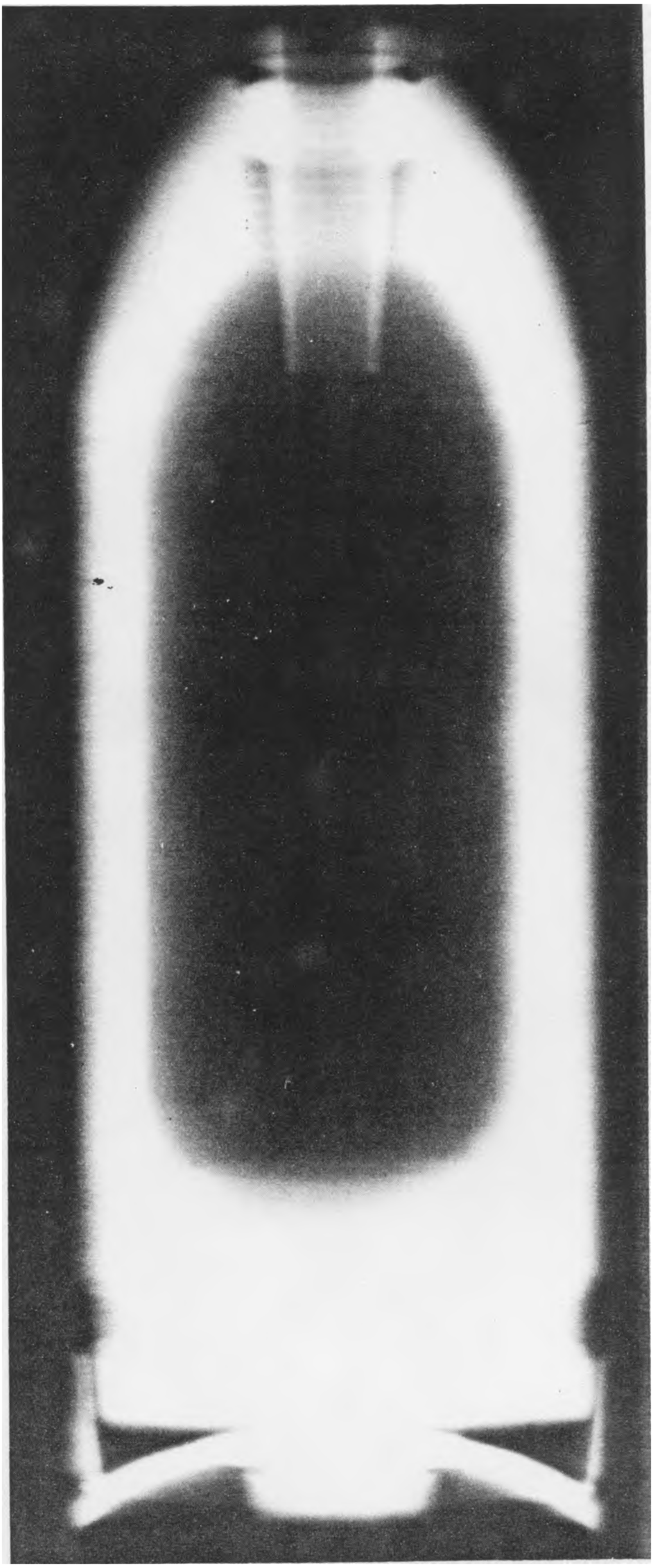


Figure 125. Radiograph of 3-Inch Stafford Shell.

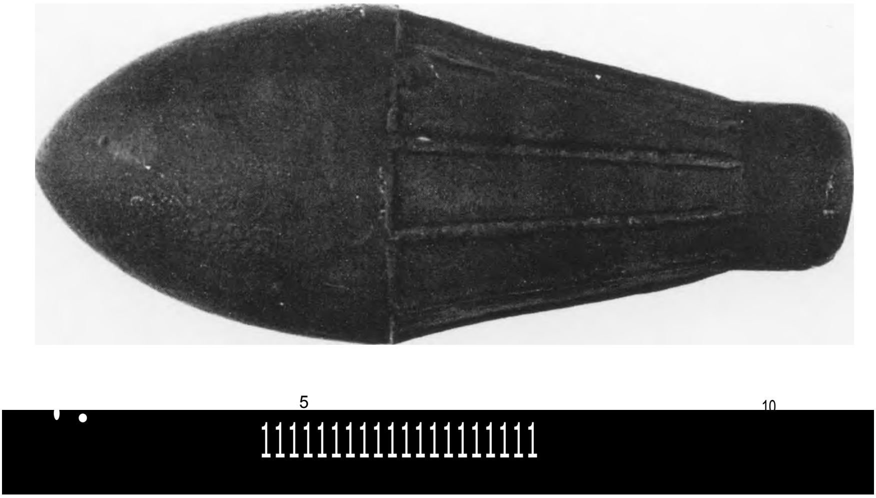


Figure 126. 3.67-Inch Schenkl Bolt (Confederate made).

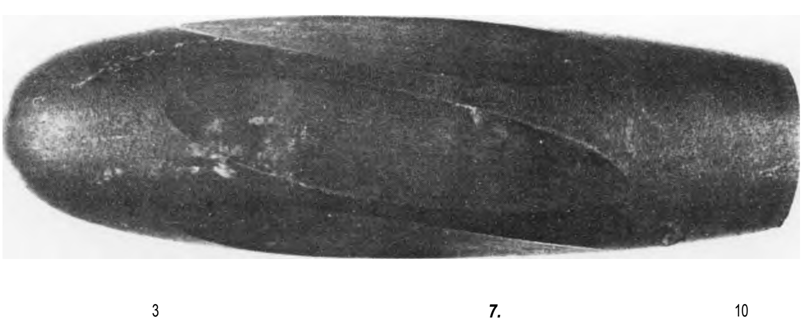


Figure 127. 12 Pdr. Whitworth Bolt (Confederate made).

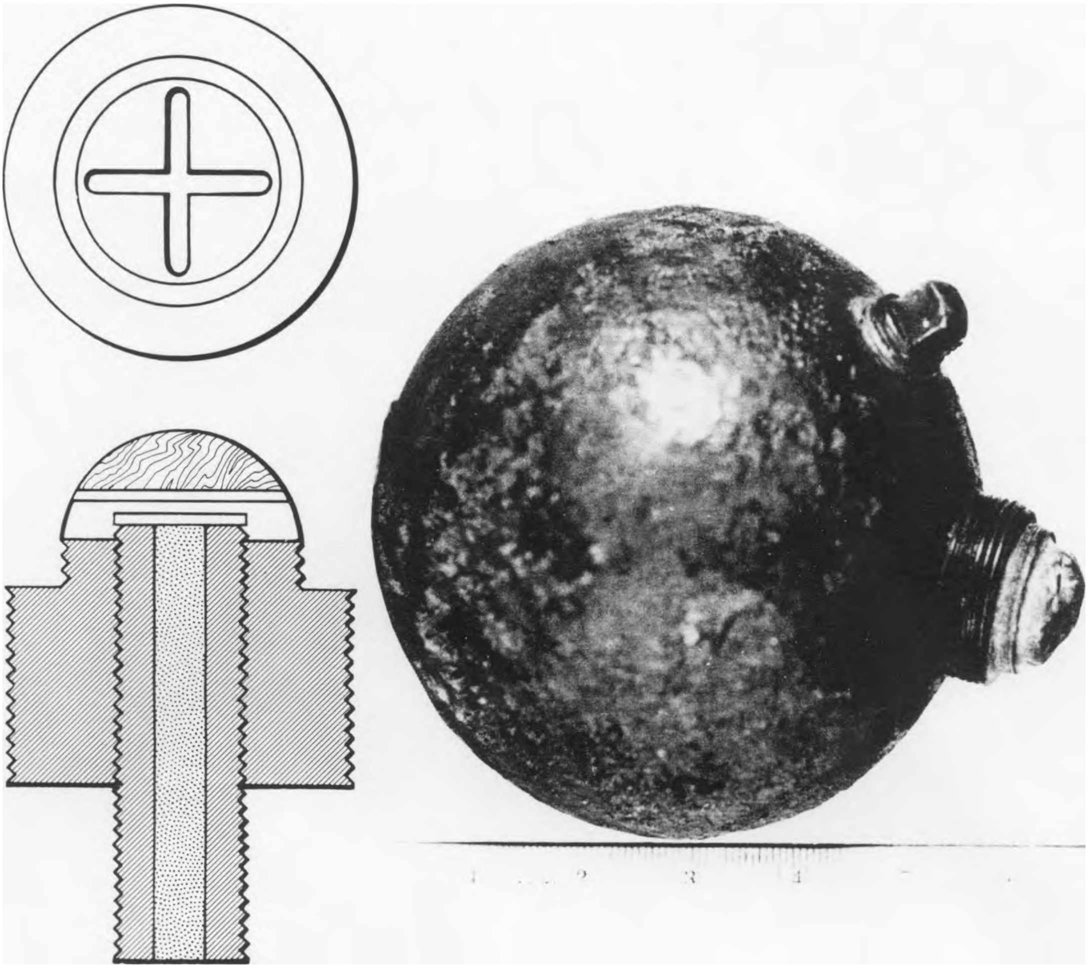
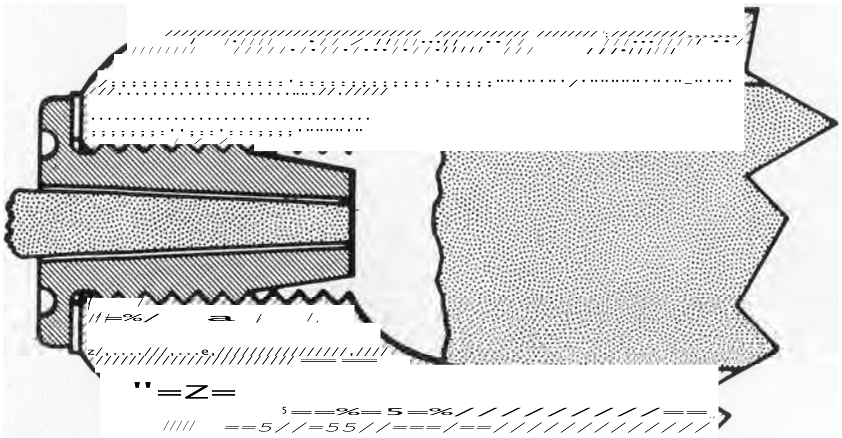


Figure 128. Confederate 24 Pdr. Land Mine.

Confederate land mines were made from converted smoothbore artillery projectiles. Sizes have been found in 24- and 32-pounder calibers. This specimen has a 5.8-inch diameter and is fitted with a filler plug and special pressure actuated chemical fuze. In operation, pressure is applied on top of brass foil cover; this action will crush cover and force top wood piece, which is fitted with a chemically saturated paper down onto lower piece also fitted with a chemical paper. The chemical reaction of the two joined pieces of paper will cause flame which is transmitted to the bursting charge. No written reference has been found describing this projectile. This information comes from disassembled field recoveries.



PART V

FUZES

A. TIME FUZES

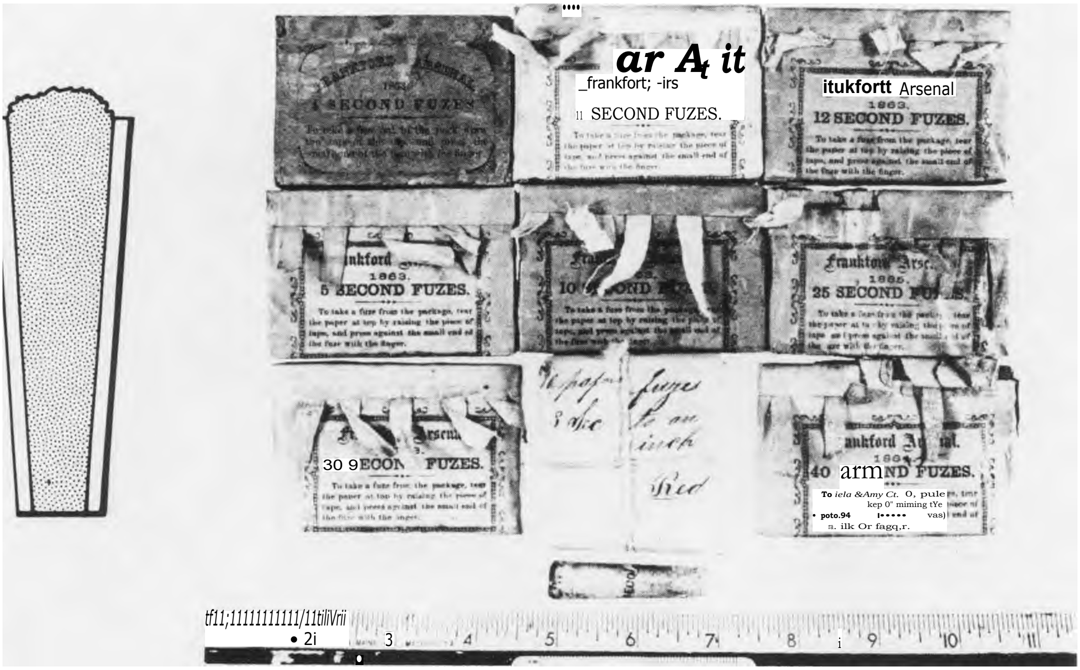


Figure 129. Assorted Paper Time Fuzes.

Fuzes are the means used to ignite the bursting charge of a hollow projectile at any desired moment of its flight. They may be classed according to their mode of operation, as time fuzes, percussion, combination, and concussion. The fuzes shown in Figure 129 are composed of a case of paper enclosing a column of burning composition, which is set on fire by the discharge flame of the gun, and which, after burning a certain time, communicates with the bursting charge of the projectile. Its successful operation depends on the certainty of ignition, the uniformity of burning, and the facility with which its flame communicates with the bursting charge.

The ingredients of all time fuze compositions are the same as for gunpowder, but the proportions are varied to suit the required rate of burning. Pure mealed powder gives the quickest composition, and the others are derived from it by the addition of nitre and sulphur in certain quantities.

1. Wooden Adapters

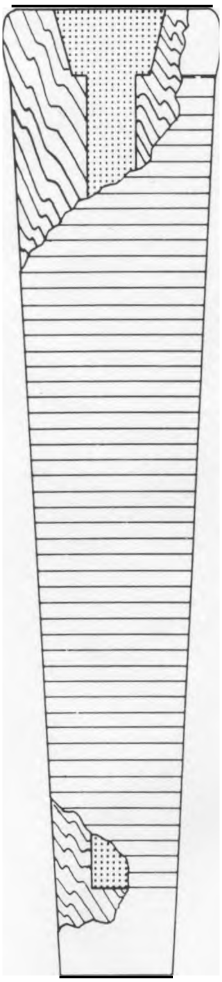


Figure 130. Wooden Adapters for Paper Time Fuzes.

The top two wooden adapters, shown in Figure 130, were made to receive the common paper time fuze while the lower adapter had its powder composition pressed directly into the center hole at manufacture. The diameters and lengths will vary depending on the size of the projectile they are used in. In operation, the fuze is cut to desired burning time and driven into the smoothbore mortar projectile fuze cavity. Upon firing, propellant gases ignite the upper end of the time fuze, starting time action for airburst functioning. The mortar fuze (bottom adapter), is normally graduated on the outside for indication of burning time. Wooden case time fuzes were also used on other types of rounds, including field and siege smoothbore and rifled bore projectiles. Both the Union and Confederates used them during the war.

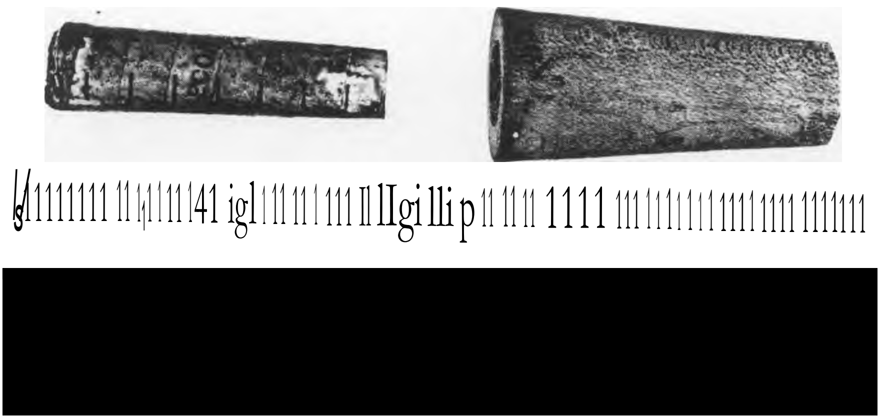


Figure 131. Wooden Adapter for Paper Fuze.

