The Verbruggen 3lb Bronze Cannon Of the 4th Battalion Royal Artillery

"The Grasshopper"

The Grasshopper

The grasshopper was the nickname for the Verbruggen 3lb. cannon used by the British army in the late 18th century as a light battalion gun to support infantry. It was designed for service in rough terrain such as the frontiers of British North America.

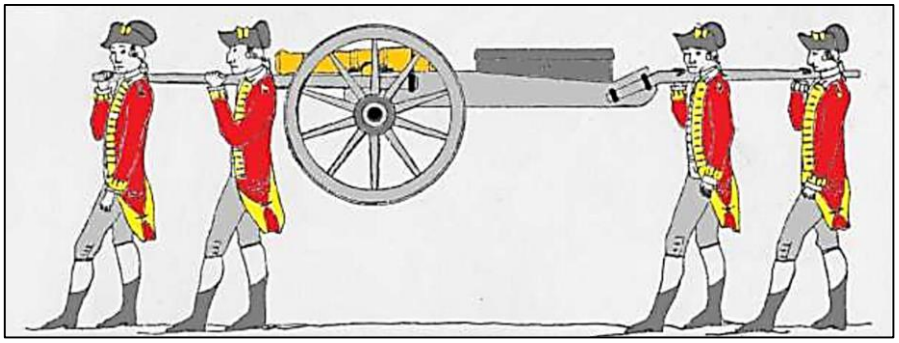
Its barrel was made of bronze instead of iron. Bronze is less brittle than cast iron, and so the barrel could be made thinner and lighter than that of an iron gun. If a bronze gun developed a defect it would rupture; an iron gun with a flaw would shatter, at great cost to its own crew. It fired a three-pound ball, grapeshot or canister shot.

3lb. Ball

Grape Shot

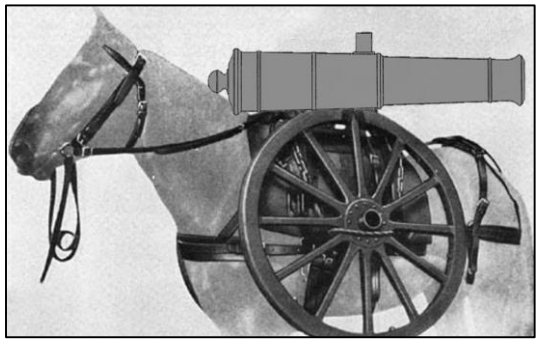
Canister Shot

The gun was designed to be mobile and could be moved by its own crew using drag ropes and wooden shafts (Hand Spikes) much like a handcart. Two straight hand spikes were placed on each side of the cheek pieces facing forward, and two angled ones at the trail. The appearance of the hand spikes when fixed in place led to the nickname of Grasshopper.



The other means of transport was to move it by means of horse and packsaddles, but once reassembled, the gun if mounted upon a standard carriage without brackets and shafts, had to be man-handled rather than carried. The basic ammunition box for each was set inside the trail of the carriage.

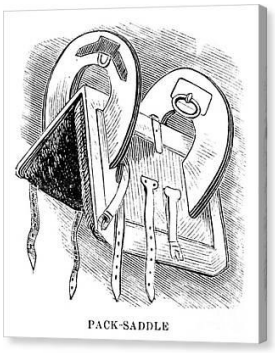
Specific types of carriages are often noted in official correspondence as being associated with a specific gun model. Once, however, any gun reached North America it appears that it was subject to immediate change, depending upon the geographical condition or environment to which the gun was shipped.



In the 18th century the terms "Bronze" and "Brass" were interchangeable. Either term is correct.

The Verbruggen "Bronze" 3 lb. cannon was produced at the Royal "Brass" Factory in Woolrich England.

Step back and take a look. Does it look like a grasshopper?



