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DRILL REGULATIONS FOR FIELD ARTILLERY

(4.7-INCH GUN)

UNITED STATES ARMY

(Provisional)

1914

WASHINGTON
GOVERNMENT PRINTING OFFICE
1915

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(4.7-INCH GUN)

UNITED STATES ARMY

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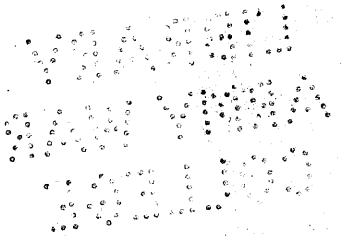
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WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, October 10, 1914.

The following system of Provisional Drill Regulations for Field Artillery (4.7-inch gun), 1914, is approved and published for the information and guidance of the Regular Army and the Organized Militia of the United States.

Battery, battalion, and regimental commanders whose commands include 4.7-inch gun matériel will submit to The Adjutant General of the Army any suggestions relative to these Provisional Drill Regulations which they think will add to their value.

By order of the Secretary of War:

W. W. WOTHERSPOON,
Major General, Chief of Staff.

TABLE OF CONTENTS.

PART I.

GENERAL PRINCIPLES AND DEFINITIONS.

See Drill Regulations for Field Artillery (Horse and Light), Part I.

PART II.

DISMOUNTED INSTRUCTION.

See Drill Regulations for Field Artillery (Horse and Light), Part II.

PART III.

FIRING INSTRUCTION.

	Par.
CHAPTER I.—*Object and sequence of the instruction*	136–137
CHAPTER II.—*The Cannoneer:*	
Section I. Method of instruction	138–140
Section II. Preliminary instruction in matériel and methods of fire	141
Section III. Individual duties in the service of the piece—	
Duties in general of the different cannoneers	142
Duties in detail of the different cannoneers:	
Duties of the gunner—	
To set the deflection scale of the panoramic sight	143–145
To set the deflection scale of the peep sight	146
To set the sight for range	147–148
To correct for difference of level of wheels	149
To lay the piece—	
For both range and direction	150–151
For direction only	152–153
To measure the deflection of a target from an aiming point	154–155

CHAPTER II.—*The Cannoneer*—Continued.
Section III. Individual duties in the service of the piece—Continued.
Duties in detail of the different cannoneers—Con.

	Par.
Duties of No. 1—	
To open the breech	156
To close the breech	157
To set off an angle of site	158–159
To set the quadrant for range	160–161
To correct for difference of level of wheels	162
To lay the piece for range	163–164
To measure the angle of site	165–166
To fire the piece	167
Duties of No. 2—	
To load the piece	168
Duties of No. 3—	
To set the fuse-setter scales and the fuses	169
Duties of No. 4—	
To pass ammunition	170
Duties of No. 5—	
To pass ammunition	171
Training of Nos. 3, 4, and 5	172–173
Duties of Nos. 6 and 7—	
To give the general direction to the piece	174–177
To set the fuse-setter scales	178–180
To set fuses	181–182

CHAPTER III.—*The Gun Squad:*

Section I. General provisions	183–185
Section II. Dispositions and exercises incidental to the service of the piece—	
Composition of the gun squad	186–188
Formation of the gun squad	189
Formation of the caisson squad	190–192
To form the gun squad	193–195
To tell off the gun squad	196–198
Posts of the gun squad, carriages limbered	199–201
To post the gun squad	202
Posts of the cannoneers, carriages limbered	203
To post the cannoneers	204
To operate the brakes	205
The cannoneers dismounted	206

CHAPTER III.—*The Gun Squad*—Continued.
Section II. Dispositions and exercises incidental to the service of the piece—Continued. Par.
To move by hand the carriages limbered 207–209
Posts of the cannoneers, carriages unlimbered 210–211
To change the posts of the cannoneers 212–214
Disposition of the carriages before and after unlimbering 215–219
To unlimber and prepare for action—
General rules 220
Duties in detail of the cannoneers at the command for action 221
To fire to the rear 222–223
To fire to the front 224–225
To fire to the flank 226
To move by hand the carriages unlimbered 227
To resume the order for marching 228
To hitch and limber 229
To leave the park 230–231
Section III. The service of the piece—
General provisions 232
Methods of laying 233–235
To load and lay—
Direct laying 236
Indirect laying 237–238
To fire the piece 239–241
To reload and re-lay 242
To change from direct to indirect laying 243
To shift the trail 244
To change target 245
To discontinue and to resume the fire 246–247
Special methods of fire 248
Continuous fire 249–250
Volley fire 251–253
Fire at will 254–256
Moving targets 257–261
Service of the piece with reduced numbers 262
CHAPTER IV.—*The Firing Battery:*
Section I. General provisions 263
Section II. Duties in general of officers and noncommissioned officers 264