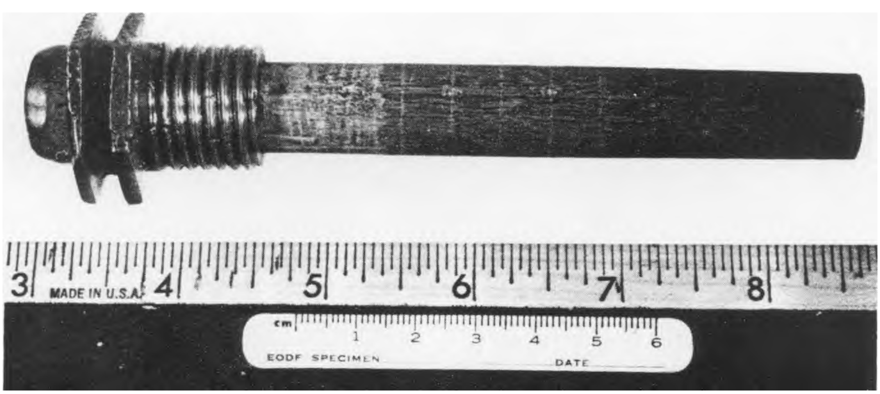


Figure 132. Wooden Adapter for 3.5-Inch Blakely Shell.

Figure 133. Metal Adapter for 3-Inch Stafford Shell.

The metal adapter used by both the Union and Confederate armies screwed directly into the fuze cavity of the projectile body. Found in both rifled and smoothbore projectiles, they are made of brass, copper, or a zinc alloy. Usually the threads were coated with white lead and a gasket of leather was placed under the head of the fuze to prevent propellant flame from entering the main charge by way of the fuze threads. The type illustrated in Figure 133 is Union. Confederate versions were usually made of copper and had two-spanner holes in the top flange of the adapter. Metal adapters will also vary in size but are approximately 1 inch in diameter and 1 5/8 inches in length. In operation, the paper time fuze was precut to desired length prior to firing and then driven into the adapter with a mall. Upon firing, the propellant gases from the discharge of the gun ignited the exposed end of the time fuze.

The particular pattern shown in Figure 133 is quite similar to a design used in the Hotchkiss case shot.

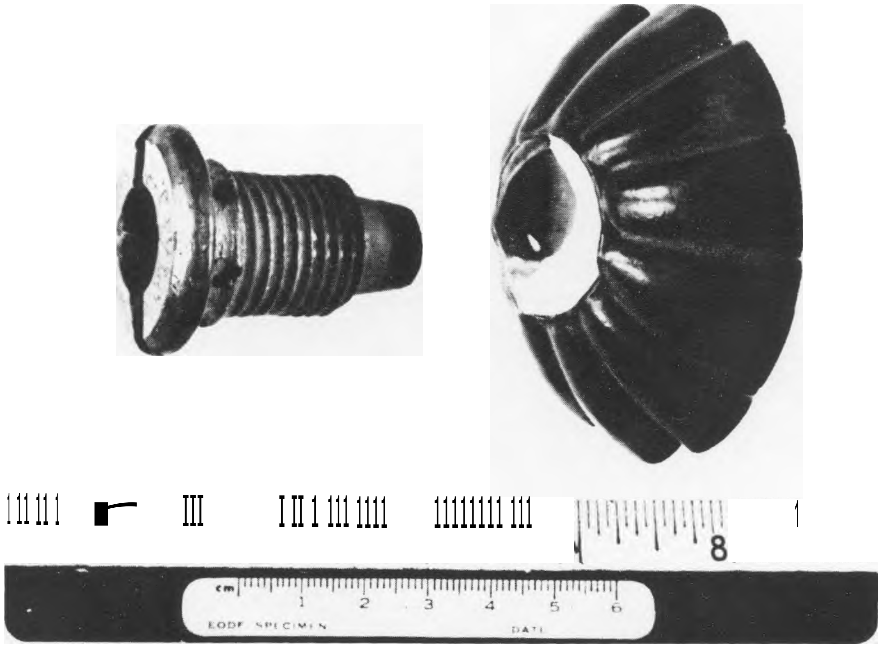


Figure 134. Taylor Adapter for 3-Inch Dyer Shell.

Figure 135. Top View of Taylor Adapter with Corrugated Cap.

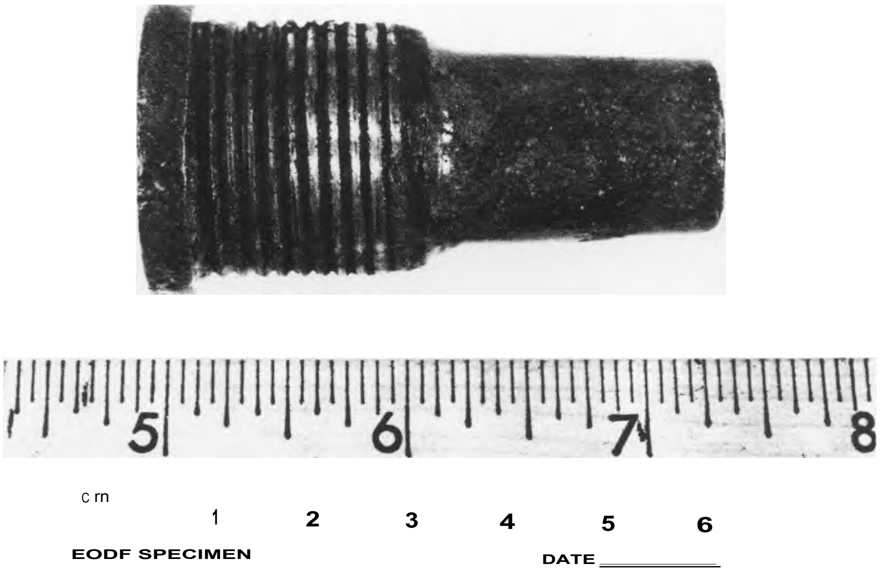


Figure 136. Zinc Adapter for Union Parrott Shells.

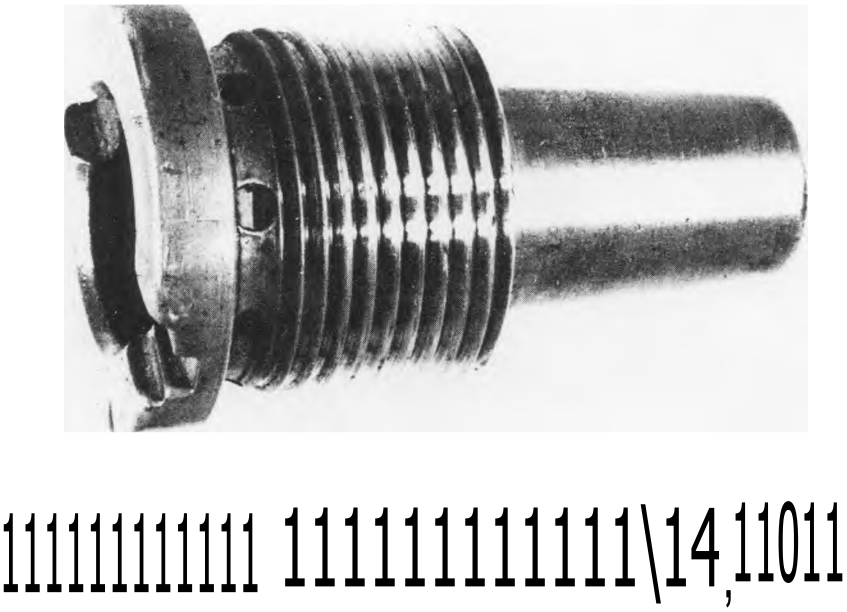


Figure 137. Brass Adapter for 3-Inch Absterdam Shell.

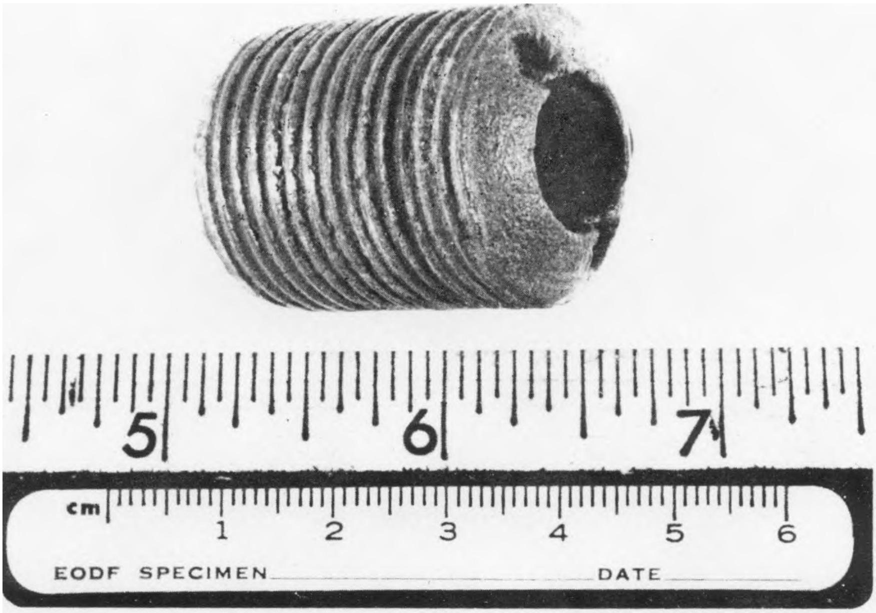


Figure 138. Zinc Adapter for Parrott Case Shot.

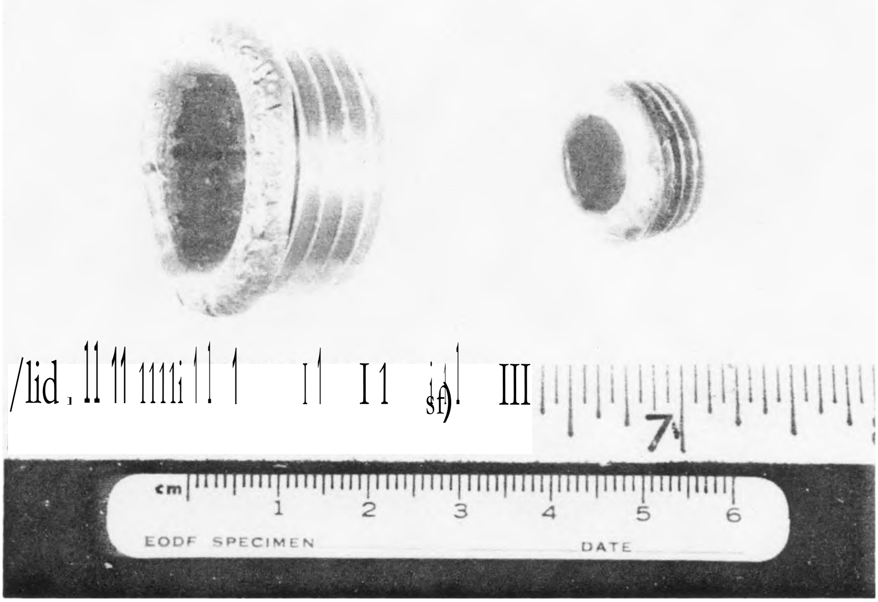


Figure 139. Brass Shipping Plugs for English Armstrong and Whitworth Shells.

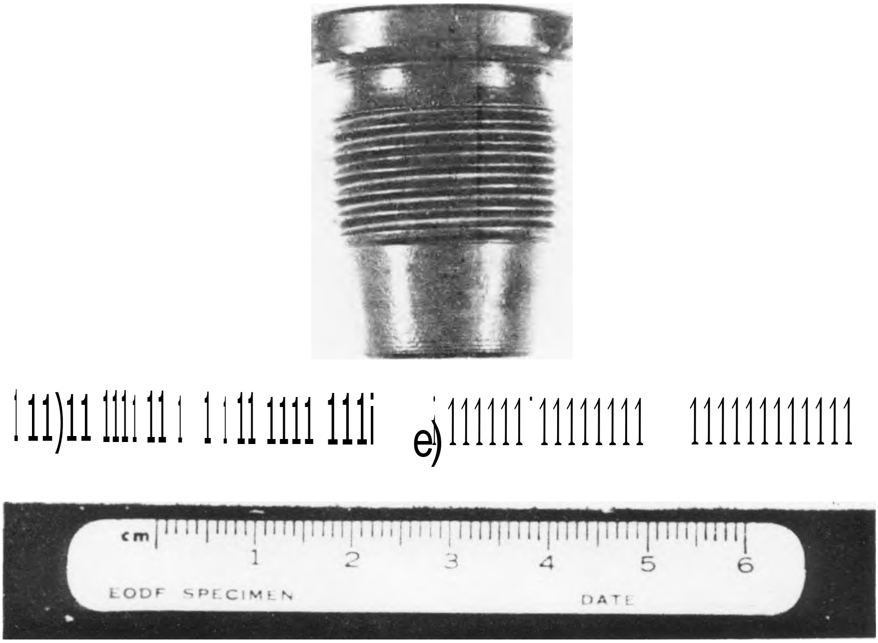


Figure 140. Copper Adapter for Spherical Shells and Case Shot.

Figure 141. Copper Adapters for Conical Shells and Case Shot.

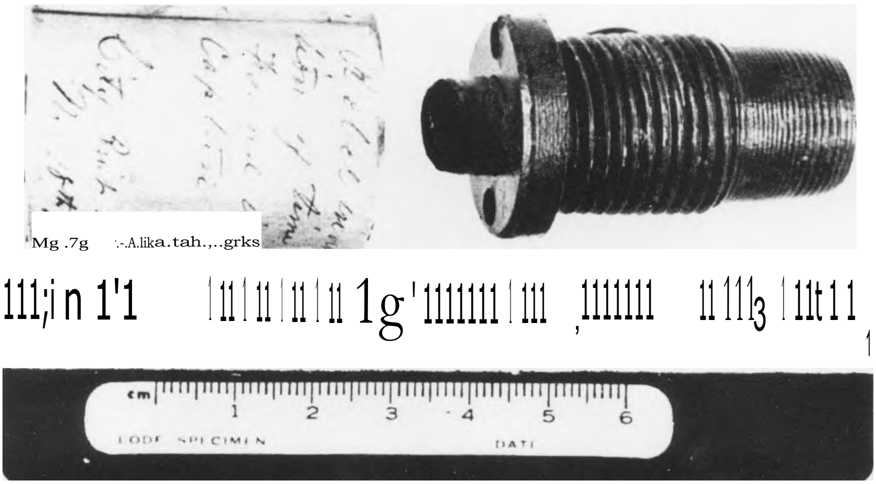


Figure 142. McEvoy Igniter for Paper Time Fuzes.

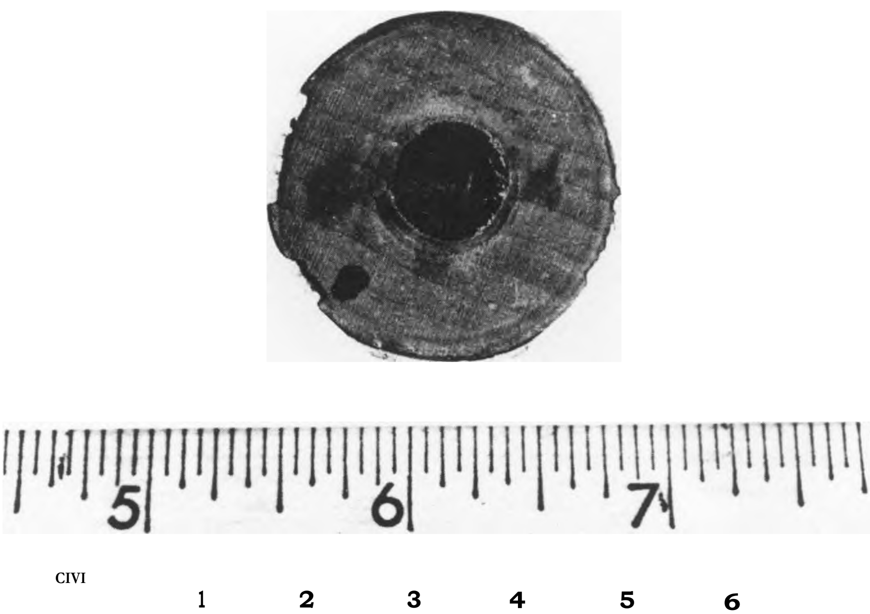


Figure 143. Top View of McEvoy Igniter.