Tools of the Artillery

Sponger

Linstock

Rammer

Wormer

Spike

Gimlet

Priming Wire

Thumb stall

Quill Fuse

Fuse Pouch

3 lb. Ball

Grape Shot

Canister Shot

The Gun Crew

Crew and Responsibilities: Firing field cannon during the American Revolutionary War required a crew, or 'cannon cocker' as they were commonly called during the war. A crew was comprised of no fewer than six men and occasionally ten or more. Pulled manually or limbered by horse, the cannon was positioned onto the battlefield and the crew took their positions.

Positions and Titles:

Gun Commander - An officer who had overall command of the gun and crew. He was solely responsible for matters pertaining to the usage and safety of the cannon, its positioning on and off the field, accuracy of shot, and defense against enemy capture. He did not assist in loading or firing the piece; however, if necessary due to casualties or lack of manpower, he would serve in the position of firer.

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Firer - This position held the linstock and touched off the charge when ordered by the Gun Commander. A linstock, from the Dutch lontstok, meaning match stick, was a long wooden staff with a metal fork or serpentine jaw at the end to grip a slow match. A slow match was a very slow burning cord or hemp twine, chemically treated with potassium or sodium nitrates. The length of the linstock allowed the firer to safely discharge the gun at a safe distance from the recoil. The linstock also had a sharp point at the base to stick in the ground. If an enemy came upon them, the linstock's sharpened point could be used as a pike to ward off attack.

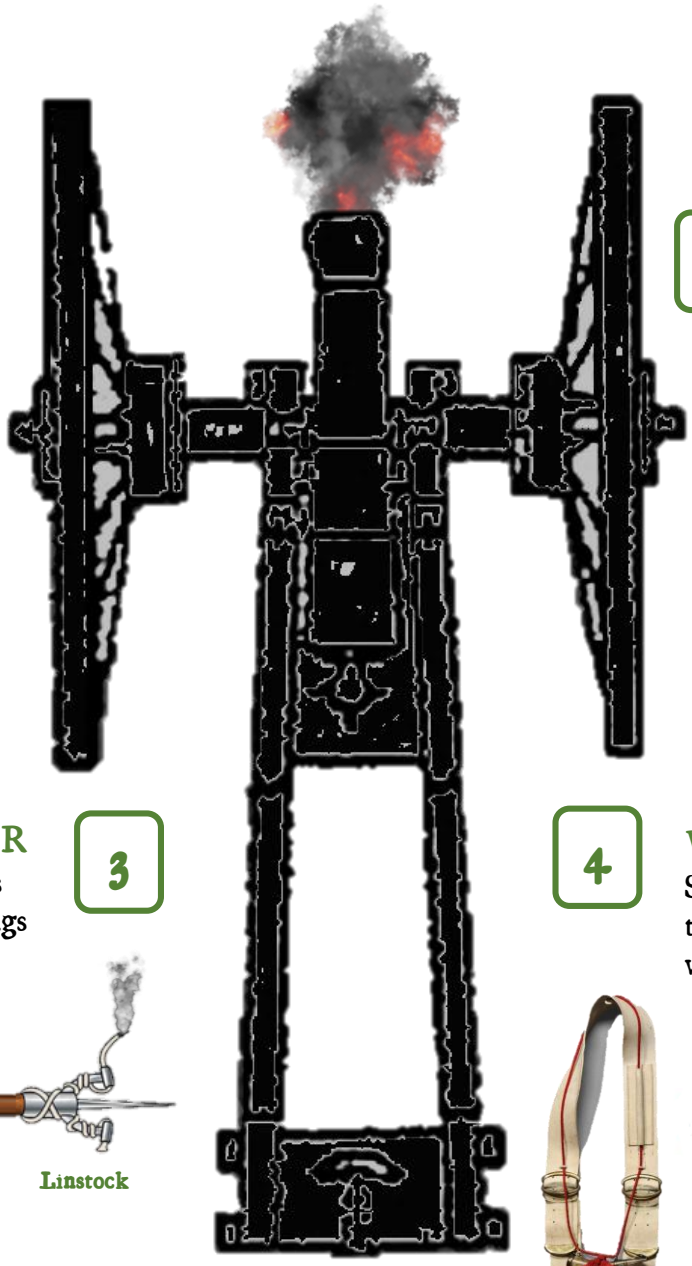
Vent Tender - The Vent Tender stops or 'tends' the vent hole (or touch hole) so no air escapes during the worming, sponging and loading of the cannon. He also picks open the charge with a priming wire and adds the powder to the vent either by horn or, more commonly, quill. This is called priming the piece. He usually had some type of protection from the heat of the barrel or chase while stopping the vent such as a leather glove or piece of hide.