CHAPTER IV.—*The Firing Battery*—Continued.
Section III. Methods of obtaining distribution of fire— Par.
Individual distribution 265
Collective distribution 266–272
Section IV. Communication of firing data to the guns 273–280
Section V. Fire for adjustment and fire for effect 281
Fire for adjustment 282
By battery salvo 283–285
By platoon salvo 286
By piece 287
Fire for effect 288
Battery salvos 289
Volley fire 290–293
Continuous fire 294–295
Fire at will 296
Moving targets 297–298
Section VI. Change of target 299–300
Section VII. Replacement of ammunition 301–302
Section VIII. Replacement of casualties 303
CHAPTER V.—*Preparation and Conduct of Fire:*
Section I. Preparation of fire—
1. Duties of officers 304–307
2. Gun positions 308–313
3. Selection of observing stations 314–316
4. Selection of aiming points 317–320
5. Designation of objectives 321–326
6. Distribution of fire 327–328
7. Determination of firing data 329
The deflection 330–332
The deflection difference 333–341
The deflection of the right piece 342–348
The angle of site 349–354
The corrector 355
The range 356
Summary of operations 357
8. Observing the terrain; sectors of observation; forming the sheaf; preparations for firing 358–361
Section II. Conduct of fire—
1. General provisions 362–366
2. Principles governing the conduct of fire 367
Fire for adjustment 368–378
Fire for effect 379

CHAPTER V.—*Preparation and Conduct of Fire*—Continued.
Section II. Conduct of fire—Continued. Par.
3. Observation of fire..... 380–390
Observation of errors in direction..... 391
Observation of errors in height of burst..... 392–395
Observation of errors in range..... 396–409
4. Rules of fire—
Minor changes in adjustment..... 410
Adjustment of the direction..... 411–414
Adjustment of the height of burst..... 415–420
Adjustment of the range..... 421–423
Percussion fire..... 424
Time fire..... 425–432
5. Application of fire..... 433–443
6. Registration of fire..... 444–446

PART IV.

Mounted instruction..... 447

PART V.

Field Artillery information service..... 448

PART VI.

Artillery in the field..... 449

PART VII.

Care of horses and horse training..... 450

PART VIII.

Ceremonies..... 451

PART IX.

Bugle calls..... 452

PART I.

GENERAL PRINCIPLES AND DEFINITIONS.

See Drill Regulations for Field Artillery (Horse and Light) Part I.

PART II.

DISMOUNTED INSTRUCTION.

See Drill Regulations for Field Artillery (Horse and Light), Part II.

PART III.

FIRING INSTRUCTION.

CHAPTER I.—OBJECT AND SEQUENCE OF THE INSTRUCTION.

136. The objects of this instruction are:

1. To train the personnel in the mechanism of the methods of fire so that, at the word of command, fire of the desired nature may be delivered with certainty and celerity. (**Fire Discipline.**)

2. To train officers in the conduct of fire, so that they may be enabled to utilize the weapons at their disposal to the best advantage. (**Conduct of Fire.**)

A progressive order of instruction will be followed in each case.

Training in the elementary duties of the two kinds should be undertaken separately at first. Drill in the mechanism of fire is the essential feature of instruction of the first kind; practice in determining firing data and in adjusting fire under various assumed conditions, the essential feature of instruction of the second kind. As soon as the two kinds of instruction have sufficiently progressed, they should be combined and the training carried on, first in the park or on the drill ground, and then on terrain of every available description; tar-

gets representing as nearly as possible those to be met in service should be attacked, first by simulated fire, then with the service ammunition.

137. Training in fire discipline begins with the instruction of the **cannoneer,** passes to that of the **gun squad,** then to that of the **firing battery,** and then to that of the higher units.

The cannoneer must be taught to perform quickly and correctly the individual duties required of him in the service of the piece. He must acquire such a thorough knowledge of these duties and such a well-grounded habit of performing them properly that in the excitement of action their execution will be a matter of second nature to him.

The gun squad must be trained as a unit, so that its individual members work together smoothly, quietly, and effectively in serving the piece.

The instruction of the firing battery and of the higher units should secure the harmonious working of the organization as a whole in delivering fire as a single fire unit, thus enabling its commander, without confusion or delay, to turn the fire of his unit from point to point and to concentrate or distribute this fire in such manner as may be desirable.

All the personnel should receive this instruction.

CHAPTER II.—THE CANNONEER.

