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PROVISIONAL DRILL REGULATIONS

ANTI-AIRCRAFT 75MM GUN

SEMI-FIXED MOUNT. MODEL 1915

Reprint of pamphlet prepared at Army Schools and Published by Headquarters American Expeditionary Forces, France, December, 1917.

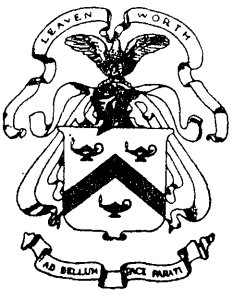


WAR PLANS DIVISION
July, 1918

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WAR DEPARTMENT,

WASHINGTON, *July* 5, 1918.

The following pamphlet, entitled "Provisional Drill Regulations, Anti-Aircraft 75mm. Gun—Semi-Fixed Mount, Model 1915," is published for the information and guidance of all concerned.

(062.1 A. G. O.)

BY ORDER OF THE SECRETARY OF WAR:

PEYTON C. MARCH,
General, Chief of Staff.

OFFICIAL:

H. P. McCAIN,
The Adjutant General.

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ANTI-AIRCRAFT 75MM GUN

SEMI-FIXED MOUNT, MODEL 1915.

INTRODUCTION.

DESCRIPTION AND MOUNTING OF THE SEMI-FIXED MOUNT. GENERAL PRINCIPLES.

1. — Description of the semi-fixed mount for fortified towns.

The model 1915 semi-fixed mount is designed for firing at high angles with the model 1897, 75mm. Gun.

It comprises essentially:

A concrete pit.

A framework, turning round a vertical axis and supporting the gun-carriage.

This carriage, before being placed on the framework, should be stripped of its wheels, wheel-brakes and shields and equipped with a beam and counter-weight and recoil apparatus specially designed for vertical firing; moreover, the range drum is replaced by a drum graduated in mils (the carriage, model 1897, may be replaced by a simplified carriage, model 1916).

The concrete pit is one meter deep and four meters in diameter. An iron roller path, secured to the upper part of this pit, serves as a track for the rollers of the framework.

A socket, fixed to the center of the pit with clamping bolts, receives the pivot which supports the framework.

A drain pipe carries off the water which falls into the pit.

The framework consists of two lateral *trusses* and two central *brackets* made from U beams assembled and riveted.

The vertical *uprights* of the trusses are cross-braced and fixed to the pivot support.

These uprights are provided at the top with trunnion bed-plates designed to receive the trunnions. They are covered with cap-squares bolted to the trunnion bed-plates.

The lateral trusses and central brackets are joined by a flooring to support the personnel of the piece.

The flooring has an opening between the two brackets in order to give space for the trail.

At the end of each truss and under the flooring is a cast iron roller which runs on the roller path.

The roller of the right hand truss is connected by a jointed shaft and a bevel gear to a controlling handwheel which turns it.

The running of the roller on the traversing circle rotates the whole framework around the pivot.

The central brackets support, at the rear, a winch fixed above the flooring.

The winch is operated by a handwheel. This handwheel, by means of a bevel gear and a jointed shaft, moves a worm; this worm sets in motion a toothed wheel fixed on the drum of the winch.

The gun trail is attached by the pintle eye to a steel cable wound on the winch.

The cable is constantly under tension by the preponderance of the weight of the trail; the rotation of the winch changes the inclination of the gun. A counterweight lessens this prepónderance and, consequently, the exertion required to elevate the trail.

For transportation, the framework is taken down in the following parts:

The right hand truss with its upright and central bracket.

The left hand truss, with its upright and central bracket.

The pivot support, the two upright *braces*, the joint shafts.

The winch.

The winch operating devices.

The equipment chest contains the sights, the night lighting devices, the spare parts, the keys and the implements necessary to the mounting of the platform.

2. — Pointing.

Elevation and traversing are accomplished separately, by means of handwheels.

(*a*) For laying in azimuth the framework rotates around a pivot in the pit. Movements of large amplitude are given by disengaging the clutch and pushing the framework by hand.

Keeping on the target is accomplished by gún pointers at the traversing and elevating handwheels.

Laying in azimuth is done with a right angle sight mounted on a goniograph, the latter apparatus giving automatically the lateral deflection correction corresponding to the displacement of the target as functions of the "firing data," viz.: The altitude, the fuse-setter range, the engine speed of the target and the angle of approach. A special graduation allows the secondary lateral deflection corrections to be registered, especially as regards wind.

There are two regular goniograph models. For each goniograph model the right angle sight has been adjusted to keep its axis parallel to the axis of the gun for all angles of site when no lateral deflection is set. The lateral gun pointer, seated on a seat fastened to the right hand truss of the platform, is placed so as to easily look through the right angle sight and operates the traversing handwheel.

A lateral deflection setter, standing close to him, sets the firing data on the goniograph. All provisions of the present Regulations are adapted alike to both models of goniographs.

The collimators joined to certain goniographs should be replaced as soon as possible by right angle sights, affording greater accuracy in pointing. In the meantime, it is of course necessary, in those stations where there is still a collimator, to interchange the seats of the gunner and the setter.

The rules given in the present Regulations for guns provided with any other apparatus than the regular goniograph, are therefore of the same provisional standing.

(*b*) Pointing in elevation is effected by the winch operating handwheel. This method of pointing is the only one possible for the guns provided with the model 1915 Range drum (Hausse Garnier).

The regulation pointing apparatus is the independent range drum, 1915 (Hausse Garnier) to which a sitiogoniograph has been adapted. The latter apparatus is mounted on a support fixed to the left hand truss of the platform and which, through an articulated parallelogram, participates in the motion of the carriage on which the cradle is fixed.

The optical axis of the aiming sight may nevertheless be displaced in relation to the gun by three different movements, a traversing movement allowing the gunner to find the objective in the field of his telescope when there is a lateral deflection; an elevating movement permitting the principal vertical deflection correction, and a third movement to set the angle of super elevation. The angle of super elevation is given automatically by a range drum graduated in fuse setter ranges. The principal vertical deflection correction is set on the sitiogoniograph. The secondary corrections are set on the right hand side of the gun carriage and are read on a drum graduated in mils.

The vertical pointer is posted on the platform facing the direction of the fire, at the left side of the winch operating handwheel.

The range drum and the sitiogoniograph are operated by two privates, seated on seats fastened to the left hand truss of the platform.

3. — Description of the semi-fixed mounts for use with the army.

This mount has the same framework as the semi-fixed mounts for fortified towns, but its earthwork is simplified.

The pit consists of an earthwork in the shape of a truncated cone 1.20 meters deep, 1.80 meters in diameter at the bottom and 4 meters in diameter at the top.

The roller path is made of an iron circle bolted to twelve blocks of wood.

For transportation, it is taken down in four parts.

The pivot socket is bolted to a bolster made up of two layers of wooden blocks bolted together and designed to distribute the weight of the pivot on the ground.

The pivot socket is centered in the roller path circle by eight iron tie rods bolted to the roller path and to the bolster.

Assembling sheers are used to mount the gun on the platform.

The entire platform is transported on two trucks, one of which should have a flat floor without side racks.

On this truck are loaded:

(*a*) The two trusses of the framework, laid down flat, the upright being placed perpendicular to the axis of the truck.

(*b*) The implement chest, containing the braces, the keys, hammers and the pointed bolts for assembling, etc.

(*c*) The winch.

(*d*) The equipment chest.

On the other truck are loaded:

(*a*) The roller path, taken down in four parts.

(*b*) The pivot socket, bearing bolster and its clamps.

(*c*) The assembling sheers.

(*d*) The operating handspike, the ropes and wood blocks.

The trucks have not been included in the materiel to the units. When needed, they are provided by the army, as well as the limber and the horses necessary for the transportation of the apparatus and various implements.

4. — Setting up the platform mount.

Laying the roller path.

This operation will be described only with reference to the semi-fixed materiel for use in the army.

The following method is used:

(a) Laying the roller path.

Level and ram the ground on which the roller path is to be set, place its four parts one after another and join them with the bolts, steel clamps and wood wedges.

Make sure that the roller path is horizontal, using the four meter-rule and the mason's level; if necessary use wedges under the lower parts and ram the upper parts.

(b) Digging the pit.

Dig a hole about 2 meters in diameter and 1.20 meter deep, join the bottom of this hole to the edge of the traverse circle by a slope. Ram loose earth against the roller path support.

Carefully ram the bottom of the hole in order to level it and make certain, by laying on the roller path the 4 meter rule and the slope gauge, that the profile of the hole is of the required size.

(c) Placing the bolster.

Bring the bolster down to the bottom of the hole by slipping it along two planks laid flat against the slope. Then with the handspikes bring the pivot to the center of the hole and set up the bolster so as to have the *sheer*-trunnion beds on one side of the pit, near the gun, and the fastenings of the tie-rods opposite the corresponding fastenings of the roller path.

Bolt the tie-rods to the bolster and the roller path.

Finally throw some earth between the joists of the bolster and ram firmly, fill in this way the bottom of the hole up to or above the joists.

5. — Mounting the framework.

(1) Remove the nut from the pivot, place the pivot support, replace the nut.

(2) Place the two trusses of the platform in the pit, place the rollers on the roller path, the leg of the upright in the bottom of the pit on a block of wood about 15 centimeters thick and laid so as to support the pivot.

(3) Set one of the trusses and lift its foot above the pivot support, place the legs of the upright and bracket against their props on the pivot support; set the assembling bolts, using, in case of need, a pointed bolt and a hammer in order to bring the bolt recesses opposite one another in both pieces; do not tighten the nuts.

During this operation hold up the end of the central bracket with wood wedges and fix the rollers on the roller path.

(4) Set both trusses in the same manner.

(5) Join the two trusses by bolting the flooring braces without tightening the nuts, then bolting the brace connecting the center uprights.

(6) Tighten the nuts, tightening first the nuts of the brace connecting the center uprights.

(7) Bolt the winch support to both trusses and tighten the nuts.

(8 Place the operating gear of the winch by assembling the jointed shaft to the end of the worm.

(9) Push by hand the rear part of the platform and rotate it completely in order to make sure that the rotation is easily effected.

6. — Mounting the gun.

In firing against aerial objectives, only those recoil cylinders are to be used which have been specially designed *for vertical firing.*

First remove the shields and the wheelbrake, then by operating the traversing wheel, place the gun carriage in the center of the axle. Then proceed as follows:

Rotate the platform so as to have the pivot support parallel to the trunnion beds of the sheers. Fix it in this position by propping the rollers.

Place the assembling sheers on the fore part of the platform, its foot trunnions having been inserted into the sheers-trunnion beds and caught by the hooks, its upright resting on the roller path, the end of the uprights resting on the roller path being from 30 to 40 centimeters above it. Place the trail between the uprights and let it rest on the central brace of the sheers, then fasten the winch cable to the pintle ring.

Back the gun so as to insert the axles into the forks of the assembling sheers in order to give the cable a light tension.

Fasten a rope on each side of the axle, having these ropes pass over a pinch bar resting on the gun trunnion seats of the central brackets.

Fix a guy-rope round the gun, in order to control the gun. The vertical gun pointer takes his place at the operating wheel of the winch; two cannoneers take their places at each wheel of the gun and two at the chase, the other cannoneers, in two equal groups, stand on the flooring and at the rear of the platform. Each group grasps one of the ropes fastened to the axle.

At the command of the gun commander, all men make an effort to lift the gun. As soon as the wheels have been lifted up a few centimeters, remove them and lay them down; then replace on the axle the cup-shaped washers and the linchpins and rings.

The gun is then lifted, by raising the sheers vertically against the uprights.

Towards the end of the operation, the pinch-bar is removed from the gun trunnion beds and the cap-squares raised again; the cannoneers standing at the wheels grasp the guy-rope and lower the sheers gently against the uprights.

The gun commander, with a hand spike, guides the trail between the uprights in order to give direction to the motion caused by the hand wheels of the gun carriage. He directs the trail between the brackets under the winch.

The assembling sheers having been lifted vertically the gun commander makes certain that the axle-covers of the carriage come in a suitable manner between the trunnion bed-plates of the uprights. If not he operates the traversing wheel in order to move the gun along its axle in the proper direction.

The axle is allowed to come down slowly into the trunnion bed-plates, by operating the jackscrews of the sheers.

The cap-squares are pulled down and bolted; the sheers are freed by driving their feet along the bolster. Remove them and lay them down outside the platform.

Place a plank serving as a bridge between the roller path and the brace connecting the upright centers. Bring the counterweight to this plank under the gun-chase.

Pass through the central hole of the counterweight the steel cable of the balancing beam; fasten a rope to the counterweight by a slip knot.

The rope is wound one and a half times around the gun-chase and its end is held by two men standing in the pit.

At the command of the gun commander, one man handles the counterweight. He is assisted by the men holding the pinch-bar, and lifts the counterweight by pulling on ropes passing through the counterweight until it is high enough to be fastened by the cable. The two ends of the cables are then fastened with bolts and nuts.

Place the balancing beam by placing its foot into the angle made by the trail upper plate and the hind transom, the slide-block of the wheel passing in the clearance made in the foot of the balancing beam. Then place its other end in the seat of the counterweight and last of all fasten the foot of the balancing beam to the trail with the ring of the balancing beam and the nut taken from the wheel-brake.

Remove the rope and the pinch-bar, and after lubricating the cable remove the plank serving as a bridge.

Remove the pintle ring fastening rope.

Bolt the upper brace, remove the rope fastened to the axle and the chase, remove the wedges stopping the rollers, finally adjust the elevating and traversing apparatus.

7. — Dismounting the gun.

Remove the upper brace of the uprights.
Unfasten the winch cable from the pintle ring.

Replace by a spare rope the towing rope of the winch cable.

Place a plank to serve as a bridge between the roller path and the central upright brace.

Remove the beam nut and washer. Put in the center of the counterweight a rope handled by a man in the manner described above for the mounting. Use the pinch-bar in the same way. Remove the nuts fastening the ends of the steel cable.

Remove the balancing beam.

Take down slowly the counterweight, two men standing in the pit support it with the pinch-bar. The man standing on the plank pays out the loose rope. Rest the weight on the plank.

Take it away and remove the plank.

Traverse the platform in order to have the pivot-supporting brace parallel to the trunnion beds in the sheers foot.

Place the sheers on the bolster in the manner used for the mounting and place the forks into the necks of the axle sleeves; fasten a rope to the axle on each side of the mount.

Lift the cap-squares, operate the sheer jackscrews in order to lift the gun and disengage the axle from the trunnion bed plates.

Push the axle forward until it is placed in equilibrium. Make sure that the ropes have been passed on the inner face of the uprights and let the gun come down slowly, the ropes being held by the men standing on the platform in the same manner as for mounting.

The vertical gun pointer operates the winch so as to facilitate this motion; he should turn the wheel rather quickly and the other men should hold the ropes sufficiently tight to allow the motion to be regulated by the winch.

Place the wheels on the axle, loosen the cable from the trail-end and limber the gun.

8. — To take down the platform.

Take down the winch operating gear; for this purpose remove the pin and the central spindle from the jointed shaft of the worm, then put back these parts on the central piece. (After separating the shaft from the operating gear, tie this shaft to the framework by a string.)

Take down the winch and the braces of the trusses, being careful to fasten the assembling bolts to each of the parts taken down, screwing the nuts by hand.

Place some planks close to the pivot in the manner indicated for the mounting.

Unbolt the pivot support.

Lift each of the trusses in order to free it from the pivot support, place it on the flat truck.

Unbolt the tie-rods, remove them from the bolster.

Dismount the roller path by driving out the chocks with the hammer.

Remove the bolster; for this purpose, clear off the earth heaped up round the joists, lift the bolster with hand spikes, then draw it up out of the hole with ropes, sliding it along two planks.

Organization and Instruction of the Battery.

9. — Composition of the Battery.

The battery comprises one or two firing guns, two as a rule. In the table below a list of the personnel is given for either case. The battery is commanded by a first or second lieutenant. In the two gun batteries, this lieutenant is assisted by another officer either first or second lieutenant or, occasionally, by an adjutant.

The battery personnel is divided into:

Two gun crews, each of which is commanded by a gun commander.

One range section at the battery commander's station commanded by a non-commissioned officer.

One search-light section commanded by a non-commissioned officer.

Personnel of the battery.