Ram and Sponge - This position sponged or swabbed the piece after firing and worming to extinguish any lingering hot embers. After the cartridge of black powder was placed in the muzzle, he rammed it home (jamming the charge to the base positioned over the vent hole).

Worm and Load - After the cannon was fired, this position would 'search' the barrel with a worm to extract spent cartridge. The worm was a large, wrought iron, blacksmith-made cork screw-like piece that was attached to a long wooden pole. He dislodged stubborn charges and cleaned the bore of the chase. After sponging, he would place the next round (solid shot, shell, grape, etc.) into the muzzle and also add the powder cartridge. Some cartridge had shot and powder combined (a larger version of musket cartridge).

Powder Handler - The "Powder Monkey's" responsibility was to remove the powder box from the carriage upon positioning the piece. He also brought the round forward to the wormer and loader and would also man the trail for aiming the piece.

Positions of the Gun Crew



Worm

1

WORMER

Loads the cartridge into the gun and worms the piece after firing.

Water Bucket

2

RAMMER

Rams home the cartridge after loading and sponges the piece after firing.

Rammer & Sponge

FIRER / GUNNER

Fires the gun and secures the linstock between firings

3

Linstock

Slow Match

4

VENT TENDER

Serves the vent, primes the gun and covers the vent after firing

Fuse Pouch

Priming Wire

Thumb stall

Spike

Quill Fuse

Gimlet

5

GUN COMMANDER

Directs the placement of the gun on the field with reference to the enemy position and directs the firing of the piece.

6

POWDER HANDLER / POWDER MONKEY

Supplies cartridges from the cartridge box to the Wormer for loading of the gun.

The Firing Procedure

The Gun Crew

The gun commander stands a short distance off so he can supervise the execution of all firing procedures. He also has a clear view of the field and can judge the cannon's accuracy, calling out orders for any adjustments. If the enemy is approaching, he can order a defense or abandon the position. The firer stands to the rear left of the trail. The vent tender stands to the rear right of the trail. The rammer and sponger stands to the front right of the wheel or chase. The wormer and loader stands to the front left of the wheel or chase. The powder handler stands behind the box.

Step 1 – Search the Piece. Before first use and after each firing, the barrel must be searched with a worm to be sure all old powder and materials (such as spent grape) were removed.

2nd Pennsylvania Regiment

Step 2 – Swab the Piece. The bore of the chase (barrel) must be swabbed or sponged. A wet sheepskin covered sponge is rammed down the barrel. It extinguishes any hot embers and removes fowling left by spent powder. A bucket of water must be available at all times. The vent hole or touch hole must be stopped up during swabbing; usually with a thumb (protected from the heat by leather or piece of hide).

Step 3 – Charge with Cartridge. A new powder charge or cartridge is placed in the muzzle and rammed home. The cartridges were made before hand usually black powder sewn into a fabric bag.