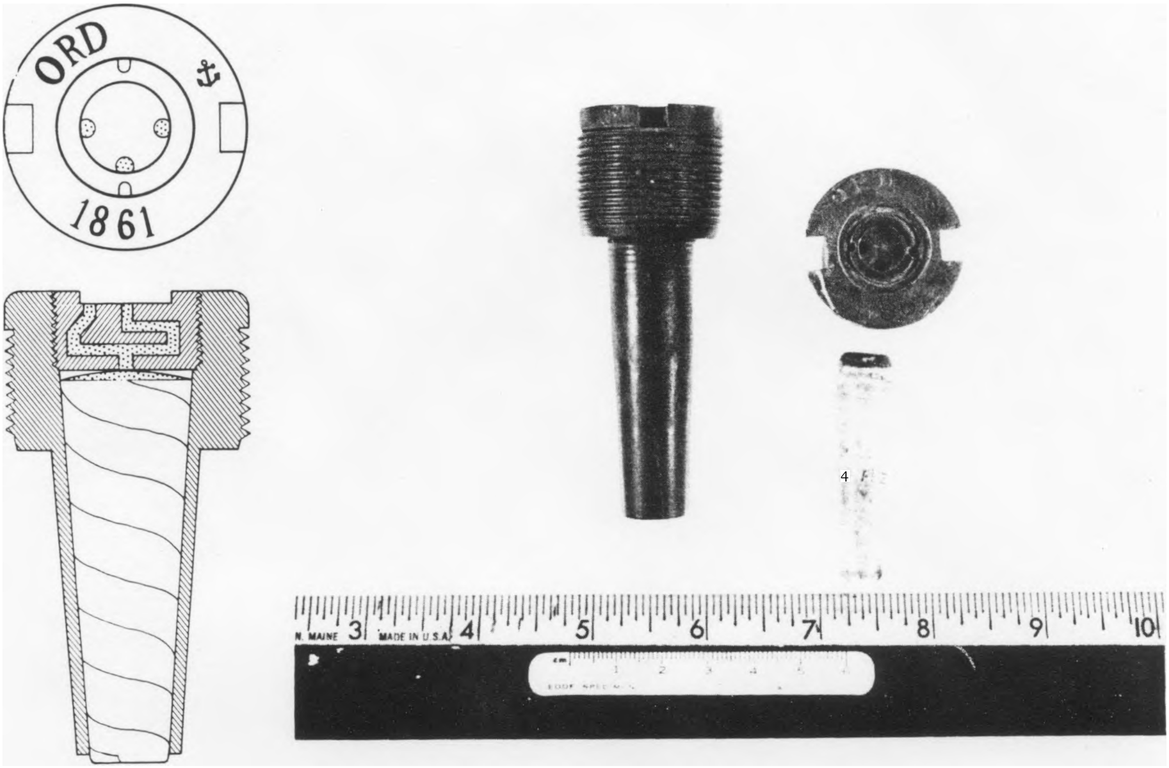


Figure 144. Brass Naval Water Cap Adapter.

The Naval water cap adapter is identified by its two-square-spanner slots with a screwed in plug (water cap), containing three small holes, in its center. It is made of brass, with a 1 1/4-inch diameter, and a length of 2 7/16 inches or longer depending on the size of the shell. It is a watertight adapter designed to hold the standard paper time fuze. Upon firing, the propellant gases ignite powder in the channels of the water cap. Flame from the burning powder is transmitted to the internal time fuze; the burning in turn, sets off the main bursting charge. Should the projectile enter the water prior to bursting, water entry into the fuze will be hindered both by the angled channels and also by the gases escaping.

Also found without threads, its seacoast counterpart is featured in Figure 145. The water cap fuze is normally used in smoothbore ordnance, although some have been recovered in rifled projectiles as shown in Figures 106 and 107. Figure 106 has an unconventional adapter added to receive the fuze.

4. Seacoast Water Cap Fuze

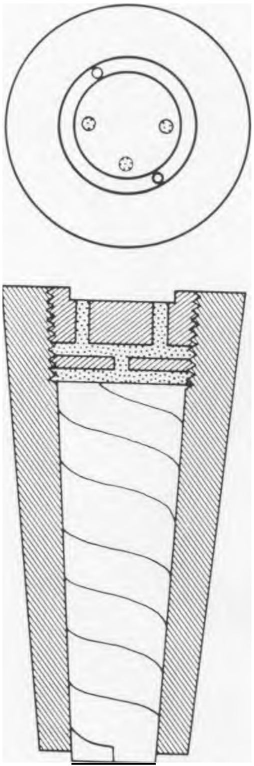


Figure 145. Seacoast Water Cap Fuze.

The Seacoast water cap fuze is principally distinguished from the mortar fuze by a metal water cap, constructed to prevent the burning composition from being extinguished when the projectile strikes against water. It is composed of a brass adapter which is driven firmly into the fuze hole of the projectile; a paper fuze inserted into the adapter, immediately before loading the piece; and a water cap screwed into the adapter after the paper time fuze has been inserted. The water cap is perforated with channels which is filled with mealed powder; the mealed powder communicates fire to the paper fuze, and the angles of the channel break the force of the water. The top of the cap has a recess which is filled with a priming of mealed powder, and is covered with a lead disk to prevent accidental ignition before loading. In firing over land, for the sake of economy, the brass adapter was replaced by the wooden adapter.

Using a flat trajectory of firing, the gunners using the water capped fuze, could skip their shells across the surface of the water without danger of having their time fuzes extinguished. The shell would strike the hull of the vessel, sink, and achieve an underwater blast.

5. Bormann-Time Fuze

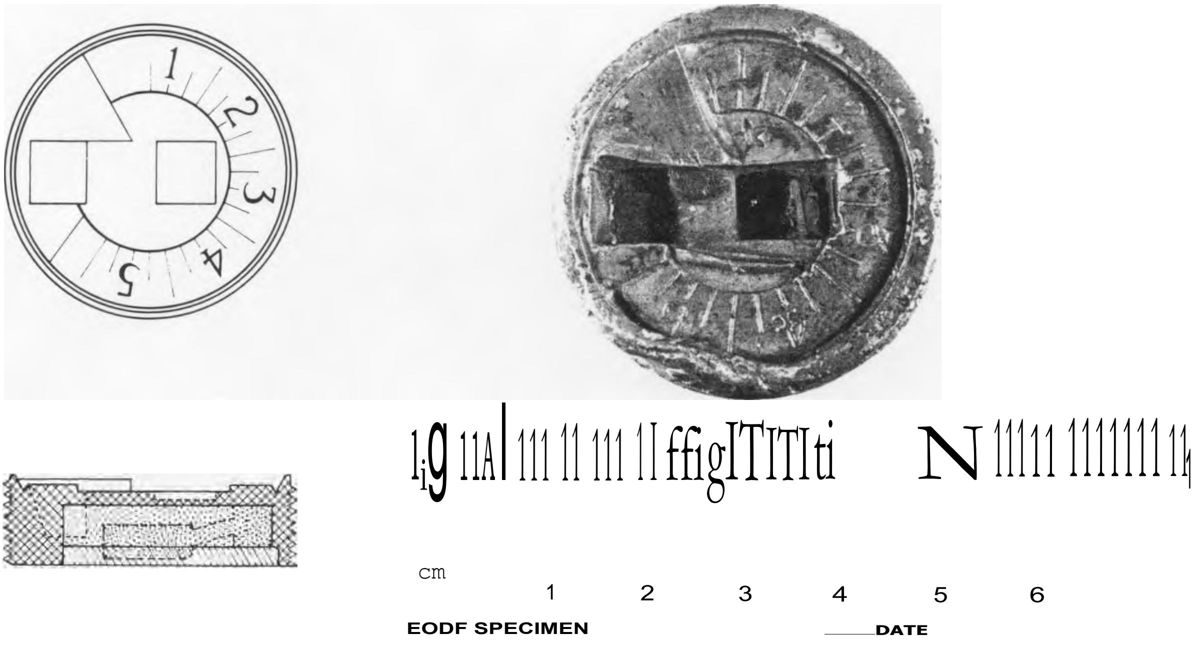


Figure 146. Bormann-Time Fuze.

The Bormann-Time fuze is identified by its lead alloy body with numbered time graduations from 1 to 5 seconds encircling the face of the fuze. This fuze is normally used with smoothbore projectiles although some have been noted in rifled shells, see Figure 86. It is 1 5/8 inches in diameter and 7/16-inch thick. Prior to use, the top of fuze case (over powder ring) is cut or pierced at desired time setting. Upon firing, propellant gases enter this cut and start black powder burning around time ring; after preset time, powder burns into central hole which in turn transmits the flame to the main charge.

It was one of the most popular smoothbore projectile fuzes in use during the Civil War. The fuze was used both by the Union and Confederates. Later in the war the Confederates replaced the Bormann with the paper time fuze fitted into their copper fuze adapter. Directly beneath all Bormann fuzes will be found a brass or steel plug with a small central hole to pass the flame. This plug is threaded into a reduced diameter hole and serves to support the center of the fuze from the forces of setback.

B. PERCUSSION FUZES

1. Absterdam Percussion Fuze

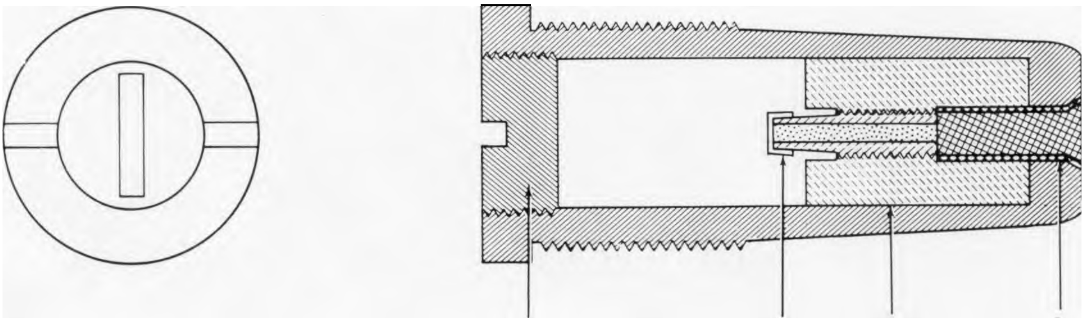
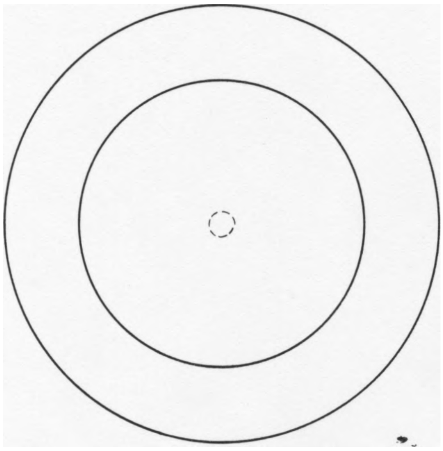


Figure 147. Absterdam Percussion Fuze.

Issued in a patent to John Absterdam on February 23, 1864, the Absterdam percussion fuze was constructed of a zinc-like material. In outer configuration this fuze is very similar to the Hotchkiss percussion fuze and was usually encountered without markings. It has a diameter of 1 3/16 inches and a length of 2 11/16 inches. In operation, at discharge of the gun, the plunger (C) remains to the rear due to setback and the restraint caused by the retainer (D). Upon impact with the target, impact inertia pulls the hollow lead retainer (D) from its wedged position, and the plunger (C) with percussion cap (B) attached moves forward striking the cap against the anvil (A). This fires the cap which flashes through the plunger and rear of the fuze into the bursting charge. During storage and shipment the only safety is the lead retainer. This fuze is one of few which has a feature built in to counteract the force of creep. This provision was purely accidental as the main function of the plunger retainer was for safety in handling. Absterdam stated in his patent claim that his fuze could withstand a drop from 12 feet and still retain the plunger. He further stated that the plunger need not be charged with its center core filled with powder.



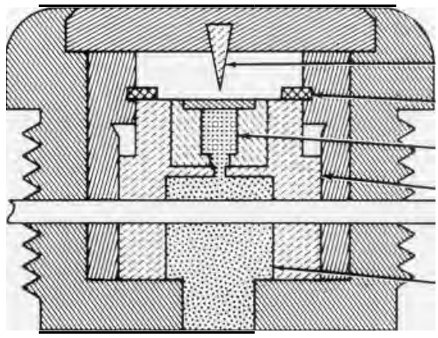


Figure 148. English Armstrong Percussion Fuze.

An imported fuze from England and in use by the South, the Armstrong percussion fuze consisted of a solid brass body with a crimped sealed closing anvil. Its free moving plunger was kept immobile by a stowage and handling safety pin and further restrained upon removal of the safety pin by four lead projections. In operation, prior to inserting the fuze into the projectile, the safety pin (E) is removed and the fuze screwed into the fuze cavity.

Upon impact with the target, the plunger (D) drives forward shearing the four lead projections (B). As the plunger continued its forward movement, the fixed steel needle (A) pierces a thin brass foil and stabs the fulminate mixture (C); the fulminate mix flashes the black powder charge (F) which communicates the flame into the projectile main charge.

The Armstrong fuze was used in the projectile shown in Figure 12 on page 20.

3. Hotchkiss Percussion Fuze

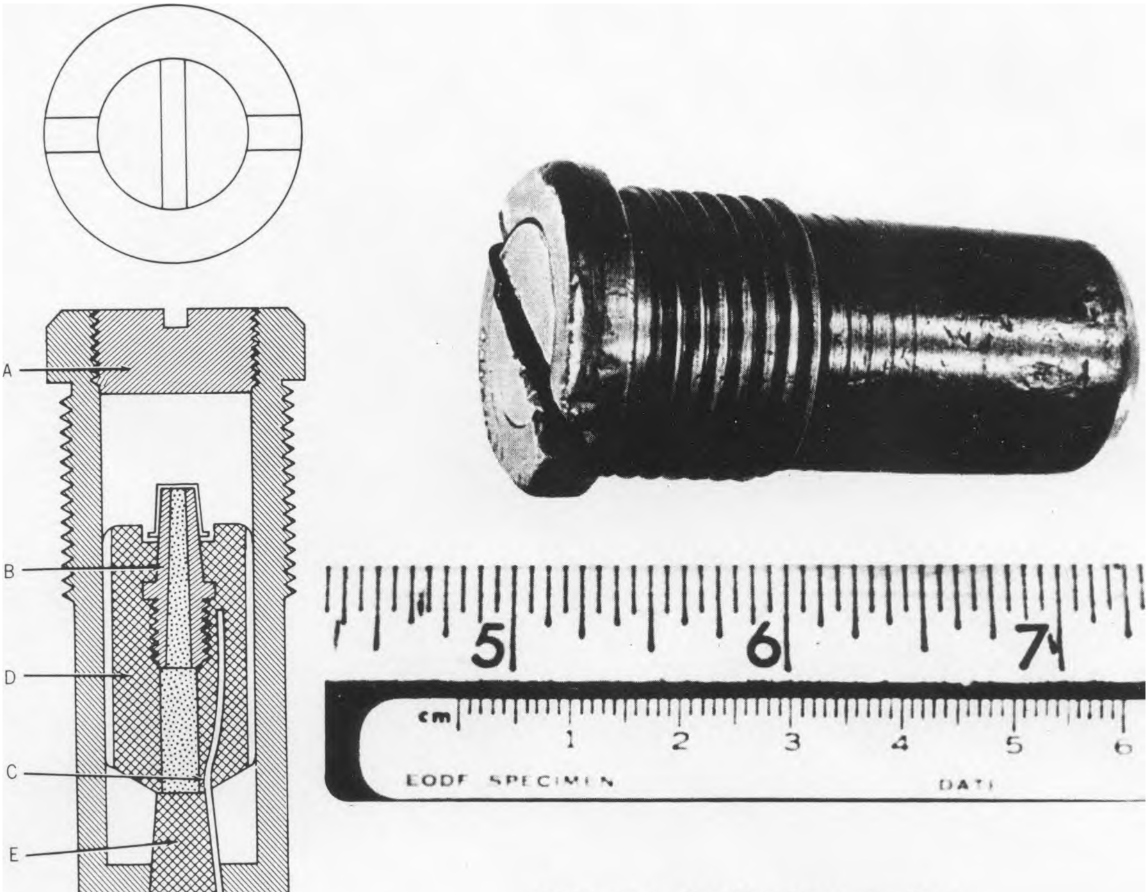


Figure 149. Hotchkiss Percussion Fuze.

Constructed of brass, the Hotchkiss fuze is normally found without markings, however, an occasional one will appear with the Hotchkiss name and patent date. Externally, it is quite similar to the Schenkl percussion fuze. The Hotchkiss is 1 1/4 inches in diameter and 2 3/8 inches in length. In operation, prior to firing, the restraining wire (C) holds the plunger (D) in a safe position. The wire is in turn anchored to the fuze base opening by a lead plug (E); upon firing, the lead plug (E) moves to the rear into the projectile freeing the plunger (D). Upon impact with the target the force of impact drives the plunger with percussion cap **(B)** attached forward and strikes the anvil (A). Upon being struck, the percussion cap spurts flame directly into the main projectile filler. A disassembled view of the Hotchkiss is shown in Figure 150. Figure 151 shows a Hotchkiss fuze patented in May 1864, that uses the Sawyer principle.

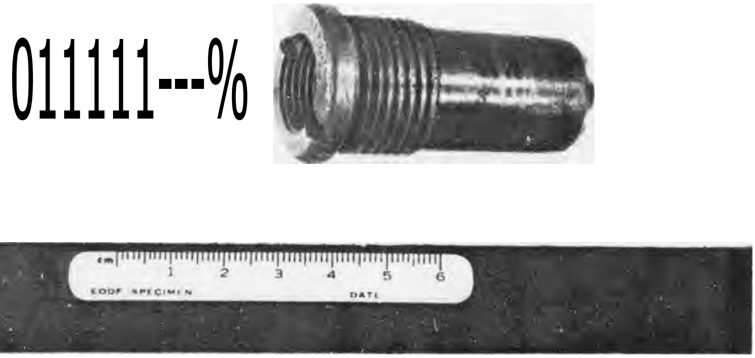


Figure 150. Hotchkiss Percussion Fuze (disassembled view).