	BATTERY of one gun (semi-fixed mount).				BATTERY of 2 guns (semi-fixed mount).			
	Officer.	N. C. O.	Corporals.	Cannoneers.	Officers.	N. C. O.	Corporals.	Cannoneers.
Battery Commander's Station	1	"	"	"	2 (1)	"	"	"
1st gun crew (2)	"	1	"	11	"	1	"	11
2nd gun crew (2)	"	"	"	"	"	1	"	11
Range Section (3)	"	1	4	13	"	1	4	13
TOTAL (4)	1	2	4	24	2	3	4	35

(1) One of these officers may be replaced by an adjutant.
(2) See particulars chapter I.
(3) Do. II.
(4) The unit has in addition:
Battery of one gun: 1 N. C. O., 1 corporal, 5 men.
Battery of two guns: 1 N. C. O., 1 corporal, 8 cannoneers. (Assigned to the different crews as a reserve) and the search-light apparatus, served by one corporal and 4 men.

10. — Division of the regulations,

The object of the present regulations is to put into practice the rules laid down in the "August 15, 1916, Provisional Instruction for Firing the 75 mm. Gun against Aerial Targets".

It comprises an introduction and three chapters:

CHAPTER I.—GUN CREW.

CHAPTER II.—RANGE SECTION.

CHAPTER III.—SCHOOL OF THE BATTERY.

11. — General principles.

"Act as a model to your men."

Individual instruction is to be given according to the following rules:

(1) Employ as many instructors as possible.

This method allows the men to be distributed into small groups and to perform often the duties they are taught.

Understanding is not sufficient; every man must actually be capable of performing his duties.

(2) For explaining a movement:

(*a*) If the movement is complicated, divide it into parts, each part being taught separately.

(*b*) First teach every man the new names which will be used in the course of the instruction. This instruction in nomenclature is to be made so as to give him an elementary notion of the working of the apparatus.

(*c*) Cause the individual soldier to see the movement, act as a model to him, speak to his eyes, avoiding all needless speech, using words only to call his attention to the most necessary precautions. For this reason the N. C. O. must perform the movements perfectly and the men be always posted so as to see distinctly.

(*d*) Make sure that the individual soldier has understood:

By making him repeat the nomenclature and actually execute the movement.

By avoiding all sham.

By asking him in the beginning to take an interest in the work. Quick performance will come naturally as a result of repetition.

(3) In order to keep the soldier's attention, vary in the course of every instruction the program and, if possible, the nature of the things taught. Do not pass over things that are not fully understood.

(4) Be careful to know the abilities of every individual soldier so as to be able to make the most satisfactory details.

Aerial targets, fleeting and transient as they are, require

extremely rapid firing. To keep his personnel in the highest training, is the duty of every battery commander.

Therefore the drill schedule for every unit should comprise two short daily drills against friendly or dummy planes, and such drills should be omitted only to give place to actual firing.

The Battery Commander will increase his firing skill by conducting, after every practice, a critique of the firing.

He will also criticise the work of his subordinates founding his criticism on observed errors or detailed reports.

CHAPTER I

GUN CREW.

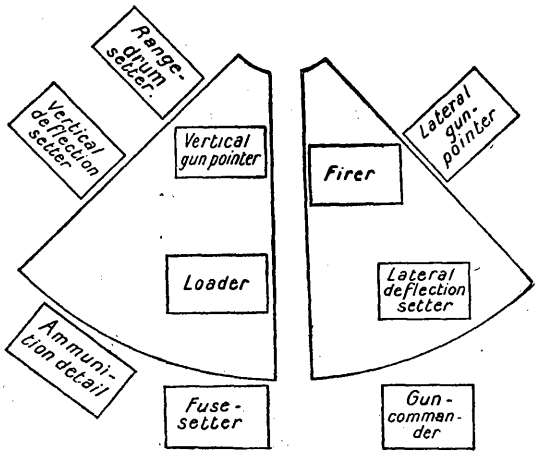
(A) Gun Drill.

12. — Duties of the crew.

The service of the guns is carried out under the direction of an N• C. O., acting as a gun commander, by eleven privates whose essential duties during the firing are:

3 Ammunition detail...	supply cartridges to the fuse-setter.
1 Fuse-setter	sets the range at the fuse-setter and cuts the fuse.
1 Loader	introduces the cartridges into the bore.
1 Firer	opens and closes the breech and fires the piece.
1 Range Drum setter...	sets the range drum continuously.
1 Lateral gun pointer..	keeps on target by operating the traversing hand wheel.
1 lateral deflection setter	sets the firing data on the goniograph.
1 vertical gun pointer..	keeps on the target.
1 vertical deflection setter	sets the firing data on the sito-goniograph.

13 Posts of the crew during the firing, as per sketch.



No. 1 ammunition detail at fuse-setter.
Nos. 2 and 3 move about the piece.

14.—Duties of the ammunition Detail Nos. 1, 2 and 3.

Posts.

Nos. 2 and 3 take position between the platform and the ammunition chest.

No. 1 takes position on the ground, in rear and at the right side of or in rear and at the left side of the fuse-setter.

Duties.

(*a*) No. 1 hands the cartridges to the fuse-setter.

Nos. 2 and 3 take the cartridges out of the chests and place them in the compartments close to the fuse-setter (1). Go to the chests containing cartridges of such model as was indicated by the Battery Commander (2), take two cartridges, come back to the platform and place them in the compartments within reach of No. 1.

Keep the cartridge compartments full.

(*b*) No. 1 supplies cartridges to the fuse-setter.

No. 1 takes the cartridges one by one out of the compartments close to the fuse-setter, with the fuse downwards, holding with one hand the ogive, with the other hand the bottom of the case. Places it without shock on the bot-

tom of the box, rotate it slowly clockwise until the protruding lug drops into the groove.

These compartments are to be filled at the beginning of the firing.

Whatever their model, the cartridges are generally distributed into three chests placed around the gun and at the three vertices of an equilateral triangle.

When there is enough personnel, another man may be added to the ammunition detail if it is easy to move around the platform. In case of need, the Gun Commander will himself act as an extra man for ammunition.

As soon as the fire is stopped the ammunition detail removes the cartridge cases which have fallen into the gun pit.

15. — Duties of the fuse-setter.

Post.

Stands facing the fuse-setter.

The fuse-setter is, as a rule, provided with a telephone head-set.

Follows the platform when it moves (*).

Duties.

(*a*) Sets the corrector.
(*b*) Sets the range.
(*c*) Cuts the fuse.
(*d*) Hands the cartridge to the loader.

(*a*) *Setting off the corrector.*—The corrector to be set, unless something else was ordered (when no modification has been introduced after trial shots).

For firing against aeroplanes.

With 30/55 fuse, corrector 14.

With 22/31 fuse, corrector 21.

With 24/31 (explosive shells) fuse, corrector 17.

For firing against dirigibles:

(1) With 30/55 fuse, the fuse-setter operates the corrector's worm knob and brings the index opposite the corrector reading ordered.

(2) With 22/31 fuse, loosens the corrector tightening lug and slides the corrector until the index is opposite the reading ordered; then, holding the corrector with one hand, tightens again the tightening lug with the other.

(*b*) *To set the range.*—The range in hectometers (**)

(*) The stations which fire shells requiring the use of two fuse-setters place them side by side on the rear part of the platform flooring. The Battery Commanders are allowed to change the position of the fuse-setting machine and to place it on a shelf fastened to the platform.

(**) It is absolutely necessary that the range set by the range drum setter be the same range which was used in setting the fuse

(see par. 34) is given to the fuse-setter, by the man who reads the altitude telemeter.

It is announced to him through the telephone or, for want of telephone, through a speaking tube or transmitter.

At the command:

SAY (range : 59),

the fuse-setter grasps with his right hand the crank handle, operates it so as to ungear it and turns it in the proper direction until the correct range is opposite the index (*). Presses down on the handle cutting the fuse.

At the command:

"WITH TRACER SHELLS,"

set the special index and read the range on the red graduatio ı.

Changing the cartridges. When nothing else is ordered the 22/31 shells are fired as far as 6900 and the 30/55 shells beyond 6900.

At the beginning of the firing and as soon as the first range has been ordered, the fuse-setter announces aloud the fuse to be used, announcing 22/31 or 30/55 (**); he then announces in the same way every change of the fuse.

(*c*) *To cut the fuse.*—Grasp the lever with the right hand, pull it down hard and raise to a vertical position, so as to withdraw the blade from the fuse.

Then pass the cartridge to the loader.

Always work the handle with the right hand.

(*d*) *To pass the cartridge to the loader.*—Grasp the cartridge with the left hand over the centering band, raise it to take it from the ogive box, then place the right palm under the ogive, hand the cartridge to the loader, point first, announcing in meters the fuse setter range that has been set.

16. — Duties of the Loader.

Post.—Stands at the left side of the gun, about 1 meter in rear and at the left side of the breech, facing the breech.

Duties.—Receives the cartridge from the fuse-setter and inserts it in the breech.

Turns to the right, takes the cartridge handed by the fuse-setter, his right hand grasping the bottom, his left

---

introduced into the gun. In order to avoid any mistake, ranges are announced in hectometers by the man who reads the telemeter; the fuse-setter, when handing the cartridge to the loader, announces the range in meters. This range repeated by the loader, comes with the cartridge and is heard by the range drum-setter.

(*) In order to avoid errors when using the 30/55 fuse it is necessary that great care be taken to see that the pointer is opposite the proper curve.

(**) Until 30/55 shells are supplied in sufficient quantities for total use.

An elongated time fuse increasing the range of the 22/31 shell beyond 6900, is being made.

hand resting in rear of the ogive, faces the breech, carefully places the ogive in the chamber, dropping his left hand from the projectile. Gives the cartridge a push with his right hand, then lets the breech block operator finish the movement.

As soon as the preceding shot has been fired, repeats to the range-setter the range announced by the fuse-setter for the next shot. Repeats also the data: 30/55, 22/31, high explosive shells.

17. — Duties of the Breech block Operator,

Post. — Stands at the right side of the gun, close to the breech, and facing the handle.

Duties. — (*a*) Operates the safety device.
(*b*) Opens and closes the breech.
(*c*) Completes the loading.
(*d*) Pulls the lanyard.
(*e*) Handles the rammer.
(*f*) Sets off the secondary vertical corrections.

(a) *To operate the safety device.* — The breech being closed and the safety device in travelling position, in order to bring it to the firing position, he grasps with his left hand the stop bolt knob, draws it to the rear, and rotates it clockwise until its motion is finished.

The safety device being in the firing position, to bring it to the travelling position, make again the same motions, rotating the safety device in a counter-clockwise direction.

(b) *To open and close the breech*, grasp the handle with one or both hands, nails downward, and rotate it to the end of the motion. At the end of the opening motion in order to eject the cartridge or the cartridge case it is necessary that the last motion be made with full strength.

When the cartridge is inserted into the bore, the cartridge case rim bears against the ejector, pushes it forward and begins the breech closing motion. The breech block operator must be careful not to oppose this motion, but to achieve it by turning the breech until the motion is at an end. He holds back the breech at the end of its motion to prevent it from springing back in case the pawl should not work.

(c) *To finish the loading.* — He finishes the loading commenced by No. 3 by shoving the cartridge case with his left hand closed, which should be protected with a special glove. He closes the breech with his right hand.

(d) *To fire the gun.* — The piece having been loaded, the lateral gun pointer having called "Ready," the firer, taking into account, when needed, the data given by the vertical gun pointer, fires the piece. To this purpose he bends so as to grasp with his right hand the lanyard handle, draws it to the rear and pulls it down lightly to the end of the motion and suddenly releases it.

In case of misfire, he pulls the lanyard several times,

waits a few seconds, then if the gun does not fire, opens the breech and operates as in article 27.

(e) *To use the rammer.* — The rammer and sponge are used only by the firer. They are replaced only in case of a change of position.

To withdraw a cartridge or a cartridge case, the breech block operator introduces the rammer into the muzzle of the gun and hits with the rammer head the fuse or the bottom of the cartridge case.

When the cartridge is to be withdrawn, No. 3, of the ammunition detail, standing at the breech, receives it in both hands.

(f) *To apply the secondary vertical corrections.* — At the call "Wind, so much," made by the wind drum operator and repeated either by the deflection-setter (*) or by the man at the voice tube, the firer brings the secondary vertical corrector to the reading ordered.

18. — Duties of the Range drum-setter.

Post. — Seated, facing the range drum, and sets the fuse-setter range.

The range having been announced by the fuse-setter, and repeated by the loader, the range drum-setter grasps the edge of the right disk, rotates it and keeps it set in spite of the index motions caused by the movement of the gun. Each range must be kept set for the shell whose fuse has been cut at this range, even if the fuse-setter has already announced the range for the following round.

Changes of range below 500 are quickly made. Changes of range beyond 500 are set progressively, to prevent the objective from going out of the telescopic field. On the compound disk, the 22/31 range curves are black; the 30/55 curves are red. At every change, the model of the fuse is announced by the fuse-setter and repeated by the loader.

19. — Duties of the lateral gun pointer.

Post. — Seated on a seat fastened to the outside of the right truss; his right eye looking through the right angle sight; both his hands resting on the traversing wheel.

Duties. — To traverse; operates in the proper direction the traversing wheel so as to bring the target on the vertical cross-hair.

At every new deflection, lays anew the gun as quickly as possible. Prevents the objective from going out of the field of the telescope by giving slight vertical motions to the goniograph. These motions are made with one hand

(*) When the wind drum has been set on the gun (See the note No. 20), the deflection setter reads directly the correction at the wind drum.

so quickly as to drop this hand from the wheel only a moment.

The goniograph may also be moved by the lateral deflection setter according to the indications given by the lateral gun pointer.

At the closing of the breech, the laying having been verified, he calls, "Ready," and keeps a very accurate laying up to the time the gun is fired.

To roughly lay the gun on the target it is necessary to use the small pointer on the left of the right angle sight. The gun is laid either by the lateral gun pointer or by the gun commander, and after the target appears in the right angle site, it is kept there by the lateral gun pointer.

20. — Duties of the lateral deflection-setter.

Post. — In rear of the traversing apparatus, seated or standing, and facing the apparatus.

As a rule, the lateral deflection-setter is equipped with a telephone head set, connecting him with the central telephone man of the B. C. Station (Par. 39). Commands reach him through the telephone, the range excepted, which is announced, close to him, by the loader.

For want of the desired telephone systems, commands are given by voice by the gun commander, who receives them through a telephone with head set (*) or through a speaking tube.

Duties.

(*a*) Sets the principal lateral deflection correction.

(*b*) Sets the secondary lateral deflection corrections.

(*c*) Transmits the commands to the firer (Secondary vertical deflection corrections).

(*a*) To set the lateral deflection correction. At the command,

"SPEED" (e. g. — speed 35),

sets the pointer opposite the speed commanded paying attention to the projectiles used (22/31, 30/55, explosive shells). If in doubt, he asks the fuse-setter.

At the command,

"ALTITUDE" (for instance — Altitude : 3500),

sets the altitude index at the desired altitude.

In the course of the firing, the altitude is altered only for large variations (beyond 500).

At the command,

"RANGE" (for instance — 6200),

sets the pointer until the curve corresponding to the desired range and shell model is brought opposite the altitude index.

In the course of the firing, the range should be given in multiples of 1000 meters (within 500 meters). It is therefore not necessary to vary it after each shot.

(*) Which arrangement saves one telephone for each gun.

At the command,

"ANGLE OF APPROACH" (for instance — coming + 45),

he operates the main alidade by grasping its tightening knob, and brings the deflection index opposite the desired angle of approach curve.

In the course of the firing, he changes the data according to orders, and at the beginning, he sees that his instruments are at zero.

(*b*) To set the secondary lateral deflection corrections.

At the command,

"INCREASE THE LATERAL DEFLECTION BY SO MUCH," or

"DECREASE THE LATERAL DEFLECTION BY SO MUCH,"

he causes the ordered deflection to be registered at the secondary corrector of the goniograph by operating its controlling screw.

(*c*) To transmit the order to the firer.

Repeats to the firer the indications, "Wind drum, so much," received through the telephone.

21. — Duties of the vertical gun pointer.

Post. — On the floor of the platform, facing the direction of the fire, at the left side of the winch operating handwheel.

Duties. — Keeps on the target.

Operates with his right hand the elevating handwheel, so as to keep the target on the horizontal cross-hairs.

Gives the desired direction to the telescope, with either the nose or the left hand.

At the closing of the breech, keeps a very accurate laying up to the instant of firing. If by accident, the piece has not been laid, warns the firer by signaling, "Stop," then, as soon as possible, signals, "Ready."

22. — Duties of the vertical deflection-setter.

If possible, the vertical deflection-setter is equipped with a telephone head set connecting him with the B. C. Station. He receives the commands through the telephone, the range excepted, which is repeated close to him by the loader, and which he can read on the range drum. If a sufficient number of telephones are not at hand, the commands are given by voice by the gun commander, (See No. 20.)