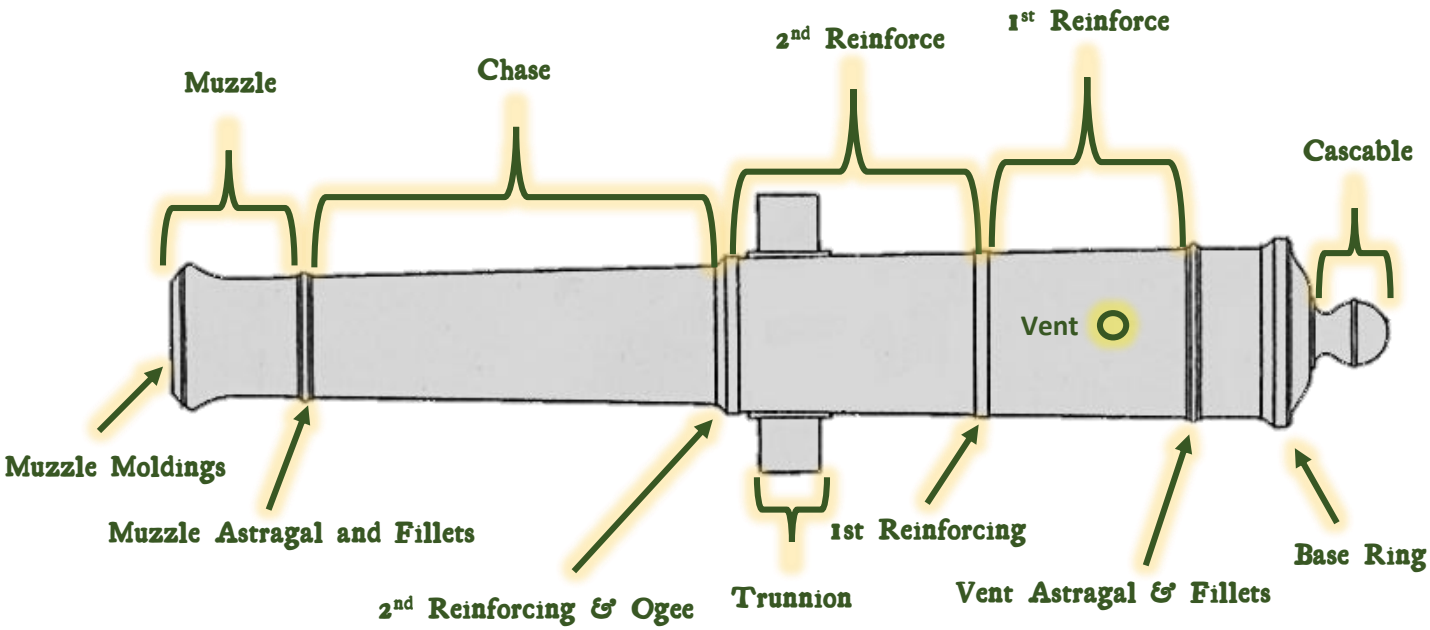
Step 4 – Ram down ball. After the cartridge or powder is rammed home, paper or hay is shoved in the muzzle then the shot to be fired. Shot and powder were sometimes made in advance, like a larger version of a musket cartridge. This quickened the response time for each firing.

Step 5 – Prick. After the bore was loaded, the powder bag or cartridge needed to be pricked so the powder would be exposed to the touch or vent hole. The prick was a small wrought iron bar with a sharpened point at one end and a small handle at the other. It was wide enough to fit the touch or vent hole easily.

Step 6 – Prime. Powder was poured into the touchhole. Powder horn was occasionally used, although more common was the use of a quill (feather of a large bird, usually turkey). It was opened at both ends leaving a hollow tube. The quill tube was filled with powder (premade) and easily laid in the touchhole, making contact with the pricked powder bag.