SECTION I.—*Method of Instruction.*

138. For this instruction a few recruits (usually not more than eight) are placed under the charge of an instructor, who, by simple directions, causes the gun and its caisson to be limbered or unlimbered and to be placed in such position as he may desire.

139. In view of the great importance of instruction of this character, it is begun as soon as the recruits have had a few drills in The Soldier Dismounted, and is continued, in addition to other instruction, until the cannoneers are thoroughly instructed and skilled in their individual duties.

140. The instruction involves acquiring:

First. An intimate knowledge of the matériel in use in the battery, the names of the different parts, their purposes, and methods of operation.

Second. Skill and dexterity on the part of the cannoneers in the performance of their duties.

Instruction of the first kind is imparted by careful and painstaking description on the part of the instructor, supplemented in each case, as far as practicable, by actual demonstration of the method of operation of the particular element of the matériel being described.

Instruction of the second kind is had by persistent drill in the prescribed duties and by continued practice with the various mechanisms under all possible conditions.

SECTION II.—*Preliminary Instruction in Matériel and in Methods of Fire.*

141. The instruction is carried on in the squad room, in the park, and elsewhere during the intervals of more advanced work.

This instruction is on such subjects as the following:

1. Nomenclature of the principal parts of the piece and caisson and their respective equipments.
2. Operation of the different parts of the gun and carriage; for example, the method of controlling the recoil.
3. Sights and quadrants: Description and methods of operation.
4. Laying the gun: Principles on which the different methods are based and conditions under which they are used. Thus:

(*a*) Laying by the sight for direction and by the quadrant for range; (*b*) laying by the sight for range and direction.

5. Powders: Kinds of powder used and their principal characteristics.
6. Projectiles: The different kinds and special uses of each.
7. Fuses: The different kinds and their mode of operation.
8. Methods of fire: Description of the different kinds and occasions in general when the different kinds are applicable.

SECTION III.—*Individual Duties in the Service of the Piece (4.7-inch field gun).*

DUTIES IN GENERAL OF THE DIFFERENT CANNONEERS.

142. *Gunner:* Commanding the gun squad.
Laying the piece—
1. For direction only, for indirect laying.
2. For both range and direction, for direct laying.

No. 1. Laying the piece for range, for indirect laying.
Opening and closing the breech.
Firing the piece.

142. *Gunners:* Commanding the Gun Squad—Continued.

No. 2. Loading the piece.

No. 3. Keeping the fuse-setter scales set at the range and corrector ordered. Setting fuses.

No. 4. Holding the projectile while No. 3 sets the fuse. Passing the projectile to No. 2.

No. 5. Passing the ammunition from the chest to No. 4.

Nos. 6 and 7. Giving the general direction to the gun.

DUTIES IN DETAIL OF THE DIFFERENT CANNONEERS.

DUTIES OF THE GUNNER.

To Set the Deflection Scale of the Panoramic Sight.

143. The limb of the instrument is divided into 64 equal parts. The micrometer scale is divided into 100 equal parts, a complete turn of the micrometer corresponding to one division of the limb. The micrometer therefore serves to subdivide the divisions of the limb into 100 parts; hence, the least reading of the instrument is one sixty-four-hundredth of the circumference, or one one-thousandth of the radius, very nearly. The least reading is called a "mil." A deflection of 1 mil corresponds, therefore, to a deviation at the target of one one-thousandth of the range.

To set off a deflection.—The gunner turns the rotating head of the instrument until the number of hundreds of the setting is shown by the index of the limb, and the number of tens and units, if any, by the index of the micrometer.

If, in setting the deflection, the rotating head of the instrument has to be moved through a small angle only, the slow-motion screw is used. But if the reading given requires a large angular movement, the slow-motion mechanism is ungeared and the rotating head is turned around by hand. The slow-motion mechanism is then thrown in gear and used to set off the exact setting.

144. The gunner is repeatedly practiced in setting deflections by command. Thus, for example: **Deflection, 1640.**

The gunner brings the index of the limb between the divisions marked 16 and 17 on the limb; then turns the micrometer until its index reads 40.

The instructor verifies the correct setting of the sight.

145. When numbers are announced as a part of a command they are habitually announced, thus:

25.....Twenty-five.
400.....Four hundred.
705.....Seven hundred and five.
860.....Eight sixty.
3805.....Thirty-eight hundred and five.
4000.....Four thousand.
4135.....Forty-one thirty-five.
5050.....Five thousand and fifty.

But when the telephone is used for the transmission of firing data, the rules laid down in paragraph 796, Drill Regulations for Field Artillery (Horse and Light) will govern.

To Set the Deflection Scale of the Peep Sight.