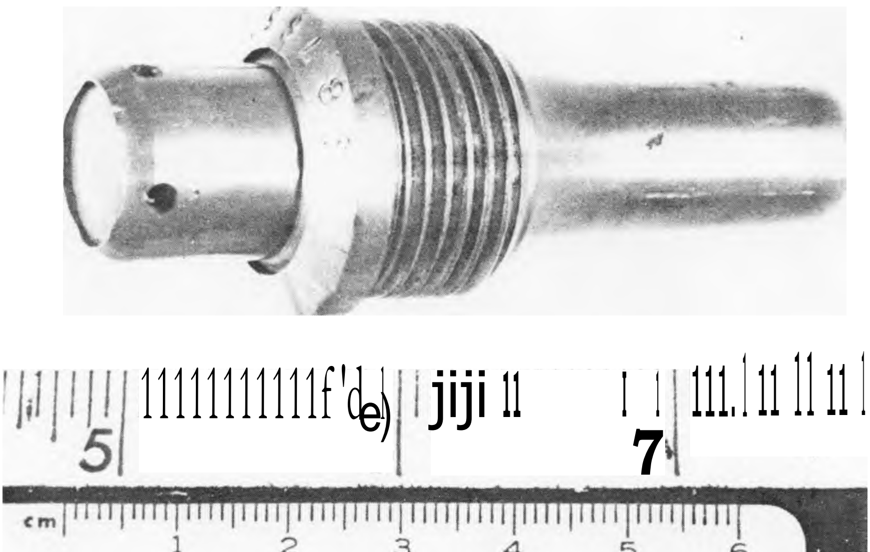


Figure 151. Hotchkiss Percussion Fuze (model 1864).

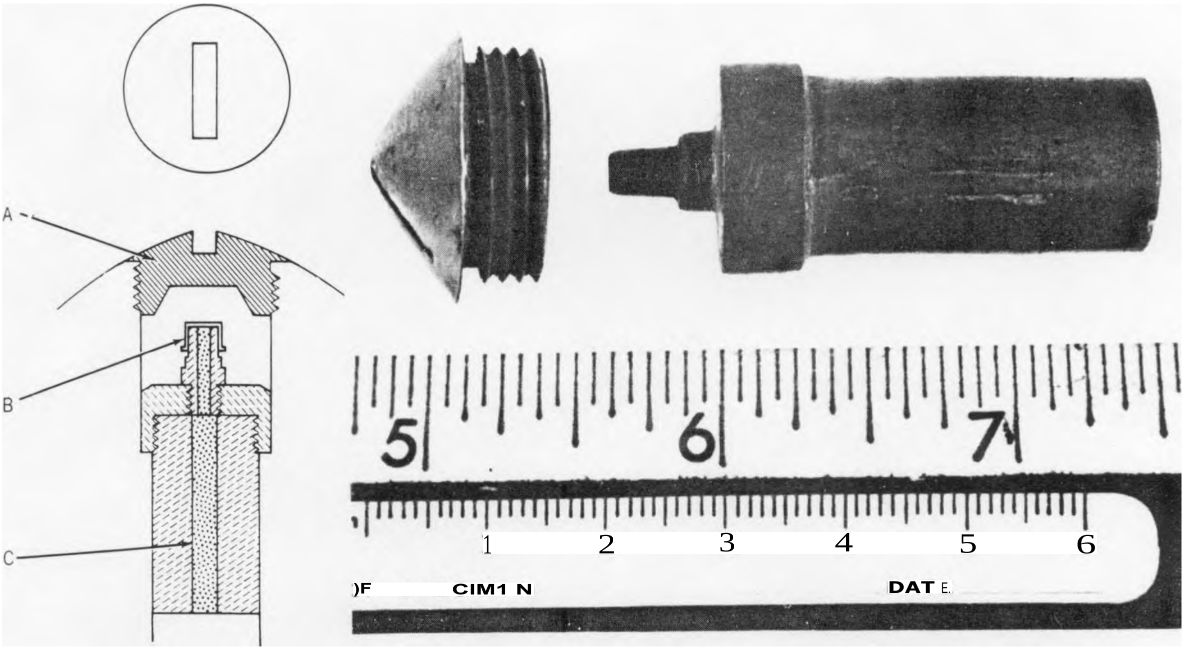


Figure 152. James Percussion Fuze.

Used only in the James Projectile, it is constructed of a simple brass or steel closing plug which serves as the fuze anvil and a free sliding plunger. The fuzing system does not utilize a fuze body in the normal sense, instead, the shell body serves to retain the plunger and provides a threaded hole for the fuze anvil. Upon impact with the target, the force of impact inertia carries the plunger (C) forward with the cap and nipple (B), striking the brass or steel anvil (A). The resulting flash of flame is spurted down to the main shell filler through a small hole in the plunger. This type of fuze is a copy of the Bourbon Percussion fuze which was invented well before the Civil War. In a slightly modified form, this fuze has also been found in Confederate field artillery projectiles. Figures 45 and 55 are projectiles using this system of fuzing. The James fuze is an extremely dangerous fuze because of the lack of any safety features. The fuze and shell should be carried in a base down attitude.

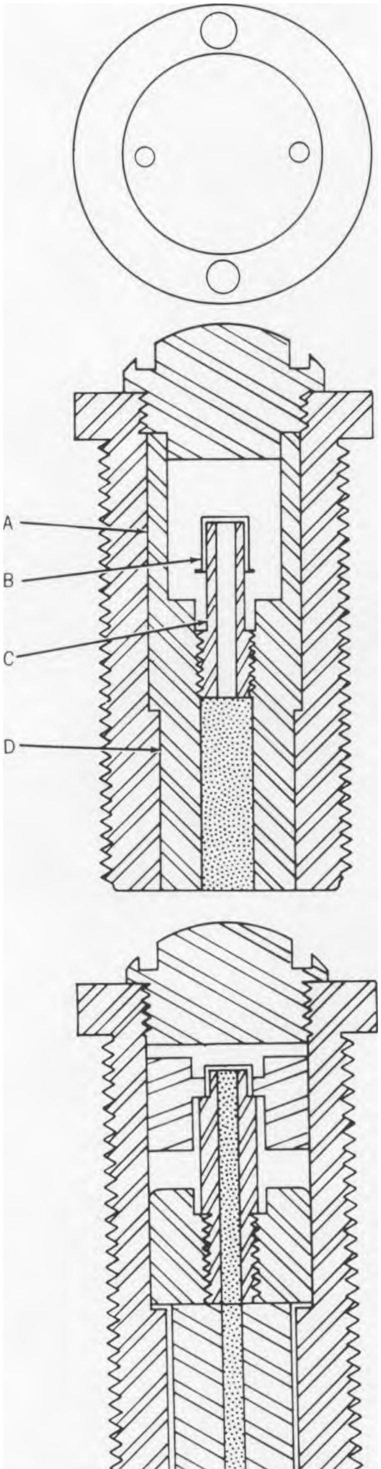


Figure 153. Parrott Percussion Fuze.

The Parrott Percussion fuze is identified by twin-spanner holes in anvil and fuze body and a slightly dome shaped anvil. It is made of a zinc material, and rarely found in good condition because of corrosion. Upon being fired, centrifugal force shears off the two leaves (A), freeing the plunger (D). Impact with the target carries the plunger forward, crushing the cap (B) against the anvil. The flash is transmitted through the nipple (C). The second line drawing illustrates the second model fuze. Its safety feature was a collar having two projections of soft metal. This collar was placed between the plunger and anvil with the projections shearing off on impact the forward motion of the plunger. The fuze is 1 3/8 inches in diameter and 2 5/8 inches in length. The safety devices often interfered with the plunger and caused duds.

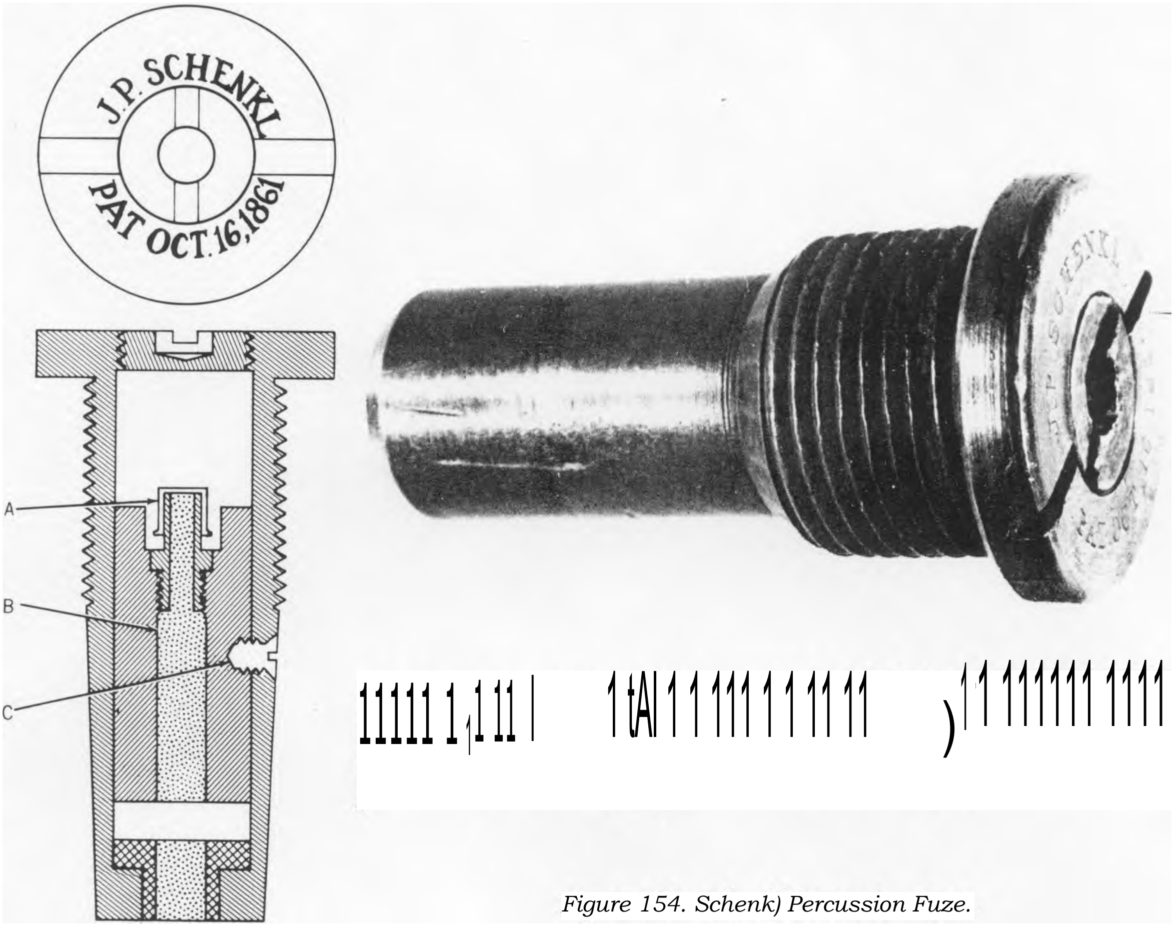


Figure 154. Schenk) Percussion Fuze.

Identified by a large brass body, the Schenkl fuze is normally stamped with the patent date. The fuze head is slotted completely across including the anvil. The center of the anvil has a countersunk recess which serves as a "turn around" feature for safety in handling. This recess is presented to the plunger, should the fuze be dropped prior to firing. Prior to firing, the anvil is unscrewed and reversed so that a flat surface is presented to the plunger. Upon firing, the force of setback drives the plunger **(B)** to the rear breaking the shear screw (C). Upon impact with the target, the force of impact drives the plunger forward, crushing the percussion cap (A) against the fuze anvil, firing the cap, which flashes through plunger and bottom of the fuze body. This fuze is usually found in the Schenkl shell, although some are noted in case shot rounds. The fuze has been noted in two sizes. Figures 155 and 156 are the original patent model that was presented for patent rights in 1861.

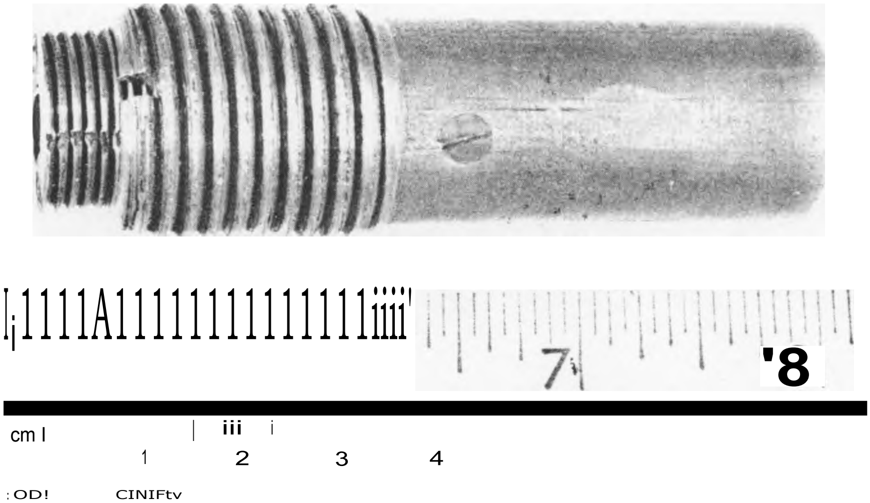


Figure 155. Schenkl Percussion Fuze (patent model).

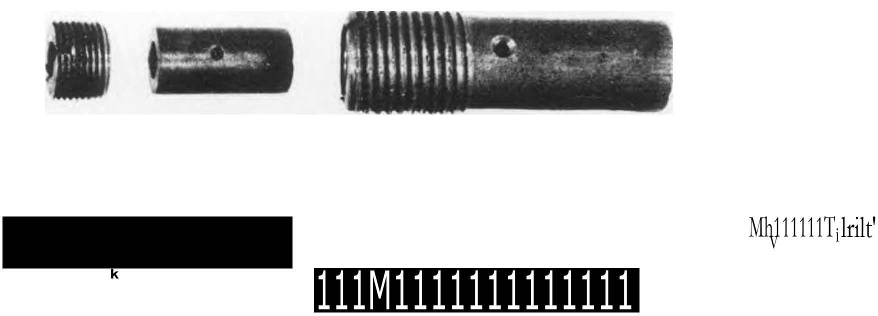
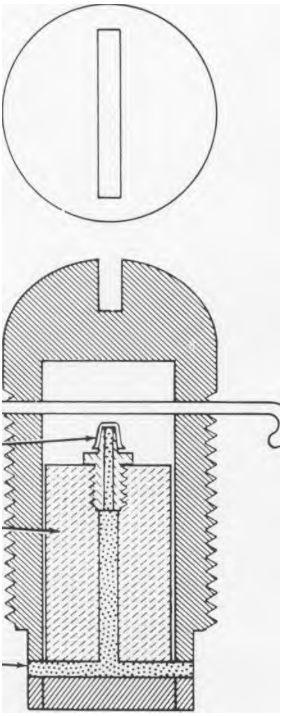


Figure 156. Schenkl Percussion Fuze (disassembled view).

7. Confederate Percussion Fuze



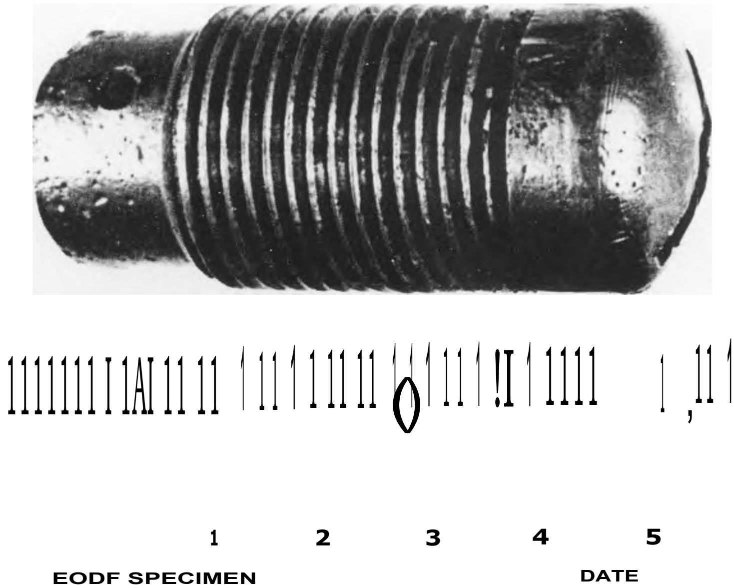


Figure 157. Confederate Percussion Fuze.

The Confederate fuze was designed for the Brooke and Mullane shells and is identified by all brass construction with a flat or dome shaped head. The fuze head is slotted and does not have a removable anvil. The plunger (C) is inserted from the base of the fuze and retained therein by a steel pin (D). A safety pin (A) passes completely through the fuze body and is off center so as to retain the shoulder of the plunger from moving forward. Prior to loading of the projectile in the gun tube, the safety pin (A) is removed; at firing, the steel pin (D) prevents the plunger from any rear travel caused by the force of setback. At impact with the target, the plunger (C) drives forward crushing the percussion cap (B) against the flat inner face of the fuze head. The flame produced by the fulminate cap flashes the charged plunger thus detonating the main filler of black powder. Some models of this fuze have a flanged head similar to the Schenkl, but have the dome shaped head which is slotted and the absence of the removable anvil.