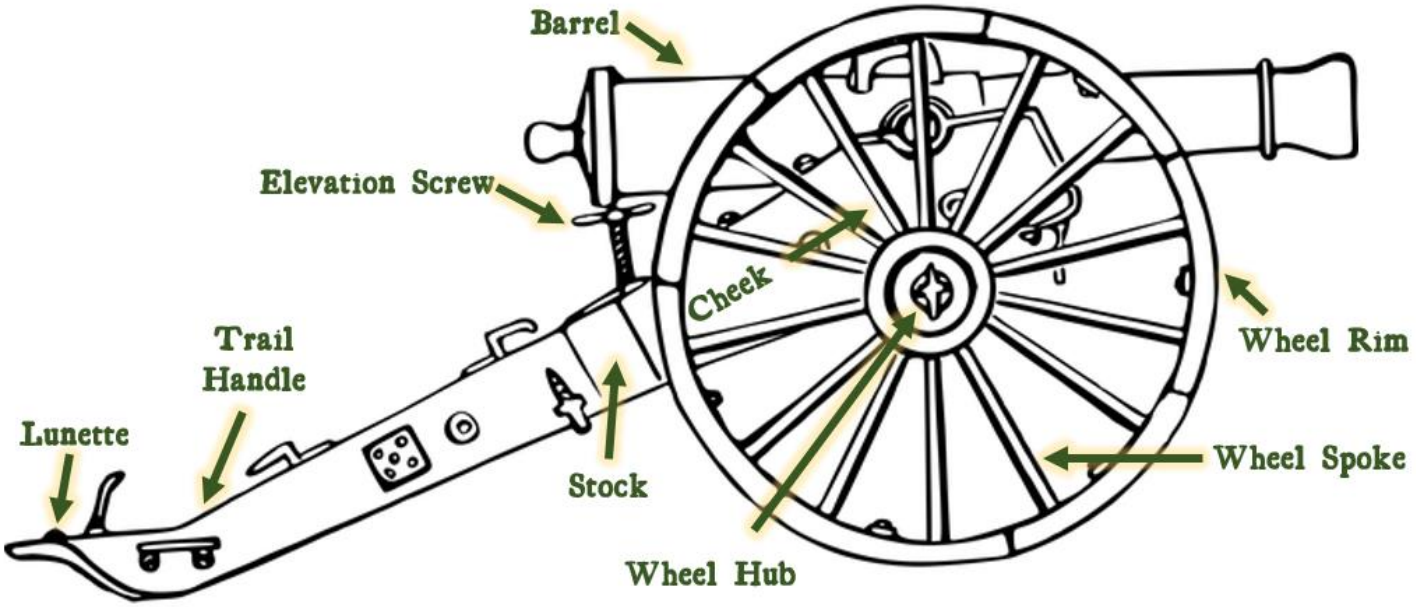
Step 7 – Fire. As soon as the quill was laid in the touchhole, *'primed and ready'* was cried out to the entire gun crew. With the command of *'make ready'* , the crew members moved to their firing positions. At the command of *'give fire'* the linstock, with slow match, was laid to the touchhole and the cannon fired.

Parts of the Cannon



An *Astragal* is a molding profile composed of a half-round surface surrounded by two flat planes or *Fillets*. A *Cascable* is a projection behind the breech of a muzzle-loading cannon. It is used to attach arresting ropes to deal with the recoil of firing the cannon. A *Trunnion* is a cylindrical protrusion used as a mounting or pivoting point. An *Ogee* is often used at the junction of two portions of a gun tube with differing diameters, or it may be used with a ring as a fillet is used with an astragal.

Parts of the Carriage



A *Lunette* is a towing ring in the trail plate of the carriage.

Calculating the Weight of the Cannon

Numbers and marks on the back of the cannon's breech above the button (Cascable) comprise the *code for the cannon's weight* - a very important piece of information to know for a variety of reasons. Guns were cast according to "patterns" specifying weight and dimensions. *Gunfounders were paid according to the mass of metal contained in each finished gun*, so in order to get paid the gunfounder marked the weight of each piece at the foundry. Additionally, knowing the exact weight of cannons destined for sea service was important in order to ballast and trim the vessels that carried them.

British cannons of this period were usually weighed and marked in "hundredweights" and fractions thereof. Counter-intuitively, a *hundredweight equals 112 modern pounds*, not 100 pounds. The cannons weight is represented by three numbers, separated by dashes as in this example 1-3-4 It was necessary to give the cannon's weight down to the nearest pound.