Post. — On an outer flooring fastened to the left truss, at the right side of the range drum-setter and facing this drum.

Duties. — Sets the principal vertical deflection correction.

(1) The piece has an independent sight with sitogoniograph.

At the command,

"SPEED" (for instance: Speed, 35),

he moves the speed slide so as to bring its index opposite the desired reading (one of the indices is adapted to the

shells with 30/55 fuses and to the explosive shells, the other to the 22/31 fuses) if in doubt, he asks the fuse-setter "fuse."

At the command,

"ALTITUDE" (for instance—Altitude:3500),

moves the altitude pointer so as to bring its point to the reading which corresponds to the desired altitude.

In the course of the firing, the altitude is to be given within 200 meters.

At the command,

"RANGE" (for instance—6200),

moves with his right hand the speed slide and altitude pointer shank so as to bring the suitable pointer to the curve corresponding to the ordered range and proper fuse.

In the course of the firing, the ranges should be given in kilometers up to 6000 m., and in multiples of 2000 m. beyond that. Therefore, it must not be modified at each shot.

At the command,

"ANGLE of approach" (For instance — coming + 45),

operates with his left hand the angle of approach disk so as to bring the speed slide index to the curve corresponding to the ordered angle of approach.

In the course of the firing, change data according to orders, and, after each change of data other than the angle of approach, set anew the last ordered angle of approach.

In the beginning he sees that the scales read zero. (If this is not done it will be difficult to locate the target.)

(B) School of the gun crew.

Verification of the lines of sight.

23.—This verification is most important. It must be made frequently by an officer.

(*a*) *Traversing Apparatus.*

The adjustment comprises three operations.

(1) *Verifying the line of sight for a point of low site.*

Aim the gun at a point beyond 1,000 meters, using the open sight. Set the sight at zero on the goniograph.

Rotate the goniograph bracket so as to bring the vertical axis (or the vertical cross-hairs of the telescope) on the chosen point.

Tighten the nuts. Make sure that the tightening has not changed the sight.

(2) *To verify the horizontality of the goniograph bracket trunnions.*

For want of a star for high aiming point (in which case, it is sufficient to make sure that the lines of sight are kept adjusted upon the star), fasten to the gun muzzle a shank nearly parallel to the axle.

Make a line with a pencil on this shank at the intersection of the aiming direction of the right angle sight, the latter being kept at the same reading as before.

Make sure that, by changing the inclination of the gun, the aiming direction of the sight is kept pointed upon this line.

If this condition has not been obtained try to obtain it by suitable displacing of the bracket. This may be done by inserting wedges between the bracket and the platform upright.

(3) *Repeat the first operation* — with this difference, that *a minus ten and not the zero reading must be set off* (*).

Tighten the sight fastening nut. Make sure that this tightening has not turned the sight and, if it has, begin anew the operation, trying to lock tight the lateral nuts before operating the fastening nut.

(*b*) *Elevating Apparatus.*

The verification of the lines of sight is made in five successive steps:

(1) *Verifying the verticality of the axis of the support socket.*

Place a level on the upper face of the socket, first in a parallel, then in a perpendicular direction to the socket, and make sure that in either position the level bubble is centered. If not so, slacken the bolts of the fixed support; according to the direction in which the verticality is not secured, move the socket forward or backward by taking advantage of the play between the fastening bolts and their sockets, or insert, between the fixed support and the balk, suitably thick iron strips. Verify again the horizontality.

This operation does not require very great accuracy.

(2) *Securing the parallelism of the axis of the axle to the range drum apparatus axis* (Hausse Garnier).

Lay for direction upon a remote point (beyond 500 meters) with the open sights of the gun.

Place the adjusting collimator on the corner-iron of the rear arm, lean it tight against the rim and rotate the whole apparatus round the vertical axis until the vertical axis line of this collimator passes through the chosen point.

Fasten the apparatus by slightly tightening the lateral securing nuts, then tighten the lower bolt. Make sure that this tightening has not turned the apparatus; begin again, if necessary.

(3) *Make sure that the range and vertical deflection drums are set at zero, that there is an angle of 45° between the aiming point of the sight and the plane of the corner iron of the rear arm.*

For this purpose, set the square at 45° on the corner iron of the rear arm, and, on this square, place the adjusting

(*) This correction is for drift.

collimator. The range drum and vertical deflection being set at zero, and the apparatus being kept fixed, make sure that the aiming line of the sight is directed on the same point. (This operation should be made before assembling the rear and the fore arm.)

If it is not, operate the two adjusting screws, fastening the telescope supporting finger until the parallelism of both aiming lines is obtained.

(4) *Verifying the parallel motion.*

Connect the rear and fore arms.

Place the level on the rear arm corner iron, and center the bubble by operating the rod adjusting nuts. Make sure that this tightening has not damaged the parallelism of the two arms.

(5) *Verifying properly the lines of sight.*

Set the secondary vertical deflection drum at the reading 100, the motion being ended by depressing the muzzle of the piece.

Place the level on the corner iron of the rear arm.

Center the bubble by the winch operating hand wheel. End the motion in a well determined direction, for instance, by lowering the trail.

Place the 45° square with its level at the top on the flat surfaces of the gun.

Operate the cradle operating wheel and center the bubble; end the motion by elevating the breech. Read on the wheel the number obtained.

Set the cradle operating wheel in the mean position between these two measures by turning in the same direction as before (elevating the breech). Pin it with its nut and fasten it to the mount.

The difference between the two measures must not exceed ten mils. If this is not the case, take up the play which may exist between the mount and its axle by adjusting each of them in relation to the other by a cut and try method.

N. B. — (*a*) If a high aiming point (star) be provided, the 3rd and 5th operation may be replaced by the following one:

The range drum and vertical deflection being set at zero and the secondary vertical deflection drum (graduated in mils) set at 100, elevate upon this point, cause the bore sights to pass through the same point by operating the cradle operating wheel. Measure twice, first by elevating; then by depressing the gun, then fix the wheel in a mean position as above. (The cradle should always be brought to its position by an upward motion of the breech.)

(*b*) For the stations provided with the Model 1916 simplified mount, measure the angle between the fore corner and the bore sights with the Model 1888 level, by taking a mean between two measures, as above.

Then make the third operation, replacing the 45° square by setting the level at the obtained angle, then the fourth operation. If the adjustment is not realized in this way,

correct the error by moving the vertical deflection correction index.

24. — Preparation for action.

The lines of the sight having been verified, in order that a gun be ready to fire, the following conditions are required:

(*a*) The muzzle cover and breech cover must have been removed.

(*b*) The recoil cylinders inspected.

(*c*) The rammer placed close to the platform.

(*d*) The sights well set.

(*e*) The fuse-setter (or fuse-setters) set.

(*f*) About 20 shells (with fuse-covers off) placed in the compartments next the fuse-setter;

(*g*) Some chests containing 100 shells (of which 40 at least have fuse covers off) placed close to the platform (*).

(*h*) The supplies provided, with the tools necessary for rapidly opening the fuse-covers (in case of prolonged firing).

(*i*) The communications with the Battery Commander's station (by telephone or otherwise) set in working order.

(*j*) The commander of the station decides, according to the time, when the preparation for action must be made.

25. — Locating the target.

For locating the target, the roller path should be provided with an azimuth circle painted on its inner edge, graduated in hundreds of mils, and turning counter-clockwise. The platform must be provided with a pointer which allows an accurate reading of the graduation. This graduation should correspond to a similar graduation reproduced on each apparatus of the B. C. Station so that all apparatus, being set at zero, may point in the same direction, by preference to the northern direction, which makes it easier to mark the direction on the map and to locate the target from the neighboring batteries. For adjusting the zero reading of the apparatus, point them all upon a remote point of which the azimuth is known.

The platform must moreover be provided with two site graduations, the first of which allows one to read the inclination given to the piece by the motion of the trail (**)

(*) In the stations where firing is not frequent, the preparations concerning the previous opening of the cartridge boxes, and removal of fuse-covers may be altered by the local commanders whose duty is then to take the necessary precautions to prevent the opening of the fuse-covers in the course of the firing from interfering with the fire.

(**) This graduation may be established by several ways, either by fixing at the end of the axle a sliding pointer opposite a graduated mil disk fastened to the platform truss, or by graduating the winch uprights and the inner edges of the platform and reading at the level of the upper edge of the trail.

the second to read the inclination of the right angle telescope sight.

The statement "220, 30°," is then sufficient to approximately direct the gun and both sights towards the point in the sky where the flying machine is, and to allow both gun pointers to see it.

Be careful, for locating the target, to set at zero the range drum, the goniograph and sitogoniograph.

26. — Opening and conduct of fire.

As soon as the target is in sight, all cannoneers must be at their posts.

The gun commander makes sure that the piece is "ready to fire" (see par. 24), that the pointers see the target, that the telephone communications are in order.

He announces that all this is done by the report "Is (2nd) gun ready," repeated by the telephone operator.

At this time, even before the opening of fire, commands for range, altitude, speed, angle of approach and secondary deflection corrections may be sent from the Battery Commander's station.

This data must be set on the various instruments by the fuse-setter and the deflection-setters, as mentioned in the school of the piece. But the fuse-setter only sets the range without cutting the fuse. The pointers lay constantly. The range drum setter sets the range in accordance with the data he has heard. If no range has been ordered, the fuse-setter and the deflection setters set at 6,000.

The opening of fire is ordered by the command,

"COMMENCE FIRING,"

made by a whistle, according to the above indicated regulations. The fuse-setter cuts the fuse, and passes the cartridge to the loader. The round is loaded and the firer fires the gun as soon as the two pointers have called "Ready." The firing goes on without interruption and without hurry, the fuse-setter cutting the fuse every time in accordance with the range last ordered.

A pause in the firing is ordered by a command, made with the whistle. (See the following signal code.) At the command to

"SUSPEND FIRING,"

the manoeuvre is continued, the commands for range, angle of approach, etc., still being sent to the piece but the gun is not fired. At the command

"CEASE FIRING,"

the fire is over and cartridges are prepared with a view to resume the fire some time later.

All commands such as,

"OPEN FIRE," "CEASE FIRE."

are made by whistle signal, according to the signal code below:

One long blast.....Attention
One blast (1 second).....Commence firing.
Two short blasts.....Suspend firing.
Five or six short blasts.....Cease firing.
Five or six short blasts, followed by one long blast.....Change target.

As a rule, long blasts mean opening of fire; short blasts mean interruption of fire.

27. — Incidents which may occur during the firing.

(1) *Misfire.*

If the gun has failed to fire, the firer, after waiting some seconds, again pulls the lanyard; in case of need pulls a third time.

If the shot has not been fired, he opens the breech, if the cartridge has not been ejected, the firer takes the rammer, introduces it into the muzzle, and by repeated slight driving, ejects the cartridge, which the loader receives and lays aside.

In order to make easier the ramming, the vertical gun pointer operates, when needed, his operating wheel so as to decrease the inclination of the gun. He should be careful, during this operation, not to lose sight of the target.

(2) *Replacement of casualties.*

If the personnel is not sufficient, the following positions, if they must, may be vacated:

Gun Commander—acts as range drum-setter, which does not prevent him from supervising his piece.

If the loader is gone, the fuse-setter stands at the right side of the winch; the firer himself takes with his left hand the cartridges, the fuses of which have been cut, and introduces them into the breech.

No. 3 of the ammunition detail may be dispensed with provided that a sufficient number of shells without fuse-covers are close to the fuse-setter.

It is not possible to reduce the personnel to a lower number without slackening the fire. In case of need the first post to be left unmanned is that of the No. 1 of the ammunition detail, the fuse-setter himself taking the cartridges and introducing them into the ogive boxes.

28. — Special regulations for night firing.

For night firing, it is necessary to light the crosshairs of the telescope, and the various graduations which are to be read in the course of the firing.

For want of the regular lighting apparatus, emergency apparatus should be made. Cover the light as much as possible, in order not to dazzle the pointers who have to look at a very dim target. This may be done by placing electric lamps in a box with small openings made so as to send out the light only upon the graduations and never towards the pointers.

In order to see that the light is sufficiently covered, it is absolutely necessary to test this arrangement in utter darkness, the eyes having been made familiar to it during at least 5 minutes.

Verify each evening the key contacts and the working of the batteries. Have always spare batteries on hand.

In the course of the firing, the firer does not fire the piece before both pointers have called, "Ready." These pointers while calling, should shut their eyes and put their hand in front of them, in order not to be dazzled by the flash and to be able to resume immediately the laying.

If bad lighting makes it difficult to perform a regular manoeuvre, the Battery Commander uses the firing system indicated in No. 75 of the Firing Regulations (Firing by 4, progressive firing by 100, 200, or 300).

29. — Firing at the sound.

When the target is not visible, it may be expedient to fire "at the sound."

The gun direction, and inclination are then ordered by the Battery Commander and given to the pieces by using graduations mentioned in par. 25. The direction is set by the lateral gun pointer, according to the indications given by the gun commander, who looks at the suitable graduation on the roller path. The inclination is set by the vertical gun pointer according to the indications given by the range drum-setter. The deflection setters are of no use.

Commands are made for six rounds, by announcing, for instance, "Azimuth, 52; inclination 40°; raise up by 3." The indication of direction (Azimuth 52) applies to the 6 rounds. The indication of inclination (40°) applies to the first round. The indication, "Raise up by 3," means that, after each round, the gunner should rotate the winch operating hand wheel by three turns in the direction which increases the inclination of the gun.

The fuse-setter sets the range as was described in par. 26. This range is announced by the Battery Commander.

CHAPTER II

BATTERY COMMANDER'S STATION.

30.— Duties at the Battery Commander's Station when firing.

The personnel of the Battery Commander's Station consists of the officers, non-commissioned officers, and necessary privates for efficient fire control.

The station is ready for use when the instruments are ready and adjusted, and when communication is established:

(*a*) Between the Battery Commander's Station and the guns (generally by telephone).

(*b*) Between the Battery Commander's Station and the altimeter (generally by speaking tube).

(*c*) Between the altimeter and the distant posts (by telephone or "field signalers").

31. — Instruments.

Instruments must be available for establishing the Battery Commander's Station (B. C.) and two distant posts for observing and spotting (P. O. 1 and P. O. 2).

(A) *Posts without tachymeter.*

Regulation instruments furnished or to be furnished by the supply departments:

A field telemeter with automatic corrector, and an altimeter (Model 1916,) or an altitude telemeter with automatic corrector and a telemeter for horizontal distances fitted for measuring altitudes.

(With these two instruments, it is possible to measure either altitude and range, or horizontal distance, if the target is at a low altitude.) (See par. 69.)

An angle of approach telescope with wind drum, Model 1916.

An altitude tachyscope, Model 1916.

Regular apparatus to be built in the workshops and by the batteries.

A string altimeter, with an observation grille. (See par. 41.)

A set of observation grilles, in order to complete the altimeter. (See par. 49.)

Apparatus to be furnished by the supply departments:

Four tubes with luminous slits for night firing. (See par. 52.)

If there is no Model 1916 tachyscope available an impro-

vised tachyscope for the wind is built. If there is no regular wind dial available, improvise one. (See par. 38.)

N. B. — (1) A certain number of altitude telemeters do not have an automatic corrector.

Those having a site corrector may be provided with an independent sitogoniograph, or with a set of tables.

Those having no available site corrector may be provided with a pointing wheel or are completed by tables giving the correct range. (See firing instructions, Chapter IV.)

(2) The altimeter, Model 1916, is issued only to a few batteries. It is replaced either by a string altimeter with thread and grille, or by a set of grilles and a field telemeter, used as an altimeter, but independent of the telemeter at the B. C. Station.

For lack of an angle of approach telescope, an experienced N. C. O. is detailed for estimating the angle of approach with a good field glass.

Non regulation apparatus, the use of which may be allowed.

Many non-regulation but well built apparatuses may be used, especially the altimeter built on the principle of the "Flag." These can be used only after a special request to the "General Inspector," who will send a member of the "Commission d'études," to verify their accuracy.

(B) *Posts provided with tachymeters.*

The angle of approach telescope, the tachyscope and the altitude telemeter, are replaced by a single apparatus, called the teletachymeter, operated by 5 cannoneers and on which are read the future fuse setter range, the principal lateral and vertical deflection corrections.

This apparatus is not yet in use; it will not be spoken of again in the present regulation; its use will be the subject of a special book.

32. — Personnel of the Battery Commander's Station.

The crew of the Battery Commander's Station is divided as follows:

(1) *B. C. Station. — Fire Control Station.*

N. C. O. — Chief of Section.

Telemeter. { 1 corporal, equipped with a telephone. 2 privates.