C. CONCUSSION FUZES

1. Alger Concussion Fuze

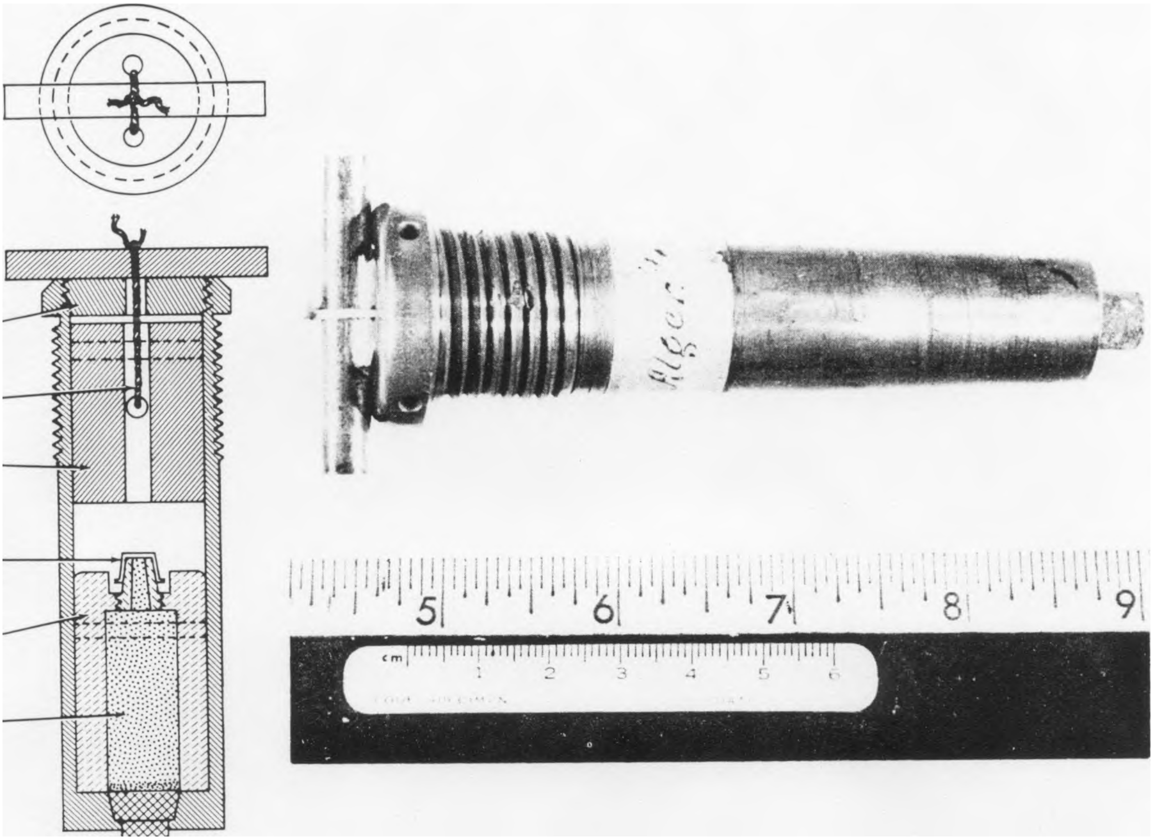


Figure 158. Alger Concussion Fuze.

The Alger fuze shown in Figure 158 is the original patent model of 1861, and the production model may have differed somewhat. The fuze consists of a solid brass body with a forward closure plug (A) and a small round bar welded across its face. Fastened to the closure plug by a piece of twine (B), was the free sliding anvil (C). Directly below the secured anvil is the plunger (E) which is anchored to the base of the fuze body by a lead plug (G). In operation, upon discharge from the gun, setback forces the weighted anvil (C) to the rear breaking the twine (B) which originally had the anvil restrained from moving under normal handling. The weighted anvil crushes the percussion cap (D) which in turn ignites the time composition mixture (F). At the end of the fixed burning time, the flash of flame is admitted to the main charge. It is thought that the fuze could be used as a percussion fuze by removing the time mixture and pinning the anvil with a steel pin. The hole in the anvil and the hole in the plunger would indicate this.

2. Ganster Concussion Fuze

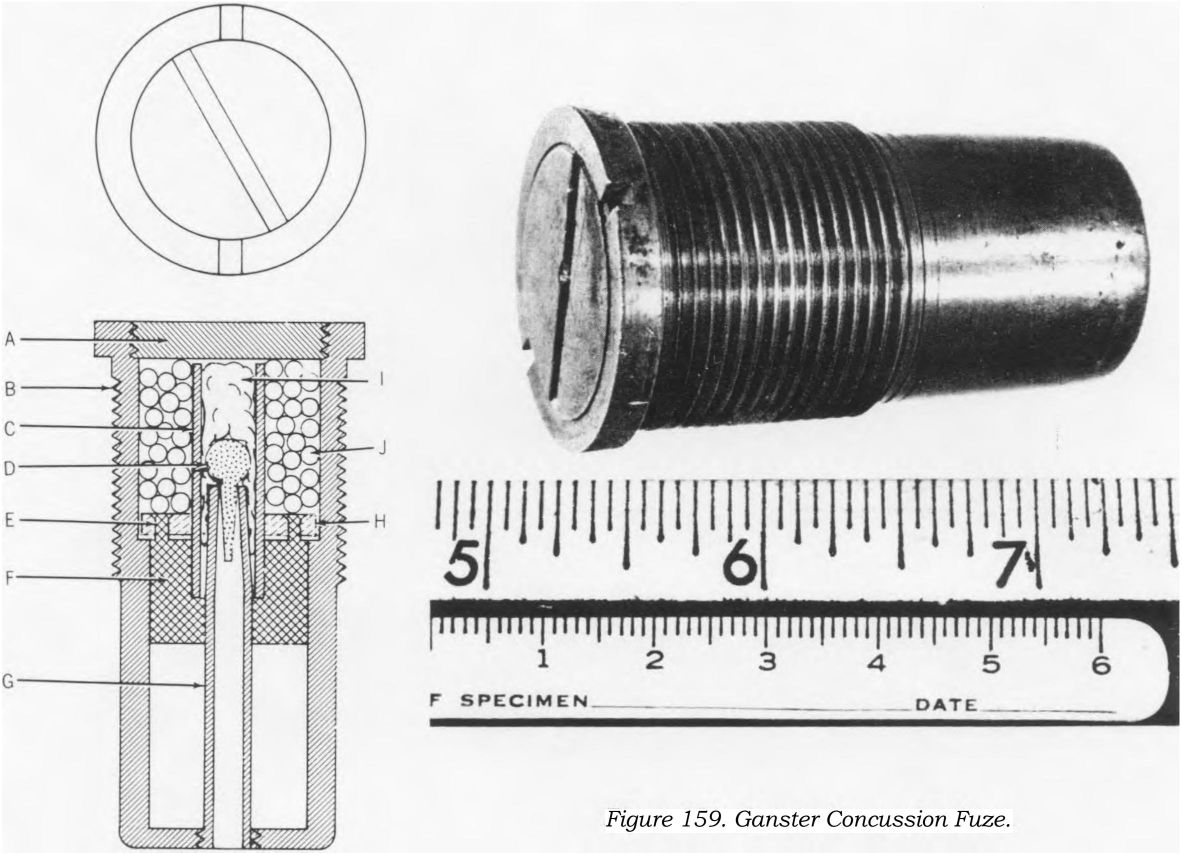


Figure 159. Ganster Concussion Fuze.

Issued in a patent to George P. Ganster on April 5, 1864, this concussion fuze body (B) was designed for spherical shells and had its exposed end closed with a threaded plug (A). The interior of the fuze was separated into two chambers by a steel plate (H). Screwed into the base of the fuze body and extending up through a hole in the center of the steel plate was a hollow brass tube (G). Mounted on the top of the brass tube was a capsule (D) filled with sulphuric acid having its exterior coated with a compound of potash and sulphur. Attached to the steel plate (H) and located directly beneath it was a lead setback weight (F). The setback weight contained a brass cylinder (C) that extended up through the steel plate (H) and protected the glass capsule (D) from being impacted by the small lead pellets (J). The capsule was further protected by cotton packing (I). On setback, the weight moved rearward shearing the two small rivets (E) and removed the protective brass cylinder (C). On impact the lead pellets crushed the capsule. The acid and compound would produce a flash down the brass tube (G) into the filler.

3. Tice Concussion Fuze

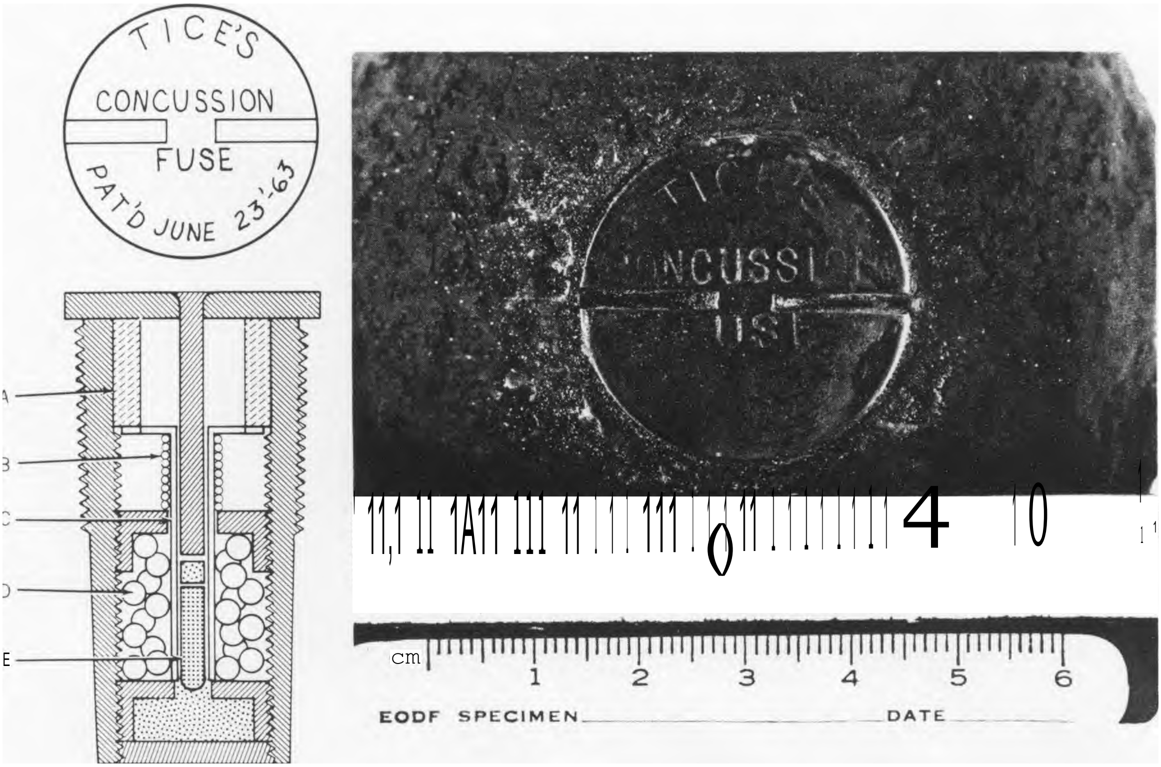


Figure 160. Tice Concussion Fuze.

The Tice fuze is identified by its all brass construction with no closing plug in the front and a spanner slot that does not cross the face of the fuze. If present, the Tice name and patent date further aids identification. Having a diameter of 1 5/6 inches and a length of 2 15/16 inches, the fuze has been recovered in both smoothbore and rifled projectiles. In operation, at firing, the setback collar (A) moves to the rear bending or shearing off the top of the safety tube (C); upon leaving the weapon, the safety tube spring (B) forces the safety tube forward, exposing a compound of fulminate of mercury and gun cotton (E) to the lead pellets (D). At impact with the target, the lead pellets crush the fulminate mixture which in turn ignites a small black powder charge. This charge blows out the lower closing plate and ignites the main filler. The Tice fuze is probably one of the most dangerous fuzes of its time. A radiographic study of any found should be made to determine if armed.

4. Confederate Concussion-Time Fuze

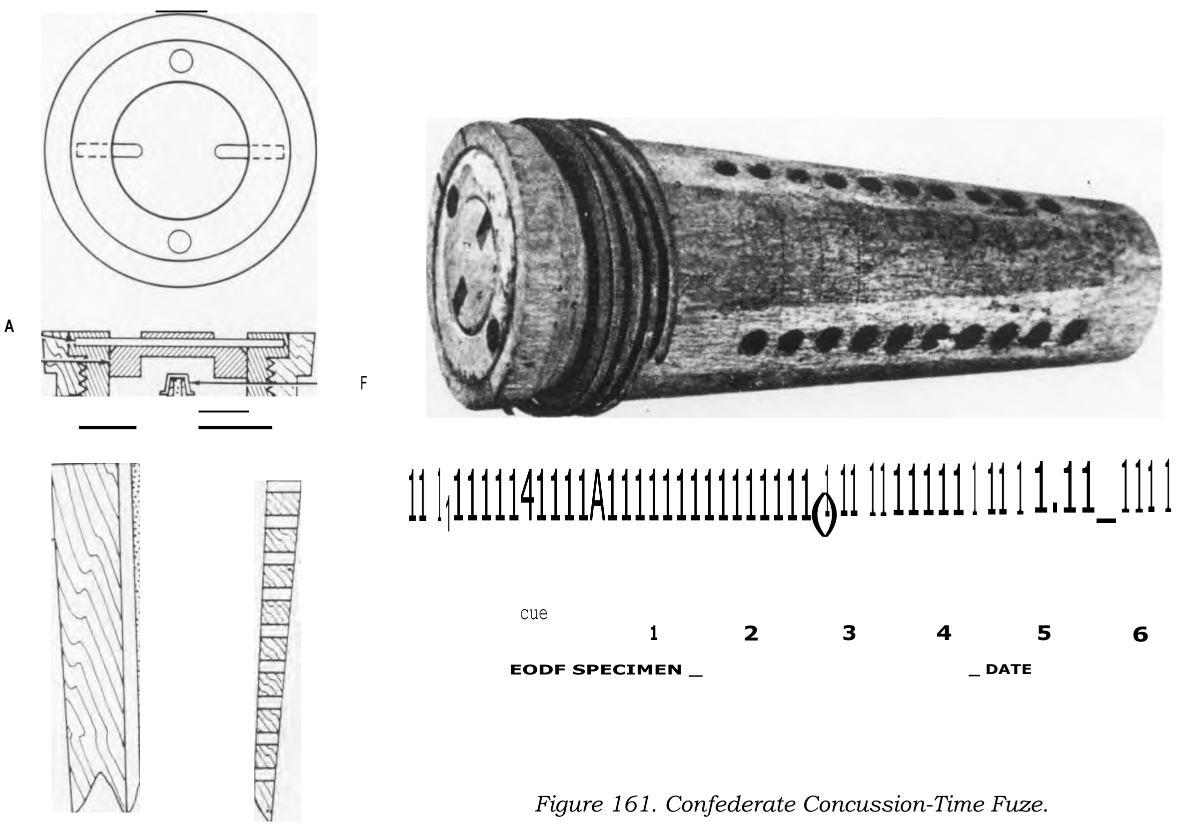


Figure 161. Confederate Concussion-Time Fuze.

Measuring 2 11/16 inches in length and 1 3/16 inches in diameter, the Confederate Concussion-Time fuze was constructed of a wooden body (E) with a common paper time fuze (D) inserted therein. A brass plug (C) containing a weighted brass anvil (B) held fast by a shear pin (A) was then screwed into the face of the wooden body. In the bottom center of the brass plug was mounted a nipple and its percussion cap (F). Although a time fuze in a wooden adapter by type, this fuze received its concussion classification by being initiated at discharge. In operation, the gunner would pierce a selected hole (G) in the fuze body with a gimlet to select desired time and the fuze was then placed in the projectile's fuze cavity. At discharge, the weighted brass anvil (B) would move to the rear shearing the shear pin (A) and would crush the percussion cap (F); the flash would ignite the time composition (D) which would burn down until the pierced hole (G) was presented; at this time the flame would leave the fuze body at right angles and detonate the main filler. It is used in spherical shells.