- The *first digit* (1) tells the number of *whole hundredweights*
  (1) x 112 = 112 pounds)
- The *second digit* (3) tells the number of *quarter-hundredweights*
  (3) x 28 = 84 pounds)
- The *third digit* (10) tells us that there were 10 individual pounds left over.
  (10) x 1 = 10 pounds)

Therefore the weight of the cannon is 112 + 84 + 10 = 206 pounds.

2nd Pennsylvania Regiment

Ballistics

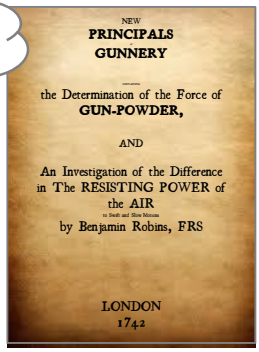
Hitting What You Shoot At

Ballistics is the field of science of the launching, flight behavior and impact effects of projectiles

3 Types

1. Interior ballistics deals with the projectile while it is still in the gun.
2. Exterior ballistics deals with the projectile after it clears the muzzle and throughout its time of flight.
3. Terminal ballistics deals with the impact, and force imparted on the target.

Thank you Benjamin Robins!



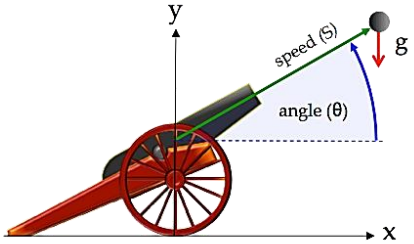
Things to Consider

Thank you Isaac Newton!

- The gun powder formulation
- The amount of powder used
- Weight of the projectile
- Different projectiles used (Ball, Canister, Grape)
- Weather conditions (Temperature, Humidity)
- Terrain (The Gun Placement)
- The Windage (The Air Resistance - Horizontal)
- The Elevation (Parabola – Vertical)
- The range to target
- The Muzzle velocity of the gun

Math is Hard

Gunnery became a subject for practical mathematics in the 16th century. Printed books and new mathematical instruments dealt with the measurement of shot, the elevation of guns and mortars, and the calculation of the range of fire. Calipers and gauges were devised to measure diameters and indicate weights. Sights and levels enabled the gunner to set appropriate elevations. By the 18th century mathematical instrument makers had become regular suppliers to ordnance departments. The prediction of range in relation to the elevation of a gun was considered the pinnacle of artillery as a mathematical science.



Lateral speed trajectory for stationary target

(1) $x = St$

(2) $t = \frac{x}{S}$

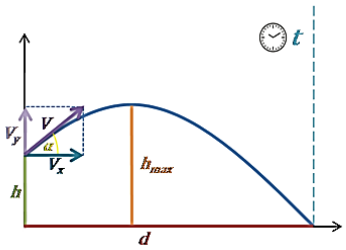
(3) $y_{peak} = y_0 + v_y(\frac{1}{2}t) + \frac{1}{2}g(\frac{1}{2}t)^2$

(4) $y_{end} = y_0 + v_y t + \frac{1}{2}gt^2$

(5) $g = \frac{-4(y_0 - 2y_{peak} + y_{end})}{t^2}$

(6) $v_y = \frac{-(3*y_0 - 4y_{peak} + y_{end})}{t}$

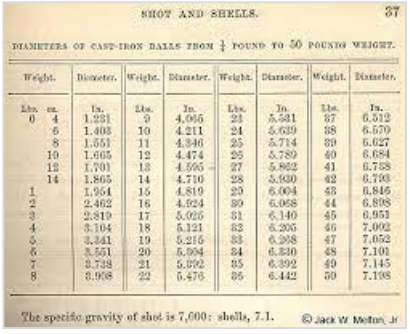
(7) $\vec{v} = (S, v_y)$ with gravity g



V – velocity
V_x – horizontal velocity
V_y – vertical velocity
α – angle of launch
h – initial height
t – time of flight
d – distance (range)
h_{max} – maximum height

Firing & Range Tables are Easy

Artillery Firing & Range tables allowed the gunners to match gun and ammunition by the weight of the appropriate shot.