Angle of approach telescope—2 privates.

Wind drum operator — (1 private) (except the batteries where wind drums are mounted on the platform).

Tachyscope (eventually) — 1 private.

Telephone central — 1 private.

(2) *B. C. Station, Observation and Altitude Crew.*

(*a*) String altimeter and grille connected with the altimeter.

1 N. C. O., chief of section — Reader.
1 Observer at the grille.
1 Observer.

1 Slide rule operator.
(*b*) Altimeter and separate grille.
Grille: 1 N. C. O., chief of section.
1 Observer.
Altimeter: 1 Observer.
1 Reader.
(3) *O. P. No 1 — and O. P. No 2.* — In each post.
Grille: 1 corporal, chief of post.
Altimeter: 1 Observer.
1 Reader.
N. B. — In the two gun Batteries, the observation and telemeter crews are placed under the special supervision of the second lieutenant, who goes frequently to the O. P. in order to be sure that the personnel of these posts use the apparatus properly.

33. — Duties of the personnel of the B. C. Station.

(1) *B. C.* — Station. Fire control. Section.
The N. C. O. in charge.
Duties: (*a*) Makes notes for the Battery Commander. Keeps all information relating to the firing. See as example the following model:
Example of firing report:
Section or semi-fixed post No. —
Date: — Hour of firing: —
Nature of the objective:
Summarized indications of the path of the objective:

SPEED.	ALTITUDE.	ANGLE of approach.	NATURE of the firing.	RANGES.	LATERAL deflection *correction* Increase—Decrease	VERTICAL deflection *correction* Higher—Lower.

LATERAL Observations.		ALTITUDE Corrections.		SPEED Corrections.		REMARKS
Short.	Over.	+	—	+	—	

(*b*) Supervises the work of the Fire Control station.

34. — Detail for the telemeter.

Duty: to determine the fuse setter range and send it to the fuse setter.

(A) Post supplied with a field telemeter with automatic corrector, Model 1916 (*).

Personnel: A corporal as reader (wears a telephone head set connected with the fuse setter).

A telemeter pointer.

A private to set the corrector.

Laying and Adjusting. (See Annex 1.)

(*a*) Duty of the pointer:

He lays on the target in direction and in elevation. The pointing in elevation should be exact; the pointing in direction may be approximate.

(*b*) Duties of the corrector setter:

1. Sets the speed.
2. Sets the angle of approach.
3. Sets the secondary sight corrections.

(1) Setting the Speed: At the order "Speed, so much" (for example: "Speed 35") loosen the screws that hold the beveled alidade; move the alidade so as to set the ordered speed; tighten the screw.

(2) Setting the angle of approach:

At the order "Coming (or Going) plus (or minus) so much" (for example: "Coming, plus 30"), move the angle of sight arm until the speed alidade, the beveled rule, and the proper angle of approach curve intersect.

(3) Setting the secondary vertical deflection corrections:

At the order "Wind drum, so much" (for example, "Wind drum, 75"), transmitted by the wind drum operator (**) and repeated by the telephone central, the ordered correction is set by moving the slide of the secondary corrections along the corresponding graduation. If the origin of this graduation is zero, the announced number is subtracted from 100. In the chosen example, instead of 75, 25 would be set.

(*c*) Duties of the reader:

1. Sets the altitude.
2. Sets the altitude corrections.
3. Reads the range.
4. Announces altitude to the telephone central at every important change (more than 200 meters).

(*) When the wind dials are on the carriage, the wind drum operator is unnecessary.

(**) Put on the secondary corrector the corrections ordered by the Battery Commander. The wind might be corrected for by a correction of the altitude (see firing instructions of 1916, August 15, par. 29) which is read by the telemeter operator on a dial similar to the wind dial and fixed at the telemeter tripod. But correction in this manner is difficult and should be done only when the wind is strong and the altitude very exactly measured.

(1) *Setting the altitude.* — At the order "altitude, so much" (for example, altitude 2000), given either by the altimeter or by the Battery Commander, if the altimeter is not available, take the altitude slide with the right hand, thumb pressing on the cross lined button in order to release it. Move the slide and set the ordered altitude.

(2) *Setting the altitude corrections.* — At the order "altitude more or less, so much," take the ballistic slide with the right hand and move it in the desired direction.

N. B. — If the altimeter is not available and if the Battery Commander wants to change the altitude, he orders the new altitude in meters. Occasionally when he has forgotten the preceding altitude, he can announce the information, "actual altitude, more or less, so much," the word "actual," telling to the reader that he has to move the altitude slide and not the ballistic one.

(3) *Ordering the range.* — Ranges are given to the fuse-setter by telephone. The ranges must be sent regularly about each 4th second. From the moment when the fire begins and is regularly performed, the reader may follow the cadence of firing, but he should continue until the command, "Cease firing." There are several firing systems. (See firing instruction, 1916, August 15, pars, 63 to 73.) If the battery commander does not give any special command, the number opposite the middle tooth of the slide is to be read.

At the order, "Combing," successively take:
The middle tooth.
The higher tooth.
The lower tooth.
The middle tooth.
The higher tooth, and so on.

At small altitudes (inferior to 1500 m.) instead of taking the higher and lower teeth, half of the distance between these teeth is to be used, in order to diminish by half the altitude jumps.

(4) Announces altitudes to the telephone central at each important change (More than 200 meters).

The altitude announced is that read on the altitude slide without knowing if this is the corrected or the actual altitude. The difference is of no importance to the deflection correction setters.

(B) Post provided with the Field Telemeter without any automatic corrector.

Just as in the preceding case, except that the corrector setter is provided either with the hand sitogoniograph, for altitude telemeter (*), or with tables. He determines the correction following the announcement of the altitude,

(*) This hand sitogoniograph should be attached to the altitude telemeter so as to give automatically the vertical deflection correction.

range, speed, and angle of approach, in the same manner as is prescribed for the vertical deflection setter at the gun. After obtaining the correction, he sets it on the graduation indicated on the apparatus, the positive corrections being set on the left, the negative corrections on the right.

The secondary corrections are set on the movable zero scale of the telemeter or of the sitogoniograph. If the vertical secondary corrections are not set on the telemeter but are on the gun, the bursts will be higher or lower than they should be and the B. C. proceeds as follows: When the burst is higher the altitude is decreased as "over 20" "Altitude minus 100 or minus 50" (100 or 50 according as the horizontal distance is greater or less than 4000). *Post provided with an altitude telemeter, Model 1915. (Without any corrector.)* Build either an improvised site corrector or a pointing wheel. (See firing instructions, par. 27.) (*)

With the pointing wheel, two privates are sufficient, a pointer and a reader.

The pointer is pointing through the aiming slit and through the point of the wheel corresponding to the ordered angle of approach.

If the angle of approach is obtained with the naked eye, the target must be seen coming into the wheel, its axis turned towards the center and its wings being tangent to the circumference.

Besides his habitual work the reader moves, if necessary, the support bracket of the wheel, in order to set the ordered speed.

35. — Angle of approach telescope.

The telescope is operated by two privates, a pointer and a reader.

(*a*) *Pointer's duties.* (1) Setting up the telescope. The bubble is set at the center of the spirit level by moving the legs of the tripod.

(2) While firing aim continuously at the target by directing the middle hair of the cross hairs either along the axis or along the wings.

"Warn the reader of the line chosen, by the command "axis," or "wings."

Announce in a low voice to the reader the direction of the angle of approach of the target (in order to avoid errors of quadrant) in this manner: "Coming, plus or minus," "Going, plus or minus."

(*b*) *Reader's duties:* Repeats the information received from the pointer (for example, coming minus) and completes it by the number read on the proper scale (axis or

(*) There is no ballistic corrector on this telemeter. If there is a string altimeter, the ballistic corrector is placed on it; if an altimeter, Model 1916, is available, the reader of the altimeter is ordered to add mentally the ballistic correction to the measured altitude.

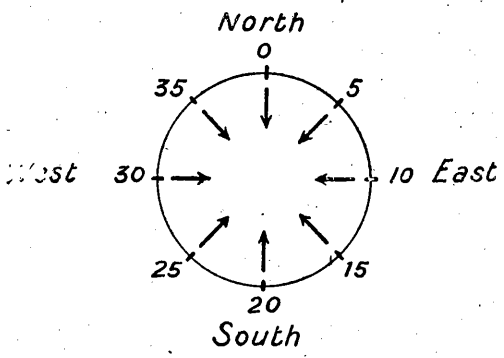
wings) of the telescope dial (for example 30, thus, as total information; Coming, minus 30).

Announces the angle of approach by multiples of 5° when this angle is slowly varying and by multiples of 15° when it is rapidly varying.

36. — Wind drum.

The wind is given by the air service or by the tachyscope (Pars. 37-38) under the form, altitude 2500, wind 15, speed 8, which means that at 2500 meters altitude the wind is coming from a point at 150 graduations to the right of the south point and at a speed of 8 m. per second.

The operator must be provided with the wind drum which may be connected to the angle of approach telescope or independent of it.



Summary Description. — Stationary dial graduated in tens of grads and in mils.

Movable dial carrying a scale of curves on which the corrections are read and an arrow is directed in a direction parallel to the wind.

Two alidades, perpendicular to each other, are moved by the angle of approach telescope or by a simple sight apparatus directed toward the target.

The alidade for the lateral wind deflection correction is graduated in speeds and has a slide. The alidade for vertical wind correction has a scale of speeds and a slide having one edge graduated in altitudes.

One of the alidades has a pointer for reading the azimuths, this pointer moves along the graduations in mils of the stationary dial.

Use. — The wind reader is provided with a table giving him the direction and speed of the wind, at the different

altitudes. He keeps this table up to date according to the information he receives every two or three hours from the air service or according to actual firings of trial shots by his own battery (see Par. 39, Firing Instructions) or according to the information received from the neighboring batteries.

Operating the drum. — The stationary dial is oriented once for all in order that the point of reading of the azimuth marks zero mils when the telescope (or the sight apparatus) is directed toward the north.

This being done, for "setting a wind 15, speed 12, altitude 3000," the dial is turned until the back part of the arrow is opposite the division 15; the slide of the lateral deflection alidade is set at the speed 12; the slide of the vertical deflection alidade is moved until the altitude 3000 intersects the speed line 12.

As soon as a target is located, read the wind corresponding to the average altitude of the target.

As soon as the altitude is ordered and at each noticeable change modify, if necessary, the positions of the movable dial and of the slides (*).

Reading and announcing the corrections. — As soon as the target is located and the telescope (or the sight apparatus directed by the wind drum operator himself) pointed at the target, read facing the index the initial corrections of wind; they are added, if necessary, to the corrections ordered by the B. C. and announced by the telephone central to the vertical deflection setter thus:

"Lateral deflection, plus or minus so much. Drum so much."

These scales are graduated in multiples of ten mils, but are read to the nearest 5 mils.

They are announced again every time they change, either following an azimuth change of the target, or following new corrections ordered by the B. C. The corrections are kept up to date by the operator.

Measuring the wind.

When the section has no regular tachyscope available and is not provided with an improvised tachyscope (see Par. 38) it is the wind operator who measures the wind,

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(*) If the wind drum is placed on the gun. Each wind drum (stationary dial) and the azimuth circle of the gun has a graduation in tens of degrees traced contra-clockwise, the zero of the dial just above the back side of the indication arrow; the zero of the platform in the direction of the north. The wind dial is set by the lateral deflection setter. At the command "wind 15" (given by the B. C.) the gun commander reads on the roller path the number of graduations the platform has turned to the left of the north; let it be 12, add the number 12 to the number received (15). Announce the total to the lateral deflection setter who sets the lateral alidade at the graduation announced.

either before the firing, or during the firing or both; and always at the end of the firing. (See par. 30, firing instructions.)

37. — Altitude tachyscope.

Use of the apparatus. (See pars. 31, 34 and 38, of the firing instructions.)

The tachyscope is used first for measuring the wind.

The wind is supposed to be obtained, either by this means or from recent information given by the air service:

If altitude is known, it gives the real speed of the target.

If altitude is not known, it gives the approximate value of the altitude.

Summary description. (For more details, see the instructions issued with each instrument.)

Horizontal grille. — Composed of 4 concentric circles corresponding to the speeds 15, 30, 40, 50 meters. The circle 30 to 40 carries each 25th grad one knot, used for determining the wind direction.

Principal diameter. — Which carries a fixed central sight needle and a movable sight needle carried by a slide moving along a graduation in wind speeds.

Vertical altitude column. — Carrying the grille, graduated from 1000 to 4500 and held in place by a split collar which acts as a tightening nut.

Rail for the horizontal distances. — Turning around the column and carrying a sliding jack provided with a sight eyelet.

Tripod. — Each apparatus is provided with a metronome and a circular slide rule.

Setting the tachyscope.

The rail is provided with a level.

The rail is placed perpendicular, then parallel to one of the sides of the triangle formed by the three tripod legs.

In each of these positions, the bubble is to be levelled by moving one leg only.

Place the metronome on the ground inside the tripod. During the firing, the metronome is open and the pendulum set free.

Use.

Pointing. — Take the jack by the under part with the thumb and the two first fingers of the right hand, carefully push it up or down in order not to bend the rail.

Lean the right temple against the eyelet so that the eye is at the height of the eyelet center.

To point in direction, turn the rail around the altitude column.

To point in height, move the jack along the rail.

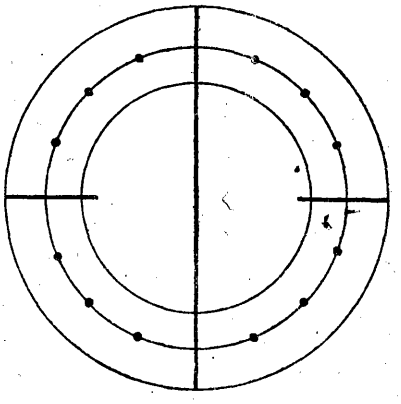
(1) *Measure of the wind,* by spotting a burst at a known altitude. (See 38 and 39 of the firing instructions.)

Place the principal half diameter which does not carry

the slide in the south direction. (Fix this direction by two pickets driven 30 or 40 meters from the tachyscope.)

Set the altitude column to mark the altitude of the burst, for example 3000, by unscrewing and screwing again the split collar a fraction of a turn. Point the tachyscope on the cloud with the central needle.

Without moving any more, count 10 beats of the metronome.



At the 10th beat, compare the position of the cloud with the circle 15 of the grille, which corresponds to the speed of 15 meters. If the wind is moving very slowly count 20 beats, and then the circle 15 will correspond to a speed of 7.5 meters.

If the burst is not seen after 10 beats on the circle 15, continue counting until the burst is seen on this circle and find the speed by means of the circular slide rule.

Measure the direction of the wind in reference to the south, using the two diameters and the knots of the circle 40.

The wind is announced in the ordinary manner, for example: Altitude 3000, wind 15, speed 12.

(2) *Altitude supposed to be known, to measure the engine speed:*

Orient the principal diameter in the direction of the wind by turning the grille and by reading on the decagrad graduation.

Place the vertical column at the altitude given by the altimeter or by the battery commander.

Aim at the target with the tachyscope by using the movable needle. At one of the metronome beats, start counting, do not move any more and count ten beats.

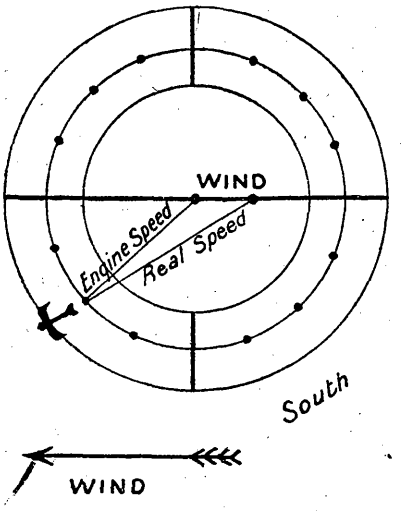
On the 10th beat read the speed on the grille, remem-

bering that the 4 circles correspond to the speeds 15, 30, 40 and 50. (For a time of 10 seconds.)

When the target changes its course during the measurement, the operation is stopped and a new measure of the speed is taken. The operator goes near the battery commander and announces the speed thus:

For altitude, 3000, speed 38.

Altitude or speeds are continually measured during the firing.



It must be remembered (See pars. 9, 55, and 56, firing instructions) if the altitude of the firing is more than 3000 then the battery commander has to increase the speed in the same proportion as the altitude.

At altitude 3500, an increase of 400 m. in altitude corresponds to an increase of 4 m. for the speed.

Case when the horizontal distance is over 6000.