D. COMBINATION FUZES

1. Sawyer Combination Fuze

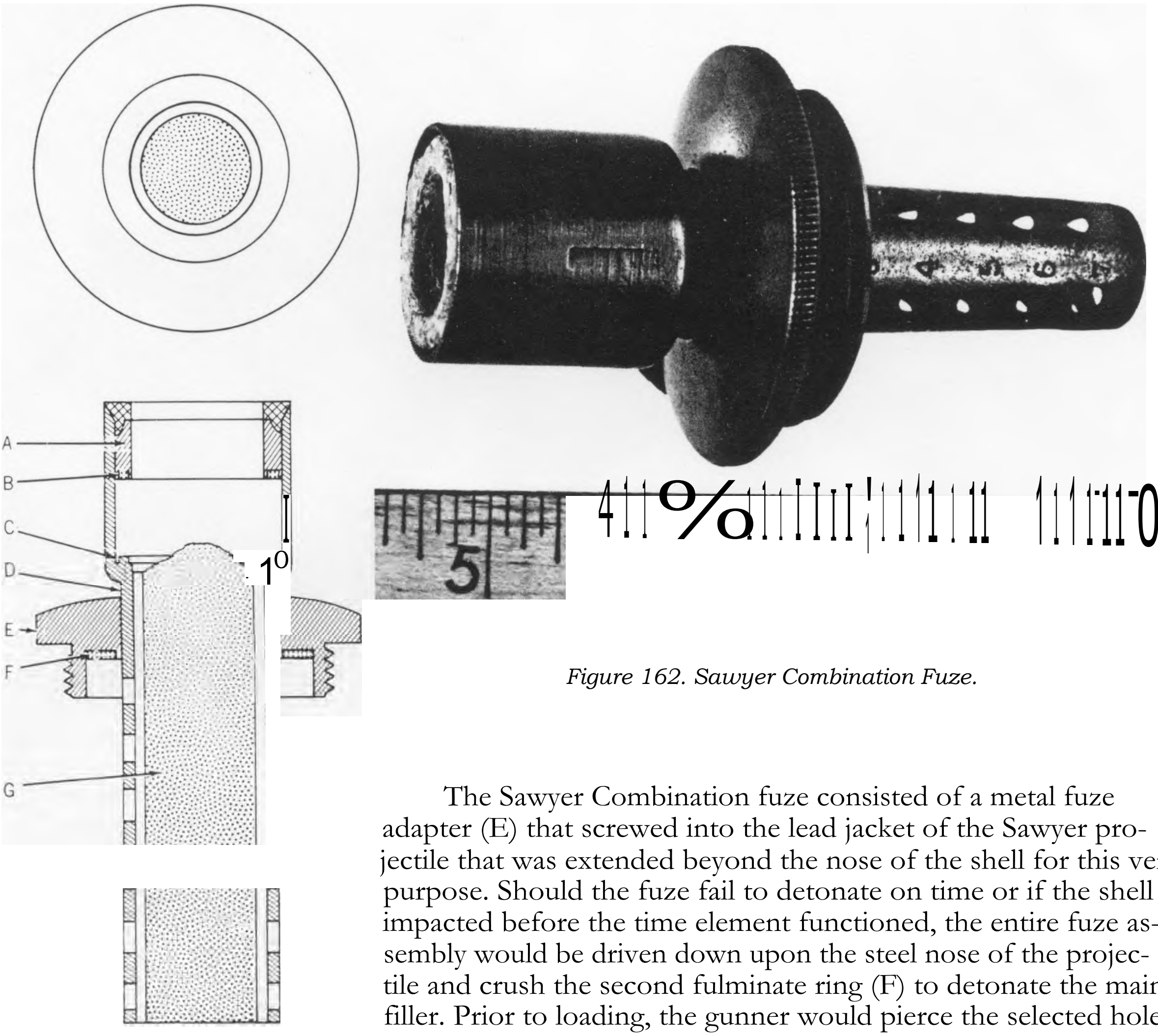


Figure 162. Sawyer Combination Fuze.

The Sawyer Combination fuze consisted of a metal fuze adapter (E) that screwed into the lead jacket of the Sawyer projectile that was extended beyond the nose of the shell for this very purpose. Should the fuze fail to detonate on time or if the shell impacted before the time element functioned, the entire fuze assembly would be driven down upon the steel nose of the projectile and crush the second fulminate ring (F) to detonate the main filler. Prior to loading, the gunner would pierce the selected hole (H) with a gimlet to gain desired time. Upon discharge from the gun, a lead and brass setback weight (A) fitted with a fulminate ring (B) would move to the rear crushing the fulminate ring (B) on the anvil (C) and ignite the time composition element (G) which is fitted into the fuze body (D). When the time element burned down to the selected hole that had been previously pierced, the flame would be transmitted into the main filler of the shell.

The brass body (D) was kept separated from the shell until needed, and the forward part of the fuze was normally closed with a cork to keep out moisture. The brass body has four rows of time apertures, the line drawing shows only two rows. The Union Sawyer projectile was unavailable for presentation in this manual.

2. Schenk! Combination Fuze

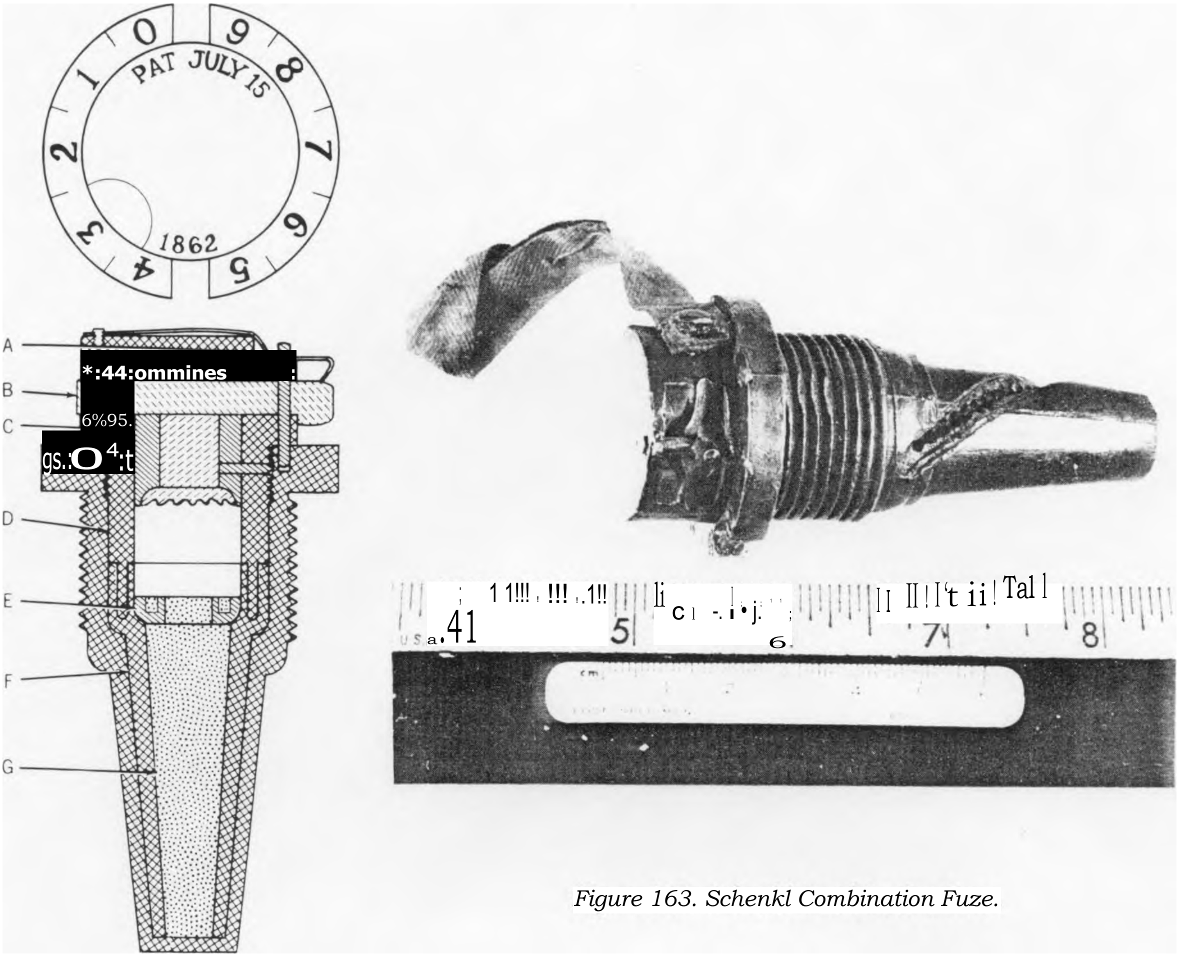


Figure 163. Schenkl Combination Fuze.

The Schenkl combination fuze was made of a pewter-like material with time graduations in seconds and patent date marked on its exterior. Having a diameter of 1 5/8 inches and a length of 2 13/16 inches, it was designed for the Schenkl family of projectiles. It is normally found in case shot. In operation, the detent latch (A) was lifted and the rotor cap (D) dialed in desired time by rotating the inner body (F) containing the time composition (G). The inner body has a series of holes fashioned in a spiral from top to bottom which will mate with one of a series of holes spiraling from top to bottom (opposite to inner body holes) on the outer fuze body. The safety pin (B) is removed and upon firing the serrated anvil drops and crushes the fulminate cap (E) which ignites the time composition (G). The outer body of the fuze was grooved along the series of holes in later models to accept a paste powder mixture to insure ignition of the main filler should it be away from the fuze.

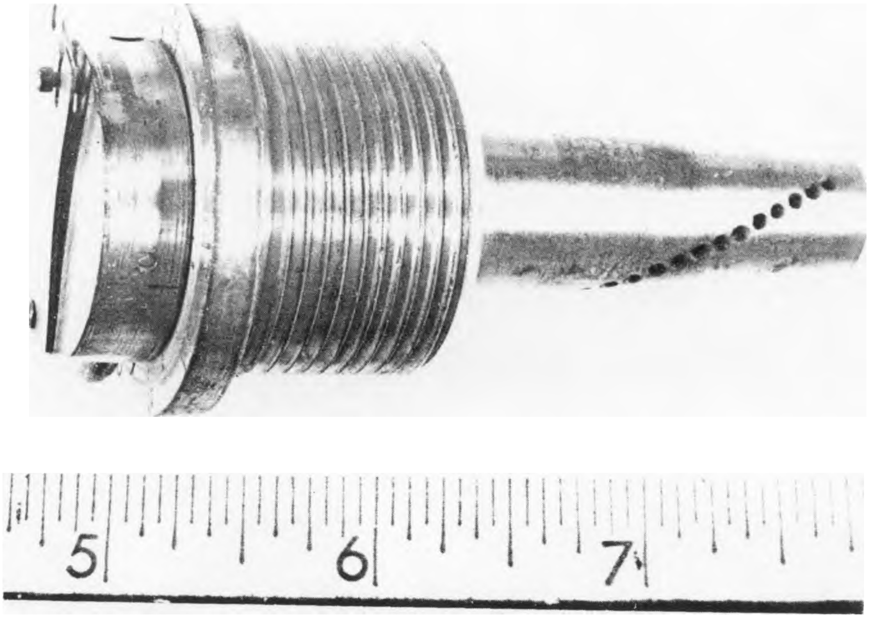


Figure 164. Schenkl Combination Fuze (patent model).

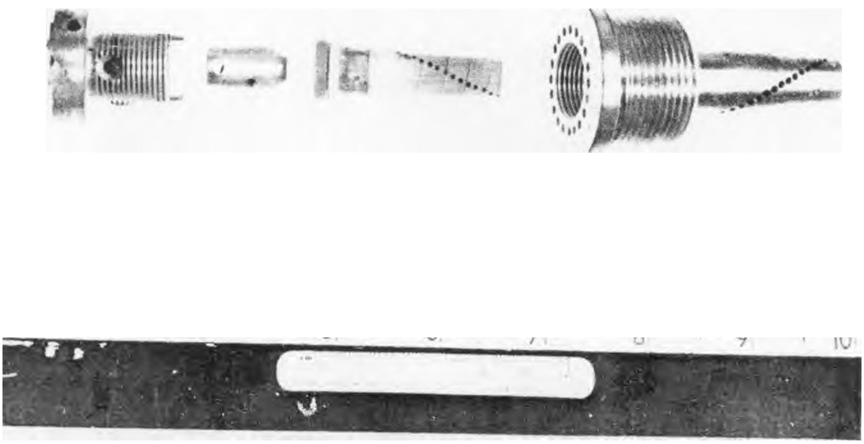
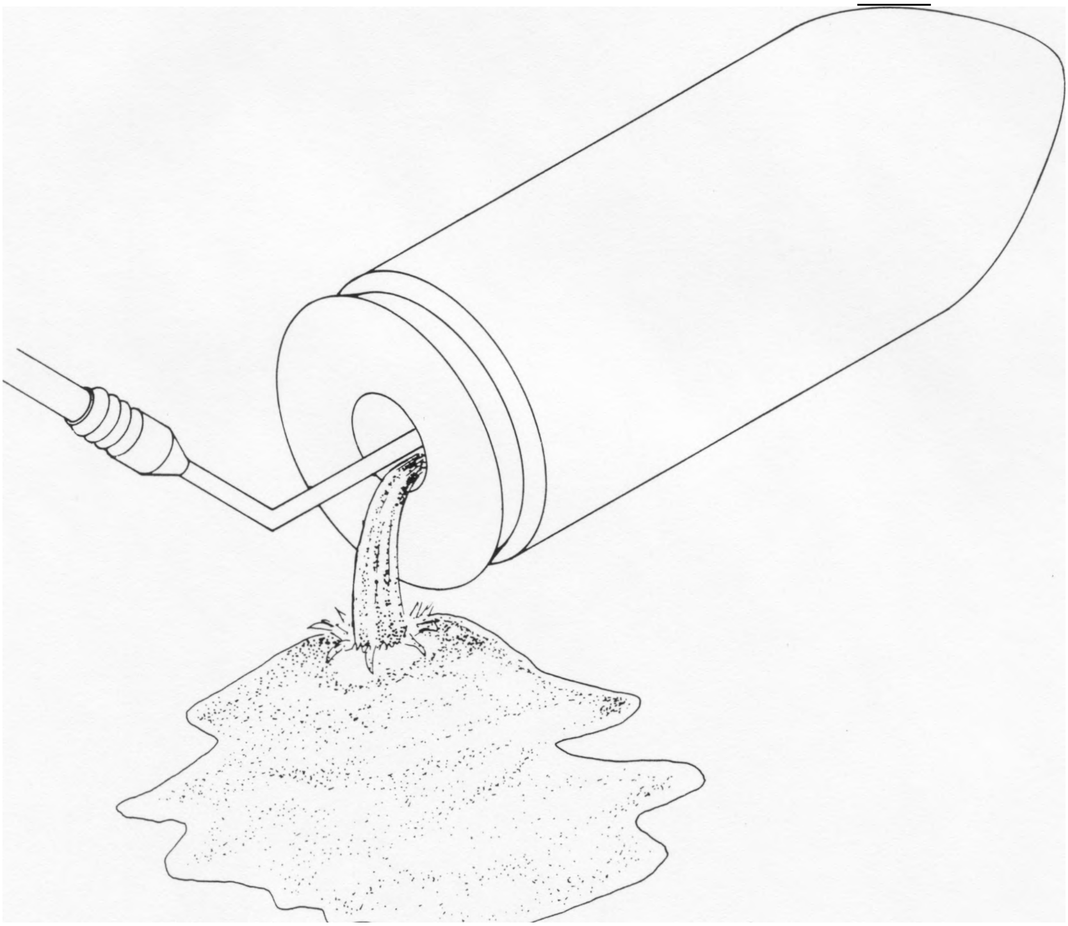


Figure 1 65 . Schenkl Combination Fuze (disassemble view).

PART VI

EXPLOSIVE FILLER REMOVAL AND SAFETY PRECAUTIONS



PART VI

EXPLOSIVE FILLER REMOVAL AND SAFETY PRECAUTIONS

A. INTRODUCTION

Documented guidance for the effective inerting procedures of Civil War munitions was hitherto nonexistent. The information and techniques that follow in this chapter are, for the most part, based on experience gained by members of Explosive Ordnance Disposal Unit Two, Charleston, South Carolina, during the period from **1954** to 1968; and on recent investigations.

Description of projectile design and fuze operation available to the EOD technician, in the early years, consisted of private endeavors of a few interested military personnel and civilian collectors. The first recognized breakthrough, since General Abbot wrote "Campaigns Against Richmond" in 1867, came with LTC Frank Hackley's manual in 1960. Later publications by McKee and Mason, Dickey and Kerksis, and Warren Ripley have provided a vast source of information and data on identification. With the sources available now on identification and modern radiographic technology, today's EOD technician can safely and effectively make a professional approach to this once obscure era of explosive ordnance.

The development and growth of rifling for artillery during the Civil War period was a substantial contribution to our modern systems. Fundamental experiments in armor piercing, projectile configuration, fuzing principles, and gun tube construction were born in wide diversity and provided a "state of the art" legacy for the conflicts to come. These important facts make artillery ammunition of the Civil War a historical benefaction to students and curators of American history in warfare.

The Centennial celebration of the Civil War sparked renewed interest in artillery ammunition by Federal, State and local museums and Park services.

Since 1961, hundreds of explosive loaded projectiles have been turned in to EOD teams for inerting. A few disposal teams have been quite successful in turning over a desirable and inert product with their success based on experience gained through early trial and error methods. Some other teams have experienced unfortunate returns resulting in damaged and unprofessional byproducts. The unfortunate incidents can be attributed to the lack of technical guidance on how to safely inert Civil War ordnance and an evaluation of professional ethics involved.