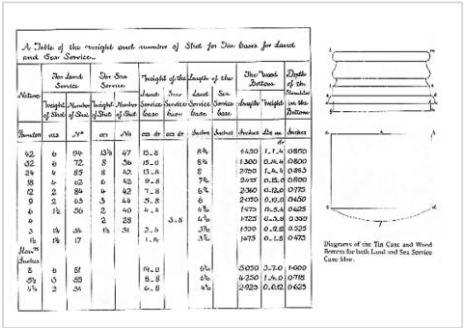


SHOT AND SHELLS. 37

DIAMETERS OF CAST-IRON BALLS FROM ¼ POUND TO 50 POUNDS WEIGHT.

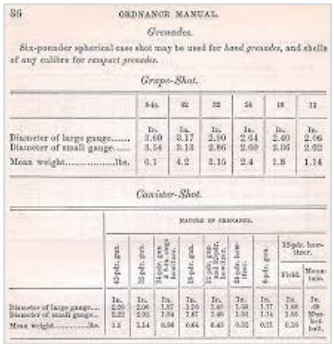
Weight.	Diameter.	Weight.	Diameter.	Weight.	Diameter.	Weight.	Diameter.
Lbs. oz.	In.	Lbs.	In.	Lbs.	In.	Lbs.	In.
0 4	1.231	9	4.066	23	5.531	37	6.512
6	1.403	10	4.211	24	5.639	38	6.570
8	1.551	11	4.346	25	5.714	39	6.627
10	1.665	12	4.474	26	5.789	40	6.684
12	1.701	13	4.595	27	5.862	41	6.738
14	1.865	14	4.710	28	5.930	42	6.793
1	1.954	15	4.819	29	6.004	43	6.846
2	2.462	16	4.924	30	6.068	44	6.898
3	2.819	17	5.026	31	6.140	45	6.951
4	3.104	18	5.121	32	6.205	46	7.002
5	3.341	19	5.216	33	6.268	47	7.052
6	3.551	20	5.304	34	6.330	48	7.101
7	3.738	21	5.392	35	6.392	49	7.145
8	3.908	22	5.476	36	6.442	50	7.198

The specific gravity of shot is 7,000: shells, 7.1. © Jack W. Melton, Jr



A Table of the weight and number of Shot for Iron Guns for Land and Sea Service.

Diagrams of the Tin Case and Wood Screen for both Land and Sea Service Case Shot.



86 ORDNANCE MANUAL.

Grenades.

Six-pounder spherical case shot may be used for hand grenades, and shells of any calibre for rampart grenades.

Grape-Shot.

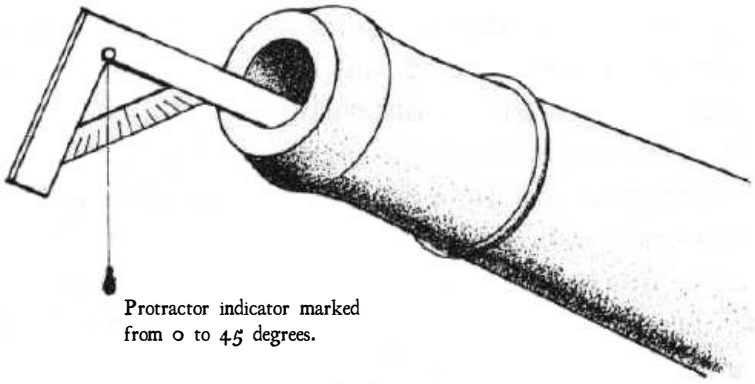
	84s.	42	32	24	18	12
	In.	In.	In.	In.	In.	In.
Diameter of large gauge	3.60	3.17	2.90	2.64	2.40	2.06
Diameter of small gauge	3.54	3.13	2.86	2.60	2.36	2.02
Mean weight lbs.	6.1	4.2	3.15	2.4	1.8	1.14

Canister-Shot.