The rail of the horizontal distances is not long enough for aiming at the target, the target being too far, the time of the operation must be increased.

Put the vertical rod at the half altitude.

Operate as before, counting *20* seconds instead of *10*.

(3) *Verification of the wind.*

It is possible to verify the wind, at any moment, by observing the bursts of the actual firing. It is sufficient to aim at one of the bursts with the movable needle. After 10 seconds, the cloud must be seen on the central needle. If this is not the case, the direction and the speed of the wind are to be corrected. They are announced in the customary manner to the wind drum operator.

(4) *Engine speed being estimated according to the type of the target and the altitude being unknown, to measure altitude.*

Choose as speed and direction of the wind those obtained for the estimated altitude. They are to be set on the apparatus as described above.

Put the vertical column at the altitude 1000.

Aim at the target with the movable needle.

The estimated speed of the target being 35, count the number of seconds until the target crosses the fictitious circle 35. Let it be 32.

Multiply by 100 the number obtained and announce the result thus:

For speed 35, altitude 3200.

Stop the action when the target is changing its path, or if it seems not to fly horizontally.

Place the vertical column at 3200, then at the successive altitudes given by the adjustment, and regularly measure the engine speed, as outlined.

This device is specially to be used against distant targets because it operates on a very long space of time which counterbalances the lack of precision due to the distance. Instead of placing the column at 1000, it may be placed at 2000 or 3000 then multiply by 200 or 300 the number of seconds found.

38. — Improvised tachyscope.

All batteries not having tachyscopes, Model 1916, available, must be provided with an improvised tachyscope to be used for the measure of the wind. This tachyscope is described in par. No. 34 of the firing instructions.

The fraction used in the construction of the tachyscope (see No. 34 of the same instructions) being chosen equal to 1/10, it is sufficient to divide the number of decameters of the altitude by the time T in order to obtain the speed of the wind W.

For the direction, one of the diameters of the tachyscope is to be placed always northward and the direction of the wind valued in grads, as explained in par. 37.

39. — Telephone Central.

Station. — Near the battery commander, preferably in a trench, in order to improve the hearing of the telephone.

Duty. (*a*) Before the firing, he establishes the lines connecting the B. C. station with the firing pieces.

(*b*) During the firing, he transmits orders to the firing pieces.

The communications to be established are the following:

(1) Connection between the telemeter reader and the fuse-setter.

(2) Connection between the telephone central and the deflection correction setters.

The connection must be established so as to be ready for work whatever the direction of the firing may be. Double wires are to be used; when they reach the gun, they must be passed under the roller path, guided around the bottom of the pit, rolled around the circular block of the pivot and drawn up under the platform, with sufficient slack for the rotation (*). One of these lines must reach the fuse-setter, the other is doubled and prolonged up to the deflection setter.

Apparatus provided with headsets permits the transmission of orders without being hindered by the noise of the gun.

During the firing. Transmits battery commander's orders to wind drum operator, as well as the altitude announced at each important change by the telemeter reader.

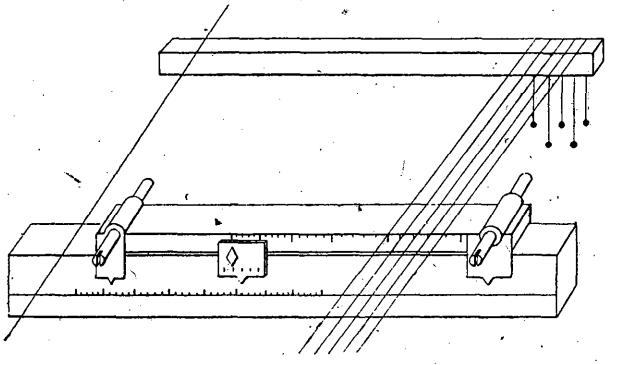
When a target is located the gun commanders announce that the guns are ready as follows: "No. 1 ready" — "No. 2 ready." The telephone central reports to the battery commander.

40. — Observation and altimeter squad.

First Case: String altimeter used with an observation grille.

The string altimeter has the great advantage of permitting, at the same time, altimeter readings and spotting. It must be considered as the regular apparatus of the semi-fixed batteries. Consequently, its working will be described first.

41. — Summarized description.



String Altimeter and Observation Grille.

(For sizes, sketch, establishment, see the annexes.)

(*) This wiring is given only as an example. Other wirings may be used, provided they are fit for good use.

Stationary rule, parallel to the base line, graduated at random, provided it be in the same way for the B. C. and the distant post instruments.

On the rule, at the B. C., *Actual altitude slide* with graduations by ten at each side of the zero, the space between two graduations being equal to that between the grille threads (see later).

On this slide an index for the *ballistic altitude* is sliding, which is moved in reference to the altitude slide a distance given by the connected observation post. Just under this index the ballistic altitude is read.

At the B. C. station and at the distant post station, a small rule slides above the large rule, carried by two support forks clamping the stationary rule.

At each end of the small rule there are two sight slits, "pointer slit" at the left end, and "observer slit" at the right end. The small rule of the B. C. station is scaled in altitudes (*).

The small rule of the O. P. carries on the middle a *reading index.* (The graduation of the fixed rule is removed at a length equal to the horizontal distance between the index and the pointer slit).

The rule is placed in a trench about 1.50 m. deep. (posts within range of the enemy guns).

The following apparatus are perpendicularly established 30 or 40 cm. above the rule:

At first the pointer thread. — This thread carries each 50 cm. small string knots, called locating knots. The central knot is just above the rule. It is called zero knot. The other knots are designated "20 before," of "30 behind" according as they are on the enemy side or on the opposite side, the space between two knots being defined as having the value 10. Besides, an observation grille (eventually 2 grilles) formed by 5 stretched threads, parallel to the pointer thread and at the same level. The central thread is shifted from the sight thread at a distance equal to the space separating the two slits. The space between two threads corresponds to 200 m. difference in altitude for $h = 2500$. (Difference to be read on the altitude graduation.)

42. — Necessary personnel.

For each post — 3 men:

A reader.

A pointer.

An observer.

(*) When the B. C. is connected with two O. P. stations one at each of the B. C. S. The small rule carries a graduation on each side. When one post is used at the place of the other, the places of the pointer and the observer are interchanged; the B. C. S. altimeter is provided with two grilles, one at each side of the central thread.

The reader of the B. C. S. is the chief of the observation and altimetry squad. The second officer or a chosen N. C. O. must be intrusted with this work.

The two readers and the two observers are connected by telephone.

When the altimeter of the B. C. Station is far from the altitude telemeter and is not connected with it by a listening tube (this connection is specially to be recommended) it is good to have a transmitter as an assistant to the B. C. squad.

43. — Duty.

The two readers and the two observers are connected together by telephones with head sets.

(1) *Pointer.* — The pointer aims at the target continuously through a slit and a sight thread.

(2) *Observer.* — The observer keeps his eye at the observation slit and looks at the bursts without looking at the target, which must always remain on the central thread, if the apparatus is well adjusted, as the distance between threads is the same as the distance between slit-sights.

Bursts are announced:

Short 10.
Over 12.

For low altitudes, it is sufficient to use multiples of 5; for high altitudes, multiples of 2. This difference comes from a difference of error proportional to the square of the altitude, thus much greater for high altitudes.

The space between the threads is considered as having the value of 10 and the bursts are announced, shorts or overs, according as they are on the side of the connected post or on the opposite side. (See firing instructions, par. 62.)

First Case. — Observation on each burst in firing by one gun.

As soon as the observer of the distant post sees a burst, he announces: "Burst," and then: "Short, or over so much."

If on the information "burst" the observer of the B. C. Station does not see any burst, the connected observation is not successful and is not to be used.

If, on the contrary, he sees the burst, he announces it to the chief of the squad who notes, first the observation transmitted by the connected observer, then his own observation, as follows:

Short 20.
Short 5.

Or, "Short 12," "Over 4." These shorts are considered minus and the overs plus. The reader takes the algebraic sum of the two.

Second case. — Observation by average in the case of

firing with two guns, or firing a number of rounds with one gun.

The observer of the B. C. Station who knows the system to be used for the firing warns his distant observer by the information "Average." The distant observer repeats "Average," then announces "Burst" when he begins to observe. He announces "Stop" twelve or fifteen seconds later, or after he has observed a sufficient number of bursts to obtain an average. He then announces "Over" or "Short, so much" which is the average result of his observations on all bursts seen between the signals "Burst" and "Stop." After a short interval, another series of bursts is observed in the same manner, and the result announced to the reader as "Short 18" or "Over 6."

(3) *Reader's duties.* (To obtain the actual altitude.)

The Distant Post reader reads and announces in advance by telephone the division of the stationary scale at which the reading of his instrument will be after three or four seconds. The instrument being set at the reading given by the Distant Post the signal "Take" is given by him at the precise moment when the announced division arrives before the index. The reading ("280" for example) as given by the Distant Post is considered as the signal "Ready." The B. C. instrument being set at this division, both observers follow the target by moving the slit-sight until the index at the Distant Post has arrived at the announced division when he signals "Take."

B. C. Station. Measure of the actual altitude.

At the signal, "Such number" (280), the double pointer slide of the actual altitude is set on the announced division. This division is set off on the bottom scale by the lower index. At the signal "Take" read the actual altitude read on the small upper rule designated by the upper index on the double pointer. He then announces it aloud to the altitude telemeter reader, or to the transmitter, as follows: "Measured altitude, so much." New readings are only sent as the altitude changes by more than 100 meters. For low altitudes, changes of 50 meters are read.

Measure of the ballistic altitude.

As the reader of the B. C. Station is the chief of the squad for observation and altimetry, he has to state the method for observing, either by single rounds or by average.

At the information, "Short 12" and "Over 4," he calculates the algebraic sum as short 8. If the observation is done by single round, he waits for two or three more readings, obtains the average and moves the ballistic index a number of divisions corresponding to the algebraic sum of the readings. When the observation is done by average, the ballistic index is moved a number of divisions corresponding to the algebraic sum of the announced numbers.

From the moment that the ballistic index has been moved the desired quantity, he sends to the altitude tele-

meter the corrected altitudes, the first being announced as: "Corrected altitude, so much." After the first reading the word "corrected" is not used. This corrected altitude is called the ballistic altitude.

The "waiting period" foreseen by the firing instructions, No. 67, must be carefully noted before another series of bursts is observed. This "waiting period" is the time between the firing of the projectile with a corrected altitude and its burst.

It must be noticed that the displacement given to the ballistic slide changes the altitude by a quantity proportional to the square of the altitude and not directly proportional to the altitude. In case of a very notable decrease in the altitude, 1000 meters at the least, it may be necessary to increase in a suitable way the displacement of the ballistic slide, because the graduations at a low altitude are further apart than the same graduations at a higher altitude. If the observations are obviously wrong, neglect them.

44. — When only the readers are connected by phone.

The same telephone line must be used at the same time for altimetry and observation. In order to avoid confusion one must operate as follows:

Perform continuous altitude readings until the burst of the first rounds. At this moment, observation takes precedence during twelve or fifteen seconds. Then begin again immediately the continuous reading of the altitude, remembering that observations made during the "waiting period" are generally not to be used, as the ballistic error is slowly varying; after the time required to serve the piece, plus the time of flight of the projectile, roughly estimated, the telephone line is reserved again for the communications relating to observation.

Execution.

Till the first bursts are observed, perform continuous altimetry, as in the case *a*. At the first burst, the observer of the Distant Post signals "Burst" and then sends his observations by "single round" or by "average" as instructed by the chief of the squad, for a period of twelve or fifteen seconds. He announces the end of the period of observation by the signal "Stop." During this period observation readings take precedence over readings of altitude. After the commands of the observer "Stop," the observation of the bursts ceases, and, immediately, the measurement of the altitude is recommenced.

45. — Identification of the Target.

Identification to the personnel of the B. C. Station.

When the altimeter is near the post of the Battery Commander and when the target is not immediately seen the

chief of the squad goes to the battery commander to receive the identification of the target.

On the contrary a rudimentary apparatus is established by lengthening the trench. This apparatus is made of a wooden rod with two sight points, turning around a horizontal axis and a vertical axis and is used as a battery telescope. A graduation for azimuth and for site helps locate the target.

When the targets are many, the target is pointed out by the battery commander by a fraction, for example 2/5, targets having been numbered from the highest to the lowest, *according to their site.* (It is generally better to choose as a target the highest, which is probably the nearest.)

Identification by the personnel of the observation post.

The pointer or the observer (he who has seen the target) looks through his observation slit, aims at the target and announces its position according to the locating knots (locating knots on the central thread of the grille or on the altimeter threads) as follows:

Before 24, or behind 12.

If several targets are projected upon the thread, the observer completes his indication by a fraction, 1/5, it is understood that No. 1 is the nearest the zero knot. (A target numbered 2/5 for the personnel of the B. C. may be indicated 1/5 to the O. P.)

The reader of the B. C. who has his head set and has given the alarm to the O. P. looks at the reading of the rule just below the estimated altitude, for example, 200, and announces:

Target, 200.
Before, 24.
1/5.

If the O. P. is signalling, "See nothing," the coordinates of the target are measured again as just explained and they are sent to the O. P. until the O. P. announces "Seen."

Second case. Altimeter separated from the observation grille.

46. — Altimeter Appparatus.

Altimeter, type 1916. *Necessary personnel.* In each post a reader and a pointer. The two readers are connected by a telephone provided with a head set.

(a) *Setting up.* (See firing instructions, Annex I, par. No. 19.)

(b) *Indication and identification of targets. At the B. C.*

Pointer. — Aims at the target.

Reader. — Moves the protractor arm until it meets the central alidade on the horizontal line corresponding to the probable altitude announced by the B. C.

Reads and transmits to the distant observer the angle indicated on the protractor and the angle marked on the graduation around the right angle telescope as follows: 215, telescope 30.

At the O. P.

Reader. — Sets on the apparatus the angle received.

Pointer. — Looks for the target where the telescope is pointed. Announces, "seen," or "unseen" to the B. C. The precision of this device is not sufficient to locate the target in the field of the telescope.

When the target belongs to a squadron, it is pointed out more completely by announcing a fraction, 2/5, for example, following conventions of par. 45. Consequently, it is necessary to establish, near the altimetry post, a thread parallel to the base.

Nevertheless, at the B. C., it is possible to do without any thread, by stooping down and looking at the number of the target along the upper edge of the plate carrying the altitude lines.

(c) *Measure the altitude of the target.*

As soon as seen, *without* waiting for the O. P.

Pointer aims at the target.

Reader reads and announces by telephone the protractor division he estimates will be indicated after 5 seconds and sends "take" at the moment when it is indicated, this information being preceded by the word, "Ready."

At the B. C. Pointer aims at the target. Aims with special care from the moment when the signal, "Ready," is given.

Reader, registers on the protractor the announced reading. Keeps eyes upon the crossing of the two alidades. At the signal "take" reads altitude on the scale. Announces it to battery commander as follows : "Measured altitude 3500." Without stopping he repeats the operation.

47. — Use of the field telemeter as an altimeter.

During the firing the field telemeter cannot be used at the same time as a range and control telemeter (apparatus converting altitudes into future fuse-setter range) and as "indirect altimeter." (See firing instructions, No. 20.)

Consequently, all posts having only one field telemeter available must establish two altimeters *independent of the altitude telemeter*. In the case where none is available, for the present, the device indicated in par. 65, firing instructions, has to be used (continuous adjustment), that is to say, that it will be attempted to measure altitude before firing and to continually observe and correct it. But this device is a make-shift only and gives no such good results as the continuous measure of the altitude, the observation giving only the ballistic error, either before the firing (trial shots) or during the firing.

Field telemeters are provided with either a metallic triangle (to get the distance on the ground), or a graduated circle and a slide rule, and generally both.

The metallic triangle is used in preference to the graduated circle on all telemeters employed as independent continuous altimeters.

In the contrary case, for all altimeters normally used as range finder and control instruments and exceptionally as altimeter, the graduated circle is to be used.

Number of necessary personnel.

At each post :

A pointer.

A reader.

The two readers are connected by telephone head set.

Setting up. (See annex I.)

Duties.

(*a*) Indication of the target *at the O. P.* by *the B. C.*

B. C. Pointer aims at the target (especially in direction).

Reader reads angle of site. Places the rectilineal edge of the protractor at an estimated distance given by the fire commander. Reads the probable azimuth of the target as seen at the O. P.

Determines its probable site by comparing the two sides of the triangle on the apparatus.