As viewed by civilian authorities, military ordnance disposal teams are the major source to obtain competent and professional inerting assistance. Part VI is presented to help augment new information and ideas to the Explosive Ordnance Disposal library and further assist our professional posture.

B. BREACHING THE PROJECTILE

Prior to breaching a black powder filled projectile, either spherical or conical in shape, the item should be submerged in water for a minimum of 24 hours.

Projectiles having a wooden or metal time fuze adapter should be placed in hot water and ptobed after the first hour of soaking. While probing the time fuze, keep the fuze opening completely submerged. Using a brass or copper probe, the time fuze composition may be gently removed from its paper wrapping. The necessary removal of the time fuze composition, which is in a pressed form, will insure the water entry into the main charge.

Spherical or conical projectiles fuzed with other than a time fuze adapter, i.e., percussion, combination, and concussion, where water entry is difficult, should be submerged in cold water in an attempt to cause internal condensation of water. The 24-hour soak for these projectiles is to allow for water to enter through possible undetectable openings, i.e., fuze threads, cracks, and casting flaws.

The main purpose for the submerged soaks is an attempt to get water in contact with the black powder filler in preparation for breaching the projectile casting. A discussion of black powder and its solubility in water follows in Paragraph C.

The availability of good quality high-speed metal twist drills will determine the success of the drilling operation. For best results, use a name brand high-speed Cobalt Twist Drill. Carbide tipped drills should be used only as a second choice due to the chipping that occurs on the cutting edge. The cast-iron projectile casings manufactured in the Civil War period have a high carbon content. Casings will be found to have large casting flaws and will have both soft and hard spots that are a challenge to the best of drills. The projectile castings of the Schenkl type will be found to be the most difficult to penetrate.

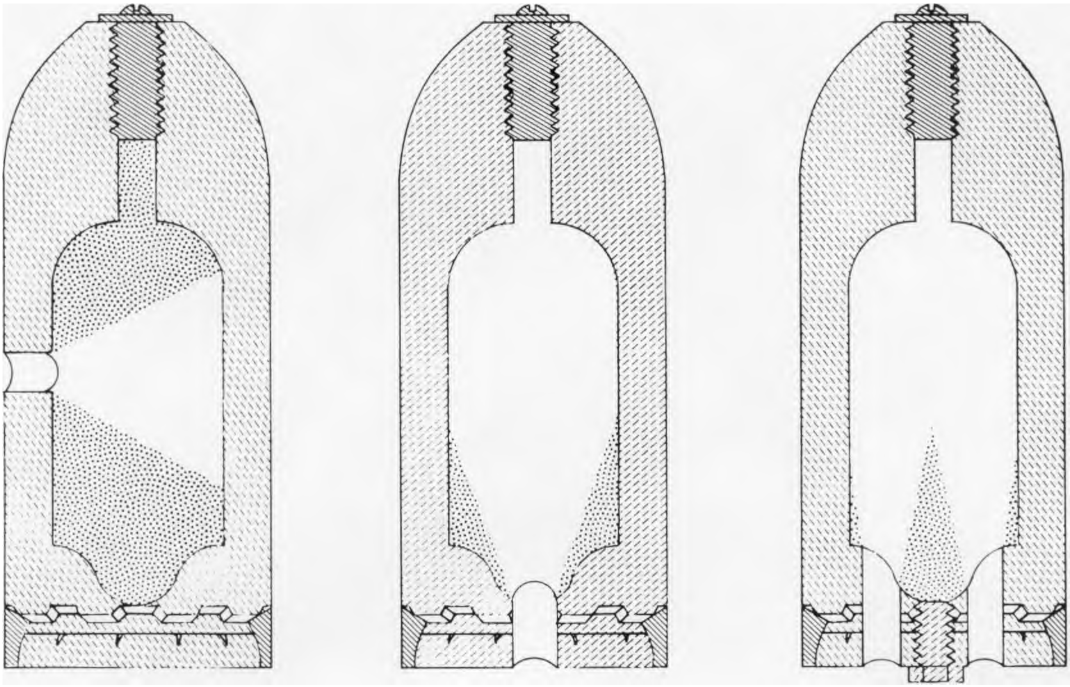


Figure 166. Comparison of Breaching Points.

The location of the breaching point will determine the ultimate effectiveness of the black powder removal. In years past most projectiles have been breached by use of the side entry technique. This position is more easily adapted to the drill stand than either the base or dual-base entry position. Figure 166 is presented to show the comparisons of breaching points and to show the more preferred point of entry. Theoretically, and as shown in "A," the side entry technique is the least preferred if maximum access to the main filler is to be gained. Even if several holes are pierced around the projectile's circumference, powder can be inaccessable in both the nose and the base. And as a second consideration, numerous holes in such a historical relic are unsightly and unnecessary. The single and dual-base entry technique will provide the most favorable access for direct contact with the filler by the washout nozzle, Figure 172, and nonsparking scrapers fashioned out of 1/8-inch and 3/16-inch brass brazing rods. For projectiles up to 3 inches in diameter, a 1/2-inch minimum size hole should be drilled. Projectiles of larger diameter will necessarily require a much larger hole if convenient access is to be achieved.

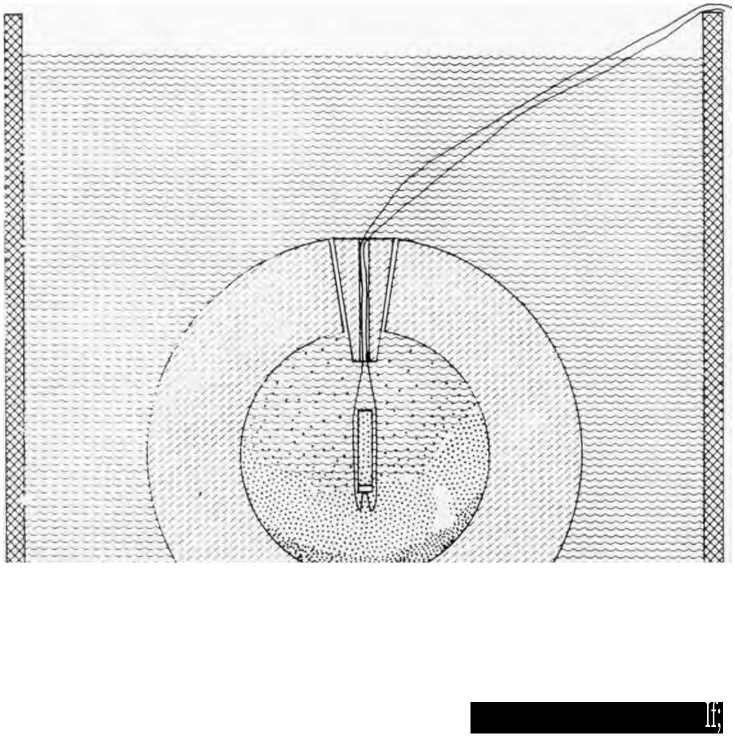


Figure 167. Removal of Mortar Fuze by Blasting Cap.

Breaching the spherical projectile is by far the least difficult as compared to the conical shell. For projectiles containing the Bormann, Naval Water Cap, Tice, and the variety of metal adapters for paper time fuzes, a hole should be drilled directly opposite the fuze. For projectiles fitted with any of the wooden adapters for paper time fuzes, a quick and effective method of removing the wooden adapters, as described below, can be employed. The inside of the projectile must be completely filled with water and a No. 8 electric blasting cap inserted in an inverted position halfway into the shell's interior. This prepared assembly is then placed into a vessel of water with at least 6 inches of side clearance in all directions. When detonated from a remotely safe area, the blasting cap will cause enough internal pressure to blow out the adapter intact and loosen any powder that may have adhered to the inside projectile wall. The removal of the adapter will provide a large access for entry into the main charge and if necessary, another hole may be drilled directly opposite the fuze opening to permit removal of powder adjacent to the fuze opening.

The drilling apparatus used to breach the projectile may take any configuration as long as its design features a remotely controlled operation. Availability of materials, machine shop facilities, and funds will control the design of the apparatus. Figures 168, 169, and 170 are provided as an example of a remotely operated drill fabricated and used successfully by personnel of the old EOD Unit Two of Charleston, South Carolina. This same apparatus is presently utilized by the EOD Detachment, Naval Weapons Station at Charleston.

In Figure 168, a side view of the remote drill is shown. The electric drill is a 1/2-inch heavy duty Black and Decker which is bolted to the center section. The center section is free to slide on a 1-inch vertical steel shaft. Downward movement of the drill is controlled by use of a small hydraulic jack and Lincoln gun mounted on the lower bracket. The lower bracket is adjustable to slide on the vertical shaft. The force necessary to feed the drill into the projectile is governed by three strong springs mounted between the upper bracket and the center section holding the drill motor.

The base of the drill stand has four adjustable jaws set to firmly hold the projectile. A 5-gallon container, fitted with a valve, supplies coolant water for the drill.

Figure 169 shows a slightly rearward view of the stand and the fixture which holds the cooling water hose. This view also shows the hydraulic jack assembly in detail. In these two views, the feeder springs are in the compressed condition with the hydraulic jack preventing the downward movement of the center section. By slowly opening the Lincoln gun valve, the springs will drive the drill into the cutting position. Figure 170 shows the feeder springs in the extended position.

Progress of the drilling operation can be judged by listening to the speed of the motor. As the drill penetrates into the explosive cavity, or the springs become fully extended on a thick walled shell, the motor will speed up. At this point the drill may be extracted by closing the Lincoln gun valve and reapplying pressure to the hydraulic jack assembly. After the drill has been extracted, the motor should be switched off by remote means at the safety shelter. The cooling water should then be allowed to continue to run into the drilled hole for several minutes before approaching the stand.

If complete penetration is not achieved on the first attempt and the feeder springs become fully extended, the following procedures should be followed: As the increase in motor speed is recognized, the Lincoln gun valve should be closed and the motor switched off. Allow several minutes to pass for the cooling water to fill the drilled hole. Do not extract the drill. Looking at Figure 169, tighten the center section setscrew (second from top) to prevent accidental downward thrust of the drill. Loosen the setscrew of the upper bracket and compress the upper bracket down against the center section with a "C" clamp, retighten the upper bracket setscrew and remove the "C" clamp. Loosen the setscrew that secures the hydraulic jack lower bracket, using the Lincoln gun, extend the jack piston; retighten the lower bracket setscrew and loosen the center section setscrew .

Retire to the safety shelter and switch on the motor and slowly open the Lincoln gun valve to control the downward thrust.

This sequence may be repeated as necessary in order to complete penetration of the projectile.

Once breaching is complete, the projectile should be completely filled with hot water and allowed to soak for a minimum of 1 hour.

If several projectiles are to be breached during one operation, those shells that have been drilled should be kept submerged with the drilled hole facing upward.

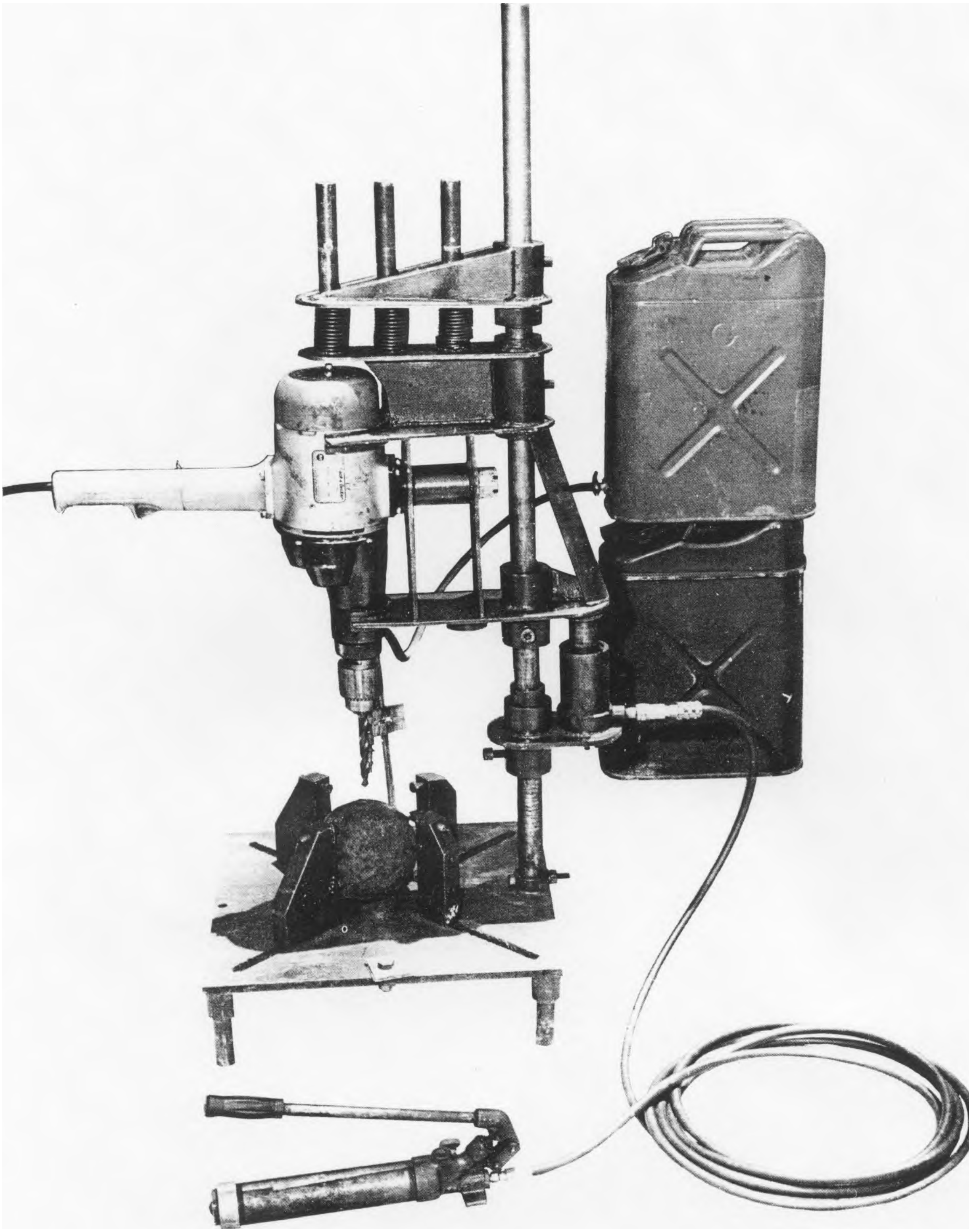


Figure 168. Side View of Drilling Apparatus.

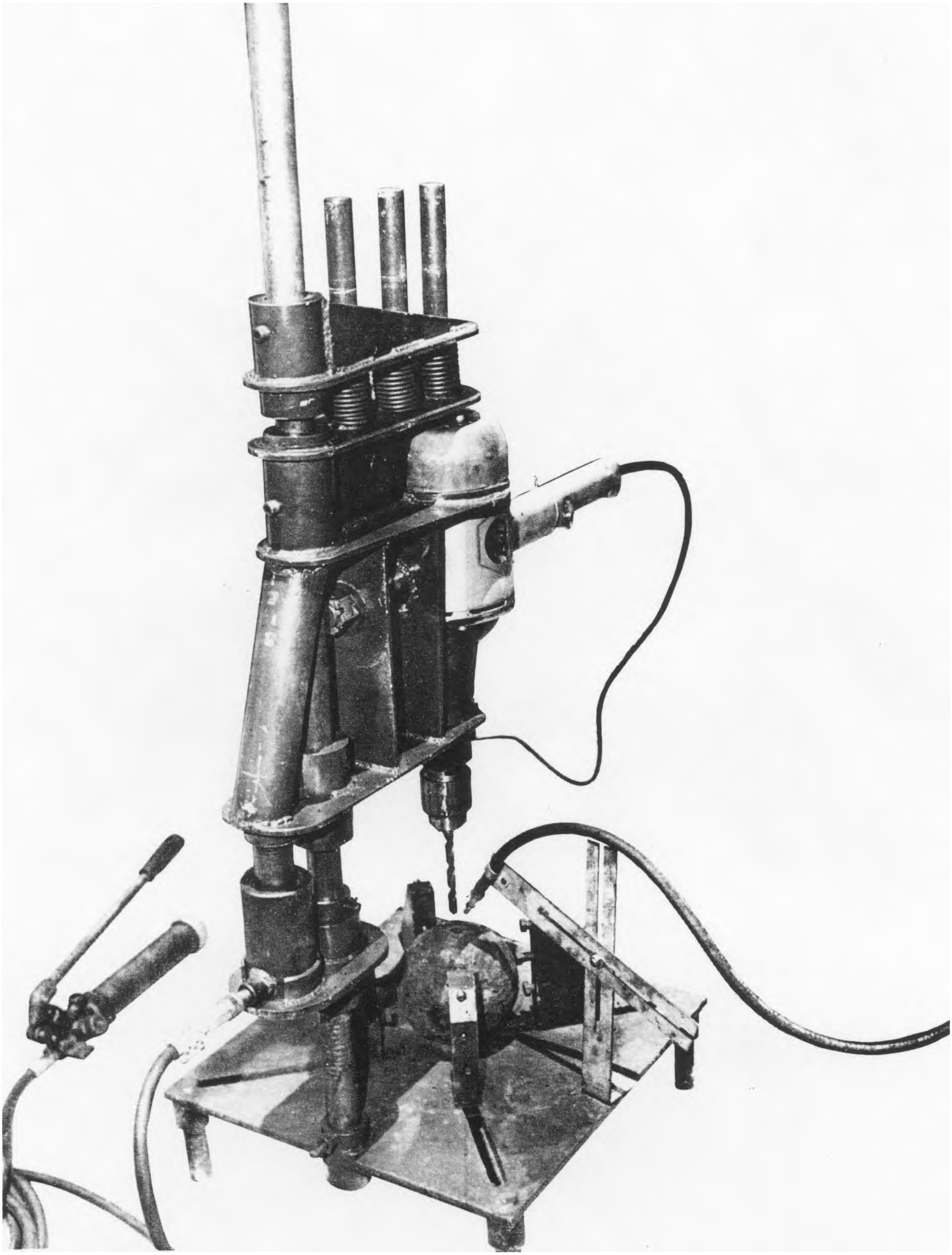


Figure 169. Rear View of Drilling Apparatus.