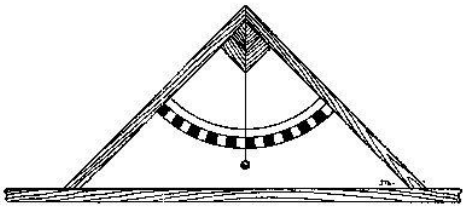
	NATURE OF ORDNANCE.								
	42-pdr. gun.	32-pdr. gun.	18-pdr. long gun & 24-pdr. howitzer.	18-pdr. gun.	12-pdr. gun & 18-pdr. howitzer.	12-pdr. howitzer.	6-pdr. gun.	12-pdr. howitzer.	Mean value.
	In.	In.	In.	In.	In.	In.	In.	In.	In.
Diameter of large gauge	3.20	2.96	2.87	3.20	2.49	2.93	2.37	3.66	.58
Diameter of small gauge	3.22	2.93	2.84	3.47	2.46	2.91	2.34	3.65	Mean bed.
Mean weight lbs.	1.5	1.14	0.94	0.64	0.45	0.35	0.31	0.35	bed.

The Gunners Other Tools

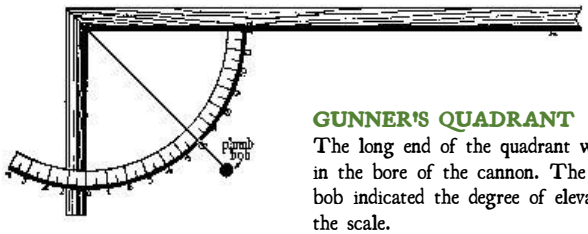
GUNNER'S CALIPER
This tool was used to measure both shot and caliber. To accommodate irregularities, and for the sake of safety, the shot of early modern artillery did not fit tightly in the bore of a gun. The difference between the diameter of the shot and the calibre of the gun was known as the windage.



Protractor indicator marked from 0 to 45 degrees.



GUNNER'S LEVEL
This tool was useful in many ways, but principally for finding the line of sight on the barrel of the gun.

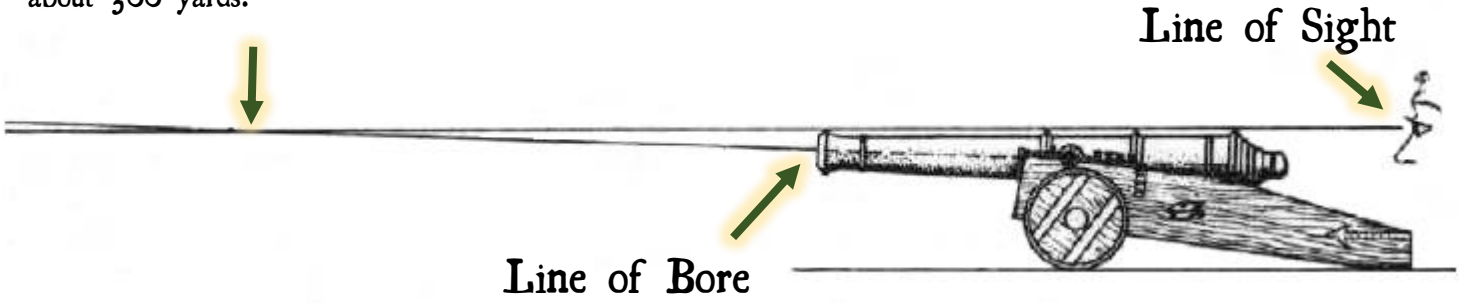


GUNNER'S QUADRANT
The long end of the quadrant was laid in the bore of the cannon. The plumb bob indicated the degree of elevation on the scale.

Firing at Point Blank Range

Maximum Range About 1200 yards
Effective Range 750 yards
With accuracy 400 yards

Trajectory will cross the line of sight at the point blank range of about 300 yards.



Trajectory is the path of a shot, subject to the forces of gravity, drag, and lift. Under the sole influence of gravity, a trajectory is parabolic.