If the side relating to the O. P. is longer than that relating to the B. C. the site measured at the O. P. is smaller than the site measured at the B. C., and vice-versa. Apparatus provided with a parallax circle. The triangle is constructed with two strings, one fastened above a hook soldered on the telemeter axis, carries three knots at a distance equal to the distance separating the hook from the axis. The distance is reckoned in multiples of the base. The triangle being formed, turn the parallax circle to place the radius of the division zero parallel to the side of triangle corresponding to the base, read the azimuth and send it to the O. P.

Reader sets on the apparatus the numbers received from the B. C. (For this purpose a graduation in site, by 10 degrees, is traced on the apparatus of the distant post.)

Pointer searches in the designated direction and announces "seen" or "unseen."

In the last case, the designation is made again.

(*b*) Measure of the horizontal distance $\triangle$.

At the O. P.

Pointer aims at the target (especially in direction) and follows it continually.

Reader reads and announces beforehand the azimuth which he supposes will be indicated after 5 seconds; for

example 340, and announces "take" at the precise moment when the number is passing before the index.

At the B. C.

Pointer follows very exactly the target in direction and in site.

Reader gives the angle which is sent by the reader of the O. P., follows the distance △, and reads aloud at the signal "take."

(*c*) Reading of altitude.

At the B. C.

Reader carries △ on the cross-lines of the telemeter sheet, reads *h* and announces as follows: "measured altitude 3500."

Continues without any interruption to measure a new *horizontal distance* or a *new altitude*, etc.

The telemeter is provided with a parallax circle.

Reader at the B. C. — At the indication 340, puts the division 340 of the parallax circle before the base index (fixed index). At the signal, "take," reads the parallax (open angle) facing the index, on the vertical plane of the altitude telemeter, let it be 120, and reads the angle of site, let it be 32°. Takes the slide rule. Put parallax 120 above azimuth 340 and reads altitude just above the site 32°.

It is necessary to mark beforehand the base on the slide rule. To do this the nuts which hold the top rule are unscrewed. The parallax divisions of the slide are placed corresponding to the azimuth division of the lower rule. Move the upper rule in order to place the number which stands for the base facing the site 45°. Tighten the nuts.

48-49. — Observing grilles.

The firing instructions allow in certain cases the use of other devices than the grille (as rake, knotted cords) for range adjustment.

(See par. No. 57, firing instructions.)

The most practical device for the platform mount is a grille stretched above a trench. A horizontal wooden rule similar to the rule of the string altimeter, against which the temple is placed, permits placing the eye at a constant height.

We suggest the following good sizes:

Threads at a distance of 3 cm. from each other.

The product $a \times b$ to be taken is equal to 900. (See par. No. 62 in firing instructions.)

The formula $\triangle h \simeq \frac{ndh^2}{10\,ab}$ must be solved (being considered that an interval has the value 10 and n is the algebraic sum of the numbers announced by the observers).

The solution is taken from a double entry table, or with a logarithmic computing rule.

For $ab = 900$, $d = .03$ cm. the table to be employed is as follows:

H \ N	10	20	30
1000	50	50	100
1500	100	150	200
2000	150	250	400
2500	200	400	600
3000	300	600	900
3500	400	800	1200
4000	550	1000	1600
4500	650	1350	2000

50. — Principles and use of Altimeter and Grille.

Rules similar to those for the string altimeter.

First case. — Readers and observers are connected by independent telephone lines with head sets.

The actual altitude is sent continuously to the reader of the altitude telemeter.

Results of observation are sent to the Battery Commander as follows: "Short (or over) so much."

The N. C. O. in charge of the altimeter orders the observation to be made on single rounds or on average (signals "burst" and "take" being sent at the beginning and the end of each period.)

Each period of observation lasts 12 to 15 seconds. It is followed by a period of waiting, during which the N. C. O. keeps for himself data resulting from the received observations or notices only the differences from preceding observations. (When these differences are noticeable.) (See No. 57, firing instructions.)

Second case. — Single line.

Altimeters only are connected by telephone with head sets.

Continuous altimeter readings are taken until the first

burst. This burst is signalled to the altimeter by the word "burst," given by the observer. During the 12 or 15 seconds following this "burst" the altimeter does not send any "take" and transmits the readings of the observer, a reading taken at each single round of 3 or 4 shots or an average applied to a period whose beginning and end are indicated by "burst" and by "take."

Altimeter readings are immediately resumed. Observation is only resumed after a time in seconds equal to five times the number of thousands of range.

51. — Use of Signal Apparatus.

In places where breaking of lines is frequent the posts are provided with field signal apparatus (small 24 cm. search lights) allowing an official connection either between the B. C. and the O. P., or between the two points connected by telephone to these posts. Field signal apparatus are served by altimeter crews which are of no use in this case.

Communications are made with following code:

Calls or errors.
Asking for a fixed fire.
Bad working.
Aircraft.
Firing or serving is to be begun.
Firing is finished (as with the whistle).
Changing the target " " " "
Days end (come back).
Read.
Attention "take."
One (I).
Two (II).
Three (III).
Four (IV).
Five (V).
Six (VI).
Seven (VII).
Eight (VIII).
Nine (IX).
Zero (0).
Observe.
Short.
Understand (yes).
Target Seen.
Signal men must know the Morse alphabet.

52. — Tracer shells and night firings.

For firing with tracer shells, as stated in par. No. 71, firing instructions replace the observing grille at the O. P. and at the B. C. by a knotted cord stretched in a parallel direction to the base at the height a above observer's eye.

During the night, these knotted cords are seen only when

the weather is very clear or when they are projected upon a very well lighted dirigible. When the remote observer does not see how far out, short or over, the rounds are, he must report whether they are short or over, according to the instructions of par. 71.

It is also possible either to fire the guns at a difference in altitude of 400 meters (Note (*) of the same par. 71. Announce the error of the lower trajectory), or to replace the knotted cord by a horizontal tube lighted inside and shining through small equidistant holes.

Be careful not to let more light shine through than necessary. The target must keep its visibility. (If need be paper is pasted over holes.)

Generally, the lighting of an apparatus is reduced as much as possible.

If no regular firing is possible owing to the lighting, firing devices (firing instructions, par. 71) are to be used. (At dirigibles progressive firing by 100 if coming; by 200 if going.) An order for the distance is sufficient each 15th or 20th second.

53. — Special orders.

(a) *Watch duty.*

A watch station is permanently established. It is looked upon as guard duty and the duty of a watchman is as important as that of a sentry.

In ordinary times, two watches are sufficient. The second officer allots the zone to be watched between them.

They remain at sufficient distance from the guns so as not to be confused by the noise, but remain within calling distance.

They are provided with good field glasses. They signal all targets within sight, determine and announce the type of the target. They give the alarm only for hostile or doubtful aircraft and in case of firing by neighboring posts. They must be frequently relieved. (As a rule, each hour.)

(b) *Allotting and trying shells.*

The projectiles are distributed in the chests by sets, according to fuse and charge.

They must be tested in the loading position. (The gun is slightly inclined; the breech is slowly opened and the cartridge is gently pushed out with the rammer staff.)

If a cartridge does not go in, try to find the cause; if need be, file the part causing the trouble. If a new trial is made without success, put the cartridge aside. Before replacing the cartridges in the chest, rifling bands must be oiled. It is even well to oil the rifling bands during the firing, if the personnel is sufficient.

(c) *Different precautions.*

Between the periods of firing, leave untied in their place the muzzle-cover and the breech cover; protect the sight apparatus, the fuse-setters, and generally all weak parts of the materiel and of the auxiliary apparatus.

Verify each hour the telephone connection with the distant posts.

Have a special detail for the periodical visit of the lines; for the verification of the lighting apparatus batteries, signal apparatus, etc., and for checking materiel.

54-55. — Distribution of the materiel.

Telephone and Fire control systems.

O. P. No. 1:
2 telephones;
1 stake;
4 wire drums (2 kilom. of wire);
1 string altimeter, with grille;
1 24 cm. search-light;
1 field glass × 8.
1st gun:
3 receivers;
3 head sets;
1 field glass × 8.

B. C. Station for Altimeter and Observation:

1 switch board;
2 telephones with head set;
4 stakes;
4 wire drums;
1 string altimeter with 2 grilles;
1 cm. search-light;
1 field glass × 8;
1 voice tube;
1 wind tachyscope.

B. C. Station firing control:

1 field telemeter with an automatic corrector;
2 telephones;
1 angle of approach telescope with a scale drum;
1 field glass × 8.
O. P. No. 2:
2 telephones;
1 stake;
4 wire drums (2 kilom. of wire);
1 string altimeter with grille;
1 24 cm. search-light;
1 field glass × 8.
2nd Piece:
3 receivers;
3 head sets;
1 field glass × 8.

Note.—The telephone switchboard for the outer communications is not indicated on this sketch.

CHAPTER III.

SCHOOL OF THE BATTERY.

56. — The battery comprises the directing piece and one or two firing pieces.

Duties of the officers and N. C. O.'s during the firing.

57. — (*a*) Battery Commander.

Decides on the target, designates it to the directing piece.

Estimates the speed and the altitude, if it has not been possible to measure them.

When he has an angle of approach telescope at his disposal (*), repeats, as confirmation (**), the angle of approach given by it, corrects it if obviously erroneous, changes it at any change of direction the aeroplane may take (***).

Makes by the whistle the commands: Commence firing, Suspend firing, Continue firing, Cease firing.

Indicates which kind of firing is to be used. (Firing by one piece, or by battery.)

Adjusts the fire for direction and elevation.

Adjusts it for altitude, according to the observation made by the observers, as often as these observations are not directly registered at the altimeter (****).

The commanding officer has full authority in his post. He maintains the strictest discipline, exacts from every one complete attention to his duties, allowing nobody to look at the firing.

58. — (*b*) Officer or N. C. O. assisting the Battery Commander.

Has charge of the altimetric and observation services.

Causes the objective to be designated to remote stations.

Designates the observation post that is to observe.

(*) If such is not the case, the assistant officer or a trained N. C. O. should calculate the angle of approach and announce it.

(**) The telescope pointer should be instructed to verify the reading of the angle of approach.

(***) In the case of a straight line of flight, see that the angle of approach is not changed. The angle in the formulas of the Firing Regulations is the actual angle of approach and not the future angle of approach.

(****) It has been seen that with the string altimeter the second method is obligatory.

Acts himself, in case of need, as an altitude reader (string altimeter) or observer at the grille.

Causes either the corrected altitude or the altitude correction to be transmitted to the Battery Commander.

His duty may be turned over eventually to an N. C. O. when either he has been sent to the remote station or assigned to take the angle of approach.

59. — (*c*) Gun Commanders.

The gun commander for the directing piece assists and replaces, in his absence, the officer or assistant N. C. O.

Each gun commander is responsible for the service of his piece; transmits or repeats the commands made by the whistle or by voice (generally through speaking tubes); make sure that the commands are duly repeated through the telephone; establishes voice transmitters in case the telephone is not working; supervises the firing; watches the recoil of the gun; secures men for replacement of casualties, when needed; in case of shortage of personnel, acts as a Range Drum Setter.

Conduct and execution of fire.

60. — (*a*) General Principles.

Fire is conducted according to the rules laid down in the Firing Instruction.

As laid down in these Instructions, the essential data to be known, exclusive of the corrector of the day, are the five following elements:

Altitude.

Angle of approach.

Engine speed.

Wind (velocity and direction).

Ballistic error of altitude.

Ideal firing conditions are realized when the first three elements are constantly measured and when the last two are known through information (*), or determinations.

It was shown in the fifth chapter of the Firing Instructions that adjustment is always difficult, and often impossible; that it is possible only after a space of time greater than the time of flight and sometimes impossible as long as the target is in view, and that it is all the more difficult to make corrections as all the data is not measured.

The Battery Commanders should therefore do their best to secure the *constant* measuring of the firing data and

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(*) In case of incorrect information, there is danger of "putting out of adjustment" instead of adjusting the fire. It is worthy of remark that, when spotting, every correct observation gives the altitude error.

especially of the altitude. After every firing, they will conduct a general critique; minutely noting the obstacles which may have become evident, and will exert their whole strength to overcome such obstacles (*).

If it has been impossible to correct the observed errors during the firing, these corrections may be determined after firing in preparation for subsequent firing. Much valuable data and especially the speed may be obtained.

61. — (*b*) Firing commands.

The same as in the gun drill.

62. — (*c*) Trial fire (**).

As has just been stated, if the wind and ballistic errors are not known through information received or measurements taken before firing, it will be possible to obtain them (***) during the adjustment, but this is often too late. The first 30 or 40 seconds of the firing and the effect of a surprise will be lost. That is why the trial fire is of so great importance. (See Nos. 37 to 46, in the Firing Instructions.)

As this fire is to be made useful in a very short time, cannoneers must be trained to perform it, as well as any other maneuver, as a matter of second nature.

63. — First case. Aeroplane within sight but out of range.

After firing the shot, the gun must not be kept fixed longer than a few moments. This shot is fired only for the purpose of determining the wind (****).

(*) The following are the only excuses admissible for an error in altitude:

(*a*) A cloud may prevent the observing station from seeing.

(*b*) The aeroplane may be indistinct and on the opposite side from the observing station.

(*c*) Telephone wires cut during the firing despite all precautions taken in order to protect them. That aeroplanes fly in squadrons is not admissible as an excuse. By numbering carefully the planes relatively to a thread parallel to the base, an agreement must be obtained.

(**) It is the duty of anti-aircraft commanders to specify which units are allowed trial firings and to direct the firing of each trial shot.

(***) This firing is easy to analyze especially concerning the allowance to be made for errors caused by the wind and errors caused by the speed. (See Chapter V in the Firing Instructions.)

(****) The aeroplane being within sight, the duty generally assigned to the altimeter observers is to look at it, and not to lose sight of it. As a rule, they are unable to observe the burst. But this rule is not peremptory, and the platoon commanders are allowed to

Example of commands:

"FIRST PIECE."

"FIRE ONE SHOT."

"AZIMUTH 220" (that is, direction 220) or such direction.

"ANGLE OF SITE 44°" (angle to be given to the gun, read in the table No. 46 of the Firing Instructions).

"RANGE 5000," then

"FIRE."

Firing piece.

Use the azimuth circle graduation and the level, model '88, to set the gun in the desired position.

Set a 22/31 fuse (unless something else be announced) at 5000.

Load.

Fire at the command "Fire."

The piece is fired by a cannoneer designated by the section leader. The chief of section does not lose sight of the aeroplane and causes the gun to be pointed upon it as soon as the shot has been fired.

Directing piece.

The wind setter determines the wind and sets his disk according to it, applying the rule laid down in par. 36 of this book.

N. B. — A trial shot is not fired for the wind when the information given by air-craft, by the previous firings, or by the neighboring batteries seems to be fairly accurate.

These methods have the advantage of being suitable to several altitudes. The wind setter should always have a copy of this information. When the wind setter has no information concerning the wind and when there is not time to fire a trial shot, he uses, in order to estimate the wind at the first attempt, the actual firing, according to paragraph 39, Firing Instructions.

It is the wind setter's duty to follow in any case the rule laid down, in par. 3 of the same No. 39, where it is ordered to take advantage of one of the last shots fired to measure the wind for the benefit of subsequent firing. He notes down all measures taken, specifying the altitude.

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transgress it, especially when another unit is already firing at the plane. (See No. 66 in the Firing Instructions.)

The ballistic error variations, however, are more slowly and less easily determined than the wind error variations. This ballistic error may be approximated, if necessary, by taking into account the previous firings, the wind, temperature, and air pressure.

It is the duty of the platoon commander to transmit this data to the neighboring units (*).

64. — Second case.

The fact that aeroplanes appear regularly proves that battery commanders should fire trial shots at regular intervals and if no aeroplane is in sight these shots may be made with deliberation.

Par. No. 40 of the Firing Instructions must be complied with.

65. — (*d*) Designating the objective.

As in the school of the Piece.

66. — (*e*) Opening fire.

As soon as the objective has been designated the gunners follow the target.

The battery commander announces the speed and altitude.

As soon as he has announced the angle of approach, the deflections are set without firing, as explained in the School of the Piece.

Fire is opened at the command: "FIRE."

67. — (*f*) Method of fire to be used.

(See par. No. 63, in the Firing Instructions.)

First Instance. — The altimeter is used at the opening of fire and during the whole course of firing.

The altimeter observers who have detected a target are ordered to keep it in sight.

(*a*) Single aeroplane not fired at—adjustment is supposed to be easy. Fire four or five shots with one gun in order to facilitate observation. Then use combing fire and fire without stopping.

If the fire is protracted, resume from time to time, for instance, every minute, the firing by one piece when it is necessary to adjust the fire by observation.

(*b*) Aeroplane not alone or already fired at. Adjustment supposed to be difficult or impossible.

Use combing fire.