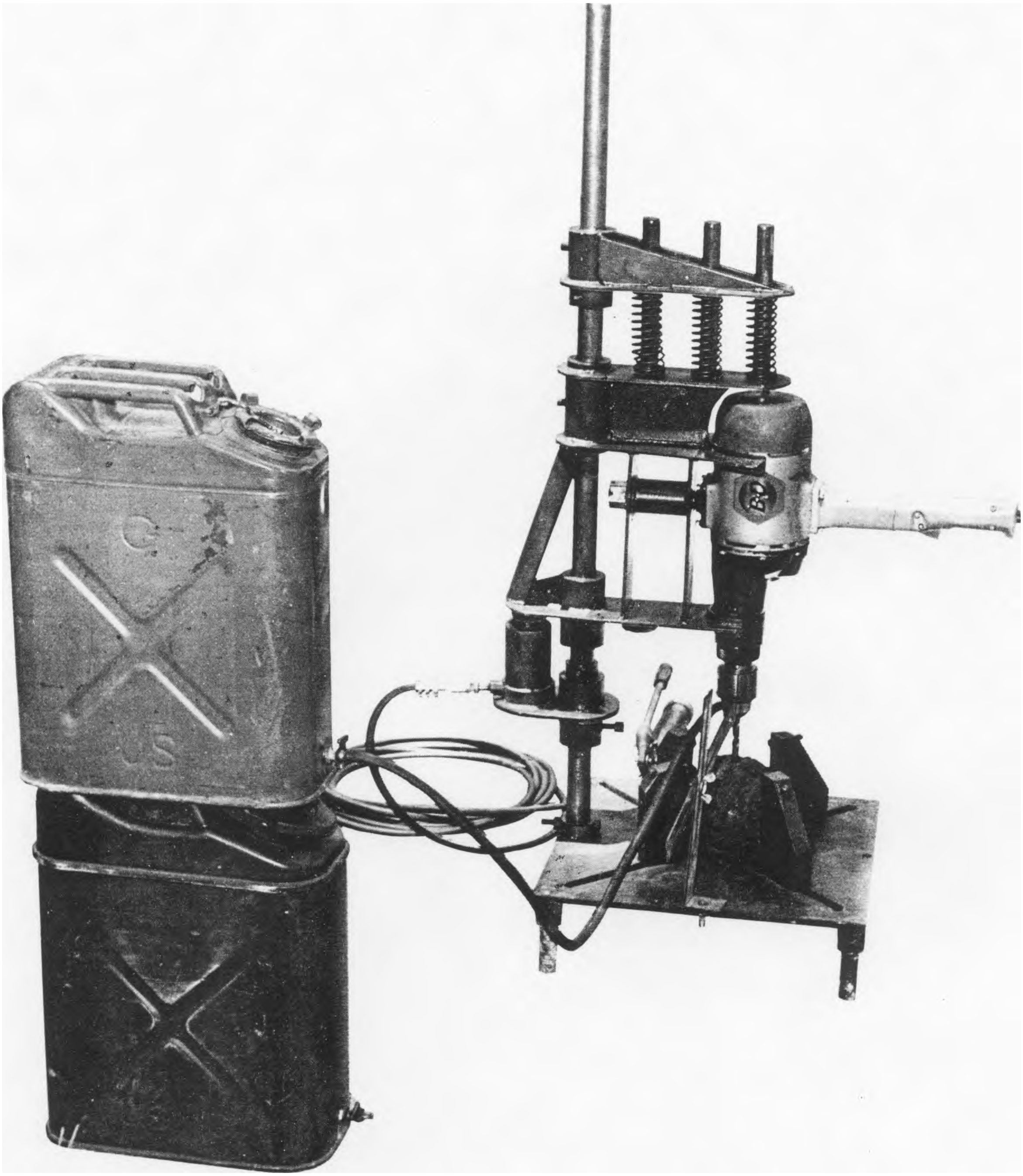


Figure 170. Side View of Drilling Apparatus.

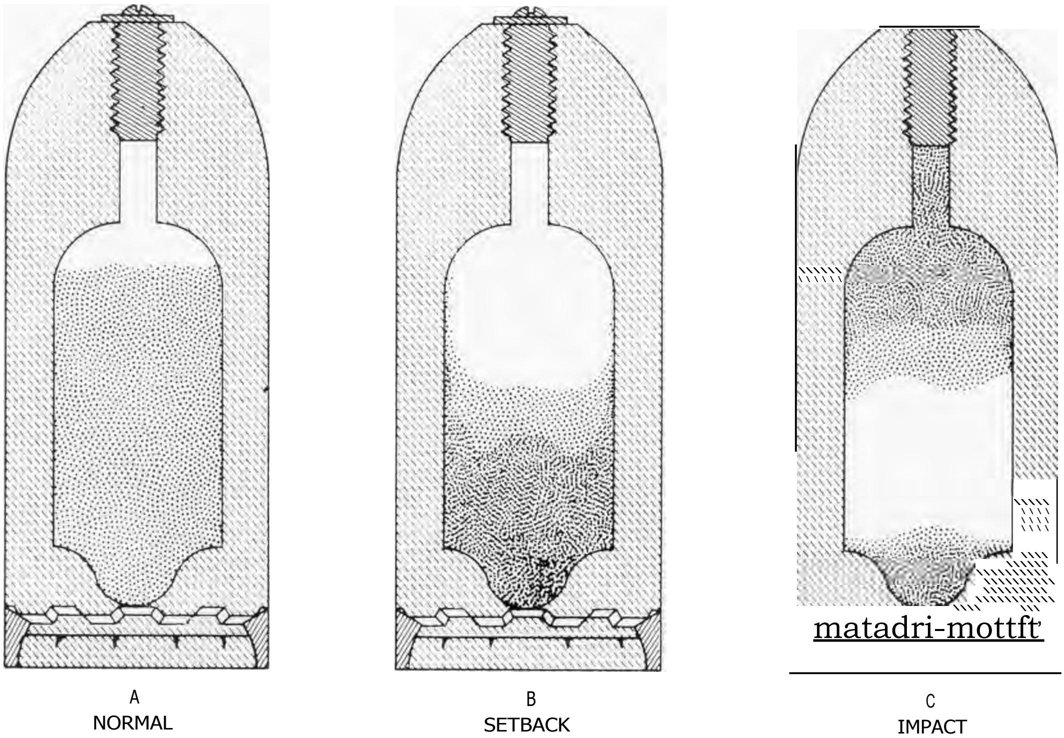


Figure 171. Compression Effect on Powder.

To further substantiate the need for changing from the side entry procedure to the more effective but difficult base entry, a discussion of black powder and its characteristics are in order.

The first characteristic to consider is the compression effect of the black powder within the projectile's explosive cavity during firing and at impact with the target. Plate "A" of Figure 171 shows the black powder filler in its normal state as being loosely filled and not occupying the entire cavity. At the moment of discharge from the gun, the violent force of setback on the loosely filled projectile will compress the powder into a tightly compacted mass at the rear of the cavity as shown in Plate "B." Should the projectile receive direct impact with a target and experience a fuze malfunction, the majority of the filler will be thrown forward and compressed into the nose of the shell as depicted in Plate "C." Normally a portion of the compacted filler will remain at the base. This compression effect on the powder, coupled with a century of changing temperatures and its undesirable hygroscopicity, forms a hard packed consistency similar to hard clay.

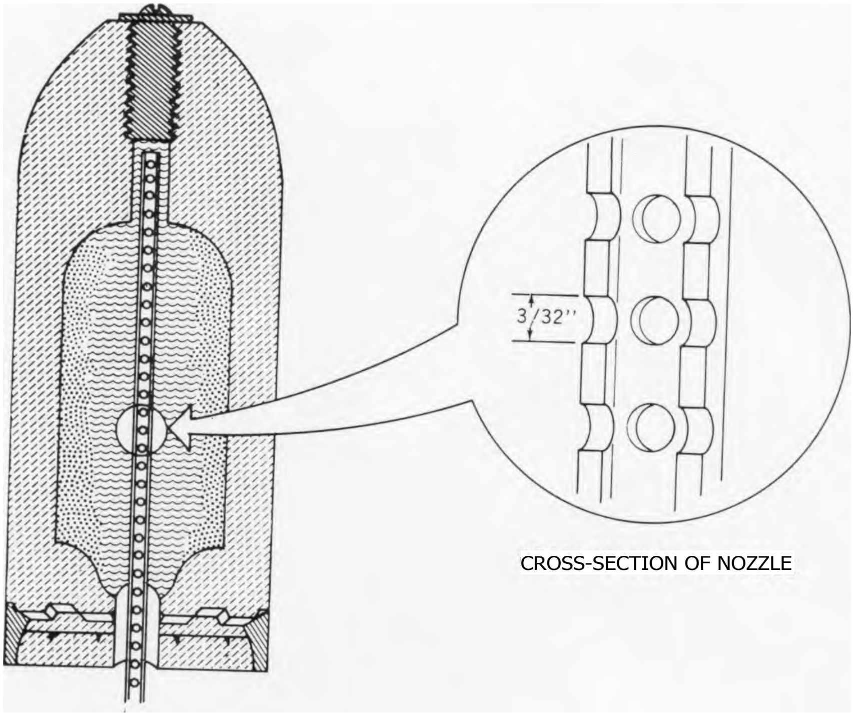


Figure 172. Washout Nozzle.

A second characteristic of the powder which hinders its removal is the action of centrifugal force that imbeds the fine grains into the vertical walls of the cavity. This is further complicated by the jagged and imperfect sand core casting particularly noted with Confederate manufacture.

Black powder can be desensitized by leaching with hot water to dissolve the potassium nitrate. The washings should be disposed of separately because the residue of sulphur and charcoal is combustible but not explosive. Civil War black powder is composed of potassium nitrate (saltpetre) at 75 percent, fine pure sulphur at 10 percent, and finely powdered charcoal at 15 percent. It has an ignition temperature of 300° C. and a detonating temperature of 356° C. It is highly sensitive to impact, friction, static electricity, spark, and flame. The red or brown colored is the most easily ignited while the black colored is less hygroscopic and more strongly carbonized, thus produces more power. It is undesirably hygroscopic because of the presence of the charcoal, but moisture does not cause it to become unstable. In the presence of moisture however, it will react and corrode steel, brass, and copper. In fuzes, the percentage of nitrate was increased and the percentage of charcoal decreased to decrease the burning time. More modern mixes are composed of sodium nitrate to aid in the "smokeless" effect.

The most effective method of removing the black powder filler is by use of a high-pressure washout nozzle as shown in Figure 172. Highly compacted powder is best removed by wet steam.

The washout nozzle can be constructed from a 24-inch length of 3/8-inch copper tubing with its end closed off and a series of 3/32-inch holes drilled at 90° angles throughout its entire length. The tubing can then be brazed to a standard female hose fitting. With the nozzle charged to household water pressure, it is inserted into the drilled hole completely to the nose of the shell. A slow reciprocating motion of the nozzle will help agitate the powder from its cavity. The projectile should be base down on a wire grill or stand during the washout procedures. After the water begins to run clear in color, the projectile should be placed gently on its nose and filled to capacity with extremely hot water. With the aid of nonsparking scrapers made from brass brazing rods, the internal cavity may be safely scraped to remove powder that has compressed against the vertical walls. After scraping is complete, the projectile should again be placed in a base down attitude and flushed with the nozzle. If the projectile is of large caliber, 5 inches or more, it can be further cleaned with a wet sandblast to insure the removal of powder from irregular shaped cavities.

If available, a final radiograph will detect any remains of compacted powder. The cavity should then be air-dried, and as a final insurance against ignition of any small traces of powder at a later date, the projectile should be completely filled with melted paraffin which will seek out and seal all cracks and crevices.

D. SAFETY PRECAUTIONS

Before specific safety precautions are presented, a short discussion on fuzes is deemed necessary in order to establish their degree of hazard.

By the very nature of the main explosive filler used in Civil War projectiles, fuzes were designed and constructed to be flame producers rather than a detonating agent. In all known Civil War fuzes, the end product of their functioning was a long spurt of flame directed at the black powder filler.

All percussion, concussion, and most combination fuzes contained a minute amount of mercury fulminate usually in the form of a musket cap or a thin wafer as shown in Figure 173. These percussion elements are comparable in power to a modern day shot gun primer. The caps are mounted on a nipple which is completely inert and serve merely as a hard surface for the fulminates to be crushed against. Figure 174 displays three different nipple styles.

Figure 173. Percussion Cap and Wafer Elements.

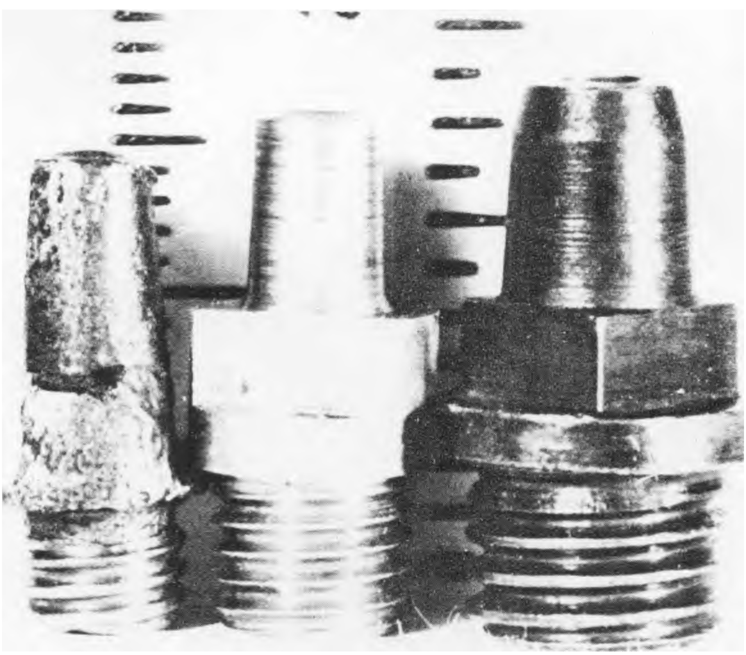


Figure 174. Assorted Nipples Styles.

The striker or plunger assembly, which contain the wafer or nipple and associated musket cap, is a metal cylinder placed inside a fuze body to act with the forces of impact inertia and strike the fulminate element against the fuze anvil. The striker assembly has an approximate 3/64-inch diameter hole through its longitudinal axis. The hole is provided to transmit the flame from the percussion element down through the fuze body to the main filler. Some strikers are charged with an infinitesimal amount of gun powder to help propagate the initial flame from the percussion element.

Figure 175 shows profile and end views of assorted striker assemblies from Civil War percussion fuzes. This figure is provided to show comparative sizes and configuration.

Figure 175. Assorted Fuze Striker Assemblies.

The foregoing facts should be considered in the assessment of actual fuze hazard once the main filler has been totally removed and the projectile cavity filled with paraffin. The Tice and Ganster Concussion fuzes should be considered as an exception because the quantity of mercury fulminate used in these two fuzes are unknown and the fact that they are confined in their internal construction.

Procedures and techniques discussed in this section have proved to be a successful and effective means of dealing with Civil War explosive ordnance. Trial and error methods and shape charge attacks against these historical relics should be considered as outmoded if they are to be preserved for posterity. Deviations in methods and procedures are likely to bring about unprofessional products that still may present an explosive hazard.

Standard safety precautions applicable to black powder should be observed at all times. All breaching operations must be conducted by remote facilities if the safety of personnel is to be insured. Projectiles should not be subjected to a fire bath in attempts to burn out the powder. Particular warning is given in the use of diesel fuel which has been suspected of causing mechanical explosions within the projectile cavity.

Projectiles received for inerting should immediately be submerged in water and stored in approved magazines until the remote breaching operations are commenced.