Second Instance. — The working of the altimeter is interrupted in the course of the firing.

(*) To carry out this instruction, he comes and stands close to the Battery Commander in order to announce to him in a low voice the corrections inferred from the measures he has taken and from the survey of his desk. This officer neglects these corrections if his fire is accurate.

Notice should be given to the Battery Commander announcing, "Altimeter interrupted."

If observation be still going on (for instance, by signalling), continue to compute the altitude (No. 65 of the Firing Instructions).

If the altimeter does not work, estimate and take into account the altitude variations of the plane. (See the third instance.)

Third Instance. — Fire opened at an altitude estimated or erroneously measured. (*See No. 60*, note (*) the only *admissible excuse for the altimeter not working.*)

Fire seven or eight shots using one gun.

Wait for an announcement and think over what has been seen. As soon as this announcement is received, indicating either the altitude measured or the altitude error, "short" or "over" use combing fire.

If the altimeter reader announces "not observed," judge according to signs (silhouetting shots, by the method "estimated speed," bursts above the airplane are supposed to be short and bursts below the airplane are supposed to be over). Fire a series of combing shots, changing the altitude as often as it is evident that the shots are very bad in direction and site.

N. B. — When the plane is diving suspend firing.

When ammunition is plentiful, fire about ten volleys, commanded by the whistle, just as the plane appears to be about to take a straight course.

68. — Insufficient strength of the personnel.

The rule for replacing the casualties is the following one:

It is better to fire with only one gun than to give up altimetry and observation. (See No. 26.)

The altimeter stations should be kept always fully manned. The altimeter cannoneers should not be removed from their apparatus unless the telephonic communication is out of order, in which case they act as signal men and as observing assistants.

69. — Firing at low altitudes.

Frequent practice should be held as it is the only way of simulating actual firing.

Goniographs and sitogoniographs are not graduated under 500. For the goniographs, this is of little importance, as the altitude has but little influence on the deflection correction.

Under 500, if the value of the angle of approach lies bteween 60 and 90, register site correction zero.

If it be not so, register the correction *plus 10* if the plane is coming, and *minus 10* if the plane is flying away.

(a) *Altitude between 1000 and 1500.*

In using combing fire use method described in par. 33.

(b) *Altitude lower than 500.*

(The altitude telemeter has not been graduated below 500.)

Battery Commander. — The Battery Commander announces, "Fire at horizontal ranges at my command (*)," and estimates or causes to be estimated at a glance the angle of approach.

As soon as a range has been announced to him by the altitude telemeter reader (see below), he lessens it by 200 meters and fires four shots according to No. 66 of the Firing Instructions.

If no range has been announced to him, he estimates the actual range (**), announces it to the telemeter reader who sends him back the corrected range (or he estimates directly the corrected range), lessens it by 400 and commands a progressive firing by 100, 200, 300, or 400, increasing by 100 the jumps ordered in No. 75.

Telescope cannoneers may be used to estimate the angle of approach if the Battery Commander judges that they are trained.

Cannoneers of the altimeter of the distant station. — Use the altimeter as an azimuth instrument, by fixing the telescope on its axis by its pin and unscrewing the tightening screw of the graduated horizontal circle. The setting up must have been made as prescribed in Appendix I. They telephone the azimuth of the plane to the Battery Station.

As range errors may be produced by many causes, it would be very difficult to adjust the base during the firing. If the distance can not be attained by measuring, it is impossible to adjust it. *Firing Pieces.* In firing by 4, the fuse-setter cannoneer sets successively four fuses at the same range. In progressive firing by 100, 200, 300, 400, he sets successively 4 fuses, the first at the ordered range, the other three at ranges progressing by 100, 200, 300 or 400.

(*) More generally speaking, the announcement, "at my command" should be made as often as the firing commander wishes to command, by himself, the ranges or firings by sets (By 4, progressive by 100, 200, 300, 400.) See Note (*) to No. 52.

(**) If a Barr and Stroud apparatus is at his disposal, he causes the range to be measured with it.

70. — Obsolete.

Altitude telemeter.

Is not graduated beyond 5000.
Divide the altitude by 2.
Double the range readings.

71. — Firing from the sound

See Auto Mount Drill Regulation.

APPENDIX I.

Article 1.

Setting up the Altimeter, Model 1916.

For accuracy to be sought see pars. 19 and 20 of the Firing Regulations. The setting up has two distinct steps:

(1) Orienting the battery station and the distant station.

(2) Masuring and reregistering the base and, finally, the difference in altitude.

(1) *Orienting one of the stations.*

Place the tripod on firm ground, and if possible, on three stakes driven into the ground at the vertices of an equilateral triangle. Adjust the lengths of the legs so that the entire apparatus will be at a convenient height and nearly level. Make the vertical axis nearly vertical by moving the leveling screws, checking by the levels (*).

Unscrew slightly one of the leveling screws so as to allow the whole instrument to rotate about its vertical axis. Then the method used for orienting depends on circumstances as follows:

First Case: The two stations are inter-visible.

Secure the telescope by means of its pin so that the line of sight will be parallel to the graduated vertical dial. Set the graduated horizontal plate at zero for the battery station and at 320 for the distant station and clamp it by means of its set screw. Rotate the whole about the vertical axis so as to direct the line of sight at the other station. Tighten the leveling screw slightly and make sure that the instrument is leveled and that the setting remains at zero (or 320).

Second Case: The two stations are not inter-visible.

First of all, if the local declination is not known, it should be determined by sighting on a known azimuth. Make sure by sighting both apparatus side by side, and *far from any metallic mass*, that both compasses agree, and if they do not, determine the declination of each of them.

Locate two stations, as accurately as possible, on the best map at hand. Measure on the map the angle formed from the magnetic north clockwise by the line to the other

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(*) Set one of the two levels so that it is perpendicular to one of the sides of the triangle formed by the three leveling screws and bring it level by actuating all three screws. Then center the other bubble by means of the two screws that are in prolongation with the level. The bubble moves in the same direction as the corresponding screw. Make sure that the first bubble has not moved. Repeat the operation if necessary.

station, e. g. 850 mils. The graduated horizontal plate being at zero (battery station) or 320 (distant station) and fixed by its clamp screws, loosen one of the leveling screws and rotate the whole apparatus to give it an approximate orientation. Make sure that the local declination has been set in the proper direction. Unclamp the clamp screw of the horizontal plate and rotate it 850 mils in the required direction (i. e., to read 850 or 3200 plus 850). Tighten again the clamp screw. Rotate the whole apparatus until the magnetic needle is exactly opposite its index. Tighten the leveling screw; make sure that the axis has been kept vertical, if not, make the required correction. Verify once more the reading and declination. Unclamp the clamp screw, set the horizontal plate at zero or 320, tighten the clamp screw.

Adjustment for Accuracy.

Even though the stations have not been very accurately located on the map, the setting of the altimeter by compass will be sufficiently accurate. The position of these stations should however be checked as soon as possible by simultaneous sighting (method of the "top") on a star of rather low site, on the moon, or the sun. (For aiming at the sun, interpose a smoked glass between the eye and the eyepiece.)

In this test, the telescope should always be fixed parallel to the vertical dial by means of its pin; the horizontal dial should be set free by unclamping the clamp screw and rotated to allow aiming at the star. At the "top" the same graduations should be read at both dials. Correct one of the instruments to secure parallelism. After having secured accurate setting the direction of the opposite station should be staked out in order to allow the required orientation of each apparatus to be checked or quickly restored.

(2) *Measuring and Setting the base.*

The base should be known to within 1/100 (30 meters for 3000) or certainly to 1/50. The map gives the first estimate of it. But the measurement made on the map is sufficiently accurate only when the positions of the posts are known to be accurate to within twenty meters.

If this is not the case, the measurement must be verified in one of the following ways: 1st Case — The station is provided with a Barr and Stroud or a telescope carrying a micrometer graduated in mils. When the ground makes it possible the base is divided into sections such that the ends of each section are intervisible. Each section is measured either with the Barr and Stroud (*) or by the following stadia survey.

Stadia Survey. — Let PO be the section to be measured.

(*) Even when the stations are intervisible, a check by measurement of sections will give increased accuracy.

A telescope is established at P. Establish at O, with two stakes, a base OA almost perpendicular to PO and whose length is at least 1/40 of the length of PO. (For example 100 meters for 3000 meters.) Measure OA with a ten meter measuring tape. Measure the angle subtended by OA with the telescope micrometer up to ¼ mil.

The distance PO is given by the formula:
PO = 1000 OA/m (In which m is the number of mils).

Second Case. — When time is lacking for getting the necessary apparatus and for using them as above:

Fire two trial shots in the probable direction of future firing and follow par. 43 of the Firing Instructions.

Article II.

Adjustment of the position of the field Telemeter.

When a position is to be occupied for a long time the adjustment should be very accurate.

By applying the rules laid down in the Firing instructions, the error of adjustment of the line of sight and the error in verticality of the telemeter axis may be determined and corrected by the following operations.

(a) *Preliminary Operation.* — Carefully measure the angle of the three registered points, x, x', and y. P being the position of the battery and x' Py and x Py being right angles. Borrow a battery telescope from a neighboring battery. In order to measure the angle of site of x, the four following measures are necessary.

First, measure the angle of site in the usual way, turn the telescope through an angle of 180 degrees and take a second measure. Remove the telescope from its holder and turn it end for end, then aim again at the same point. Turn it again through 180 degrees and measure the fourth time. Take the average of the four measurements thus found. In the same manner measure the angles of site for x' and y.

(b) *Telemeter Adjustments.* — Let s and s' be the angles of site obtained for x and x' with the battery telescope. Measure the same angles of x and x' with an altitude telemeter taking the average of several measurements to be the correct angle.

Let S and S′ be the angles found (these angles are read in degrees and converted into mils : one degree has a value of 17.7 mils).

Let E be the error of the telescope (error of adjustment of the line of sight) counted as positive if inclined above the true line.

Let N be the error or verticality of the axis, positive when the axis is inclined toward X′.

E and N are given by the formulas:

$$E = \frac{s + s'}{2} - \frac{S + S'}{2}$$

$$N = \frac{s - s'}{2} - \frac{S - S'}{2}$$

These formulae are to be applied carefully. S, S', s, and s' being taken with their signs.

If E and N are smaller than 5 mils no correction need be made.

On the contrary, when

$$E = 12 \text{ mils}$$
$$N = 8 \text{ mils.}$$

E being positive, the telescope must be inclined forward 12 mils. The telescope is mounted in a collar moved by a finger fitted between two support screws. In order to move it a desired quantity two remote points are chosen in the same vertical plane and 12 mils one from the other. Aim at the higher point and carefully measure its angle of site on the telemeter. Unscrew the under support screw (if E is negative the upper support screw is to be unscrewed) and lower the telescope carefully until it bears on the lower point. See that the angle read on the telemeter is the same as it was before the telescope was moved. Repeat the operation until the error is corrected.

The error E being corrected, in order to correct the error N set the angle s on the telemeter and aim at X by using the support screws of the tripod. See that the site of X′ is exactly that of s'. Set the site of Y on the telemeter and aim at Y by using the support screws of the tripod. By aiming once more at X see that the verticality in the direction XX′ has not been disturbed.

These operations make it possible to obtain a much more precise verticality than that which the spherica level can give.

APPENDIX II.

TABLE I.

Corrected ranges.

Small altitudes (500 m.) Speed 35 m. T/D = 0.0049.

HORIZONTAL distances	COMING 0	15	30	45	60	COMING 75	90	GOING 75	60	45	30	15	GOING 0	HORIZONTAL ranges
2000	19	19	20	20	21	21	22	23	24	25	26	26	26	2000
2200	21	21	21	22	23	23	24	25	26	27	28	29	29	2200
2400	23	23	23	24	24	25	26	28	29	30	30	31	31	2400
2600	24	24	25	25	26	27	28	30	31	32	33	33	33	2600
2800	26	26	26	27	28	29	30	32	33	34	35	36	36	2800
3000	28	28	28	29	30	31	32	34	35	36	37	38	38	3000
3200	29	29	30	31	32	33	34	36	37	39	40	40	40	3200
3400	31	31	32	32	34	35	36	38	39	41	42	43	43	3400
3600	32	33	33	34	35	36	38	40	42	43	44	45	45	3600
3800	34	34	35	36	37	38	40	42	44	45	47	47	47	3800
4000	36	36	37	37	39	40	42	44	46	47	49	49	50	4000
4200	37	38	38	39	41	42	44	46	48	50	51	52	52	4200
4400	39	39	40	41	42	44	46	48	50	52	53	54	55	4400
4600	41	41	42	43	44	46	48	50	52	54	56	57	57	4600
4800	43	43	43	45	46	48	50	52	55	57	58	59	60	4800
5000	44	44	45	46	48	50	52	55	57	59	61	62	62	5000
5200	46	46	47	48	50	52	54	57	59	61	63	64	65	5200
5400	48	48	49	50	52	54	56	59	61	64	66	67	67	5400
5600	49	50	51	52	54	56	59	61	64	66	68	69	69	5600
5800	51	51	52	54	56	58	61	63	66	68	70	71	72	5800
6000	53	53	54	56	58	60	63	66	68	71	73	74	74	6000
6200	55	55	56	57	59	62	65	68	71	73	75	76	77	6200
6400	56	57	58	59	61	64	67	70	73	75	77	79	79	6400
6600	58	59	59	61	63	66	69	72	75	78	80	81	82	6600
6800	60	60	61	63	65	68	71	74	77	80	82	83	84	6800
7000	62	62	63	65	67	70	73	76	79	82	85	86	87	7000
7400	65	65	67	68	71	74	77	80	84	87	89	91	92	7400
7600	67	67	68	70	73	76	79	83	86	89	91	93	94	7600
7800	68	69	70	72	75	78	81	85	88	92	94			7800
8000	70	71	72	74	77	80	83	87	91	94				8000
8200	72	72	74	76	78	82	86	89	93					8200
8400	74	74	76	77	80	84	88	91	95					8400
8600	76	76	77	79	82	86	90	94						8600
8800	77	77	79	81	84	88	92	94						8800
9000	79	79	81	83	86	90	94							9000

TABLE II.

Super elevation as function of the Fuse Setter.

Range (B) and of the Altitude (h).
(Expressed in degrees and tenths of degrees).
Shrapnel 22/31 (V_0 = 535 m)
(From the experiments of Gâvre.)

B \ h	500	1000	1500	2000	2500	3000	3500	4000	4500
Mets.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.
2000	2.4	2.3	1.8						
2500	3.5	3.4	3.1	2.4					
3000	4.6	4.6	4.3	3.9	3.2				
3500	5.8	5.8	5.7	5.4	4.8	4.0			
4000	7.2	7.2	7.2	6.9	6.5	5.9	4.8		
4500	8.7	8.8	8.8	8.7	8.4	7.9	7.2	6.0	
5000	10.3	10.5	10.6	10.5	10.3	10.0	9.4	8.4	6.9
5500	12.1	12.4	12.6	12.6	12.5	12.2	11.7	10.9	9.6
6000	14.2	14.5	14.7	14.8	14.8	14.6	14.2	13.5	12.4
6500	16.3	16.7	17.1	17.3	18.4	17,3	16.9	16.3	16.4
6900	18.2	18.7	19.1	19.4	19.6	19.6	19.3	18.7	17.7

TABLE III.

Super elevation as function of the Fuse Setter.

Range (B) and of the altitude (h).
(Expressed in degrees and tenths of degrees.)
Shrapnel 30/55 (p = 7.365 kg. — V_0 = 525 m.)
(From the experiments of Gâvre.)

h / B	500	1000	1500	2000	2500	3000	3500	4000	4500
Mets.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.
2000	2.3	2.1	1.6						
2500	3.3	3.1	2.8	2.2					
3000	4.3	4.2	4.0	3.6	2.9	1.0			
3500	5.5	5.4	5.3	5.0	4.5	3.6			
4000	6.7	6.7	6.7	6.5	6.2	5.6	4.6		
4500	8.1	8.2	8.2	8.1	7.9	7.4	6.7	5.5	
5000	9.6	9.7	9.8	9.8	9.7	9.2	8.7	7.8	6.5
5500	11.2	11.4	11.5	11.6	11.5	11.3	10.8	10.1	9.1
6000	12.8	13.1	13.3	13.4	13.4	13.3	13.0	12.4	11.4
6500	14.7	15.1	15.4	15.6	15.7	15.7	15.5	14.9	14.1
7000	16.8	17.2	17.6	17.9	18.2	18.2	18.0	17.6	16.8
7500	18.9	19.5	20.0	20.4	20.7	20.8	20.7	20.3	19.5
8000	21.4	22.2	22.8	23.3	23.8	24.0	24.0	23.6	22.8
8500	24.2	25.1	25.9	26.5	27.2	27.5	27.5	27.2	25.9
9000	28.4	29.5	30.5	31.5	32.3	32.6			
9500	31.4	32.6	33.8	34.9	35.9	36.5			

TABLE IV.

Super elevation as function of the Fuse Setter.

Range (B) and of the Altitude (h).
(Expressed in degrees and tenths of degrees.)
High Explosive Shells 24/31 ($V_0 = 550$ m.)
(From the experiments of Gâvre.)

h / B	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
Mets.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.
2000	2.34	2.12	1.64	,,	,,	,,	,,	,,	,,	,,
2500	3.34	3.24	2.84	2.12	,,	,,	,,	,,	,,	,,
3000	4.46	4.43	4.15	3.58	2.70	,,	,,	,,	,,	,,
3500	5.72	5.74	5.57	5.18	4.50	3.40	,,	,,	,,	,,
4000	7.13	7.19	7.11	6.83	6.31	5.45	3.96	,,	,,	,,
4500	8.68	8.80	8.79	8.62	8.21	7.50	6.42	4.59	,,	,,
5000	10.38	10.57	10.63	10.54	10.24	9.64	8.74	7.32	4.82	,,
5500	12.24	12.51	12.65	12.64	12.42	11.95	11.12	9.84	7.79	3.39
6000	14.27	14.65	14.87	14.93	14.79	14.42	13.66	12.45	10.48	6.86
6500	16.52	16.99	17.30	17.44	17.40	17.12	16.44	15.22	,,	,,
7000	18.98	19.54	19.97	20.24	20.31	20.10	19.48	,,	,,	,,
7500	21.66	22.35	22.93	23.40	23.56	,,	,,	,,	,,	,,
8000	24.55	25.43	26.25	26.93	27.18	,,	,,	,,	,,	,,

TABLE V.

Shrapnel 22/31 — $V_0 = 535$ m.

Corrections to be made to the true Distance D to obtain the Fuse Setter Range B.

(In the table the differences B — D are functions of D and of h.)

(From the experiments of Gâvre.)

D \ h	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
500	+215	+185	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1000	+165	+145	+120	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1500	+145	+115	+ 85	+ 60	,,	,,	,,	,,	,,	,,	,,	,,	,,
2000	+140	+100	+ 60	+ 25	— 5	— 35	— 75	,,	,,	,,	,,	,,	,,
2500	+140	+ 95	+ 50	+ 5	— 35	— 75	,,	,,	,,	,,	,,	,,	,,
3000	+145	+ 90	+ 40	— 10	— 55	—100	—145	,,	,,	,,	,,	,,	,,
3500	+150	+ 90	+ 30	— 25	— 70	—115	—160	—205	,,	,,	,,	,,	,,
4000	+155	+ 85	+ 20	— 35	— 85	—130	—175	—220	—260	,,	,,	,,	,,
4500	+160	+ 80	+ 15	— 40	— 95	—140	—180	—220	—255	—285	,,	,,	,,
5000	+160	+ 75	+ 10	— 45	— 95	—140	—180	—220	—250	—265	—260	,,	,,
5500	+155	+ 65	+ 5	— 55	—100	—140	—175	—205	—220	—215	—200	—185	,,
6000	+145	+ 60	— 0	— 50	— 95	—130	—160	—175	—170	—140	— 85	+ 20	+220
6500	+135	+ 55	— 5	— 50	— 85	—115	—125	—115	— 70	+ 35	+255	,,	,,
6900	+125	+ 50	— 5	— 45	— 75	— 90	— 80	— 25	+120	+500	,,	,,	,,

TABLE VI.

Shrapnel 30/55 — V_0 = 525 m.

Corrections to be made to the true Distance D to obtain the Fuse Setter Range B.

(In the table of the differences B — D are function of D and of *h*.)

(From the experiments of Gâvre.)

D \ *h*	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500
500	+180	+135	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1000	+190	+145	+135	,,	,,	,,	,,	,,	,,	,,	,,	,,
1500	+195	+155	+130	+125	,,	,,	,,	,,	,,	,,	,,	,,
2000	+205	+160	+125	+100	+ 65	,,	,,	,,	,,	,,	,,	,,
2500	+210	+165	+120	+ 75	+ 30	0	,,	,,	,,	,,	,,	,,
3000	+220	+165	+110	+ 55	+ 5	— 30	— 50	,,	,,	,,	,,	,,
3500	+225	+160	+ 95	+ 40	— 15	— 65	— 95	—120	,,	,,	,,	,,
4000	+230	+150	+ 85	+ 30	— 30	— 90	—125	—165	—205	,,	,,	,,
4500	+235	+145	+ 80	+ 20	— 40	—105	—145	—190	—215	—250	,,	,,
5000	+245	+150	+ 75	+ 15	— 45	—115	—155	—200	—220	—235	—240	,,
5500	+250	+155	+ 80	+ 20	— 45	—110	—160	—195	—210	—210	—195	—180
6000	+260	+165	+ 85	+ 20	— 40	— 95	—140	—175	—180	—165	—120	— 45
6500	+270	+175	+ 95	+ 30	— 25	— 70	—105	—125	—110	— 50	+ 50	+185
7000	+280	+185	+110	+ 50	+ 0	— 35	— 45	— 25	+ 30	+175	+610	,,
7500	+295	+205	+135	+ 80	+ 45	+ 40	+ 65	+160	+470	,,	,,	,,
8000	+310	+235	+175	+140	+130	+180	+335	,,	,,	,,	,,	,,
8500	+330	+270	+235	+240	+330	,,	,,	,,	,,	,,	,,	,,
9000	+360	+330	+370	+470	,,	,,	,,	,,	,,	,,	,,	,,
9500	+430	+490	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,

TABLE VII.

Increases to be made to the true distance D to obtain the Fuse setter Range B.

High Explosive Shells 24/31 ($V_0 = 550$ m.; $p = 5.555$ kg.
(From the experiments of Gâvre.)

D \ h	0	500	1000	1500	2000	2500	3000	3500	4000	4500
500	175	170	,,	,,	,,	,,	,,	,,	,,	,,
1000	155	130	,,	,,	,,	,,	,,	,,	,,	,,
1500	160	135	110	,,	,,	,,	,,	,,	,,	,,
2000	175	155	120	90	70	,,	,,	,,	,,	,,
2500	220	185	145	110	80	,,	,,	,,	,,	,,
3000	265	225	180	130	90	50	,,	,,	,,	,,
3500	315	265	210	155	110	60	25	,,	,,	,,
4000	365	300	245	185	140	90	65	50	,,	,,
4500	415	345	280	230	185	145	120	95	80	,,
5000	470	400	340	290	260	235	215	200	205	230
5500	530	475	415	375	360	360	380	415	480	580
6000	610	570	530	500	505	545	625	760	,,	,,
6500	715	700	675	665	705	855	,,	,,	,,	,,
7000	855	850	880	900	,,	,,	,,	,,	,,	,,

TABLE VIII.

Time of Flight as a Function of the Fuse Setter Range and of the Altitude.

Shrapnel 22/31 — $V_0 = 535$ m.
(From the experiments of Gâvre.)

B \ h	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
Meters	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds
500	0.4	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1000	1.7	1.7	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1500	3.0	3.1	3.2	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
2000	4.4	4.5	4.7	4.8	5.0	,,	,,	,,	,,	,,	,,	,,	,,
2500	5.9	6.1	6.3	6.5	6.7	6.9	,,	,,	,,	,,	,,	,,	,,
3000	7.5	7.7	8.0	8.2	8.5	8.7	9.0	,,	,,	,,	,,	,,	,,
3500	9.1	9.4	9.7	10.0	10.3	10.0	10.9	11.3	,,	,,	,,	,,	,,
4000	10.9	11.2	11.6	12.0	12.3	12.7	13.1	13.4	13.8	,,	,,	,,	,,
4500	12.8	13.2	13.6	14.1	14.5	14.9	15.4	15.8	16.3	17.7	,,	,,	,,
5000	14.9	15.3	15.8	16.3	16.8	17.3	17.8	18.3	18.8	19.3	19.8	,,	,,
5500	17.1	17.6	18.1	18.6	19.2	19.8	20.4	20.9	21.5	22.1	22.7	23.3	,,
6000	19.3	19.9	20.5	21.1	21.8	22.4	23.1	23.8	24.5	25.2	25.9	26.6	,,
6500	21.5	22.3	23.0	23.8	24.5	25.2	26.0	26.8	27.6	28.4	29.3	30.1	31.0
6900	23.7	24.4	25.2	26.0	26.9	27.7	28.6	29.5	30.4	31.3	32.3	33.3	,,

TABLE IX.

Time of Flight as a Function of the Fuse Setter Range and of the Altitude.
Shrapnel 30/55 — $V_0 = 525$ m.
(From the experiments of Gâvre.)

h / B	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
Meters	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds
500	0.67	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1000	1.78	1.8	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1500	2.96	3.0	3.1	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
2000	4.23	4.3	4.5	4.6	,,	,,	,,	,,	,,	,,	,,	,,	,,
2500	5.63	5.8	6.0	6.2	6.4	,,	,,	,,	,,	,,	,,	,,	,,
3000	7.19	7.4	7.6	7.9	8.2	8.4	8.6	,,	,,	,,	,,	,,	,,
3500	8.85	9.1	9.4	9.7	10.0	10.4	10.7	10.9	,,	,,	,,	,,	,,
4000	10.61	10.9	11.3	11.6	12.0	12.4	12.8	13.2	13.6	,,	,,	,,	,,
4500	12.44	12.8	13.2	13.7	14.1	14.6	15.0	15.5	15.9	16.3	,,	,,	,,
5000	14.34	14.8	15.3	15.8	16.2	16.8	17.3	17.8	18.3	18.9	19.4	,,	,,
5500	16.33	16.0	17.4	18.0	18.5	19.1	19.7	20.3	20.9	21.5	22.1	22.8	,,
6000	18.41	19.1	19.7	20.3	20.9	21.5	22.2	22.9	23.6	24.3	25.0	25.7	,,
6500	20.60	21.3	22.0	22.7	23.4	24.1	24.9	25.7	26.5	27.3	28.1	28.9	29.7
7000	22.91	23.7	24.5	25.3	26.1	26.9	27.7	28.6	29.5	30.4	31.4	32.4	33.4
7500	25.35	26.2	27.1	28.0	28.9	28.8	30.8	31.8	32.8	33.8	35.0	36.2	,,
8000	27.96	28.9	29.9	30.9	32.0	33.0	34.1	35.2	36.4	37.7	,,	,,	,,
8500	30.82	31.9	33.0	34.2	35.4	36.6	37.9	39.2	,,	,,	,,	,,	,,
9000	33.97	35.2	36.4	37.8	39.2	40.7	,,	,,	,,	,,	,,	,,	,,
9500	37.44	38.9	40.4	42.0	43.7	,,	,,	,,	,,	,,	,,	,,	,,

TABLE X.

Time of Flight as a Function of the Fuse Setter Range and of the Altitude.

Explosive Shells 24/31 ($V_0 = 550$ m.; $p = 5.555$ kg.)

B \ h	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
Meters	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds
500	0.62	"	"	"	"	"	"	"	"	"	"
1000	1.73	1.83	"	"	"	"	"	"	"	"	"
1500	3.00	3.10	3.19	"	"	"	"	"	"	"	"
2000	4.39	4.50	4.64	4.78	"	"	"	"	"	"	"
3500	5.85	6.00	6.18	6.36	6.53	"	"	"	"		
3000	7.37	7.59	7.82	8.06	8.27	8.49	"	"	"	"	"
3500	9.00	9.29	9.58	9.89	10.17	10.50	10.55	"	"	"	"
4000	10.78	11.11	11.47	11.84	12.20	12.58	12.87	13.21	"	"	"
4500	12.69	13.07	13.49	13.92	14.35	14.77	15.18	15.61	16.00	"	"
5000	14.71	15.14	15.63	16.13	16.62	17.12	17.63	18.15	18.64	19.05	"
5500	16.81	17.33	17.89	18.46	19.03	19.62	20.23	20.85	21.43	21.92	22.25
6000	19.00	19.64	20.29	20.95	21.62	22.31	23.01	23.72	24.42	25.07	25.80
6500	21.35	22.10	22.85	23.62	24.40	25.19	25.99	26.80	27.64	"	"
7000	23.90	24.72	25.58	26.47	27.37	28.27	29.17	30.10	"	"	"
7500	26.60	27.49	28.47	29.49	30.53	31.59	"	"	"	"	"
8000	29.38	30.40	31.48	32.63	33.86	"	"	"	"	"	"

TABLE XI.

Firing against terrestrial objects.

Shrapnel $V_0 = 535$ m.

RANGES.	CORRECTIONS of site increase in multiples of 2 mils.	DRIFT.	RANGES.	CORRECTIONS of site increase in multiples of 2 mils.	DRIFT.
300	204		2000	246	
400	206		2100	250	
500	208		2200	252	
600	210		2300	256	
700	212	0	2400	260	
800	214		2500	262	2 mils.
900	216		2600	266	
1000	218		2700	270	
1100	220		2800	274	
1200	224		2900	278	
1300	226		3000	282	
1400	228		3100	286	
1500	230	1 mil.	3200	290	
1600	234		3300	296	3 mils.
1700	236		3400	300	
1800	240		3500	304	
1900	242				

TABLE XI (continued).

Firing against terrestrial objects.

Shrapnel $V_0 = 535$ m.

RANGES.	CORRECTIONS OF SITE INCREASE in multiples of 2 mils.	DRIFT.
4000	328	5 mils.
4500	254 + 100 at the range drum.	6 mils.
5000	284 + 100 at the range drum.	7 mils.
5500	316 + 100 at the range drum.	9 mils.
6000	352 + 100 at the range drum.	11 mils.
6500	290 + 200 at the range drum.	14 mils.
7000	334 + 200 at the range drum.	17 mils.
7500	284 + 300 at the range drum.	21 mils.
8000	342 + 300 at the range drum.	27 mils.
8500	308 + 400 at the range drum.	37 mils.

TABLE XII.

Firing against terrestrial objects.

High Explosive Shell (short fuse) $V_0 = 550$ m.

RANGES.	CORRECTIONS of site increased in multiples of 2 mils.	DRIFT.	RANGES	CORRECTIONS of site increased in multiples of 2 mils.	DRIFT.
300	204		2000	250	
400	206		2100	254	
500	208		2200	258	
600	210	0	2300	262	
700	214		2400	266	2 mils.
800	216		2500	270	
900	218		2600	276	
1000	220		2700	280	
1100	222		2800	284	
1200	224		2900	288	
1300	228		3000	294	
1400	232	1 mil.	3100	298	
1500	234		3200	302	5 mils.
1600	236		3300	308	
1700	240		3400	312	
1800	244		3500	318	
1900	248				

TABLE XII (continued).

Firing against terrestrial objects.

Explosive shell (short fuse) $V_0 = 550$ m.

RANGES.	CORRECTIONS OF SITE INCREASED in multiples of 2 mils.	DRIFT.
4000	348	6 mils.
4500	280 + 100 on the range drum.	7 mils.
5000	316 + 100 on the range drum.	9 mils.
5500	258 + 200 on the range drum.	12 mils.
6000	302 + 200 on the range drum.	15 mils.
6500	254 + 300 on the range drum.	18 mils.
7000	212 + 400 on the range drum.	23 mils.
7500	290 + 400 on the range drum.	30 mils.
8000	306 + 500 on the range drum.	41 mils.

TABLE XIII.

Increase of the Range by an increase of the super-elevation of 1 mil.

Fuse 22/31.

RANGES.	1 MIL (approximate value).
1000 m.	40 m.
2000 m.	30 m.
3000 m.	25 m.
4000 m.	20 m.
5000 m.	15 m.
6000 m.	15 m.
7000 m.	10 m.

TABLE XIV.

Increase of the Range by an increase of the super-elevation of 1 mil.

Fuse 24/31.

RANGES.	1 MIL (approximate) value).
1000 m.	35 m.
2000 m.	25 m.
3000 m.	20 m.
4000 m.	15 m.
5000 m	10 m.
6000 m.	10 m.
7000 m.	5 m.

NOTE. — To pass from the 22/31 to the 24/31 fuse (I. A., Model 1915, or I. A. L., Model 1916), increase the angle of fire of:

2 mils at 2000 m.
3 mils at 3000 m.
6 mils at 4000 m.
16 mils at 5000 m.
42 mils at 6000 m.
108 mils at 7000 m.
162 mils at 8000 m.