146. The graduations on the deflection scale of the peep sight correspond to those on the panoramic sight, the unit of the scale being 1 mil. When set at 0 (6400) the line of sight is parallel to the line of fire. Toward the left the readings increase, the maximum reading being 45 mils; toward the right the readings decrease, the minimum reading being 6355 mils.

To set off a deflection: The gunner turns the deflection screw head until the index is opposite the desired graduation.

He is practiced in setting off deflections as before.

To throw the projectile to the left, increase the deflection; to throw it to the right, diminish the deflection.

To Set the Sight for Range.

147. The range scale is graduated from 0 to 9400 yards, the least reading being 50 yards. The scale may be readily set by the eye to read to 25 yards.

To set off a range: The gunner moves the sight shank up or down in its socket until the desired graduation is opposite the index.

The sight shank is moved up or down by means of a scroll gear. If a considerable movement of the shank is necessary this mechanism is ungeared by drawing outward the scroll-gear handle with the right

hand; the shank is then raised or lowered with the left hand until the desired graduation is near the index. The mechanism is then thrown in gear and utilized to set the scale at the exact setting desired.

148. The gunner is practiced in setting the sight for range, thus: The sight being in its socket, the instructor commands, for example, **5700.**

The gunner sets the sight as just described, and the instructor verifies the setting.

To Correct for Difference of Level of Wheels.

149. The gunner centers the bubble of the cross level by turning the leveling screw on the sight bracket.

To Lay the Piece.

150. For both range and direction: When it is possible for the gunner to see the target clearly and to aim directly upon the part of it which the fire of his gun is intended to reach, the gun may be laid by the gunner both for range and direction. This is called **direct laying.**

The designation **target** (so and so) is the indication that this method of laying is to be employed.

151. The gunner may be practiced in this duty as follows:

The gunner being at his post at the piece unlimbered, the sights in their sockets, the instructor commands, for example:

1. **Target, that gun.**
2. **Deflection, 10.**
3. **5400.**

1. At the indication of the target the gunner causes the piece to be pointed in its general direction.
2. Seats himself on the gunner's seat.
3. Sets off the deflection ordered.
4. Sets off the range ordered.
5. Corrects for difference of level of wheels.
6. Operates the elevating and traversing apparatus, so as to bring the line of sight upon the target.
7. Calls **ready** when the gun is laid, and takes his post.

The instructor verifies the sight settings, the centering of the bubble of the cross level, and sees that the gun is laid accurately upon the target.

152. For direction only: When it is impracticable for the gunner to aim directly upon the part of the target which the fire of his gun is intended to reach, the gun is laid by him for direction only. In this case, an aiming point which can be clearly seen by the gunner is designated and a suitable deflection given, such that, when the line of sight is directed upon the aiming point, the gun will be directed upon the target. This is called **indirect laying.**

The designation **aiming point** (so and so) is the indication that this method of laying is to be employed.

This method of laying may also be used when the target can be seen by the gunner.

153. The gunner may be practiced in this duty as follows:

The gunner being at his post at the piece unlimbered, the sights in their sockets, the instructor commands, for example:

1. **Aiming point, the chimney on that white house.**
2. **Deflection, 240.**

1. At the indication of the deflection the gunner sets it off on the panoramic sight.
2. Causes the trail to be shifted until a side face of the rotating head of the sight is directed upon the aiming point.
3. Seats himself on the gunner's seat.
4. Corrects for difference of level of wheels.
5. Centers approximately the bubble of the elevation level by raising or lowering the sight shank in its socket.
6. Traverses the gun until the vertical cross hair is on the aiming point.
7. Calls **ready** when the gun is laid in direction, and takes his post.

The gunner takes care not to touch the elevating gear in this method of laying.

The instructor verifies the sight setting and the centering of the bubble of the cross level, and sees that the sight is accurately directed upon the aiming point.

If the piece has been laid for a given deflection, the instructor may command, for example: **ADD (SUBTRACT) 80.**

The gunner applies the correction to the old deflection and lays the piece as explained above.

NOTE.—When laying at stationary targets, using either method, the gunner should traverse the gun approximately to the middle point of traverse before the general direction is given from the end of the trail.

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To Measure the Deflection of a Target from an Aiming Point.

154. The gun being laid directly on the target with zero deflection: The gunner turns the rotating head of the panoramic sight until the vertical cross hair is on the aiming point; the reading of the instrument is then the deflection sought.

155. The gunner may be practiced in this duty as follows:

The gun being laid in direction on any target, with zero deflection, and the gunner seated astride the seat, the instructor commands, for example:

1. **Aiming point, that clock tower.**
2. **MEASURE THE DEFLECTION.**

1. The gunner turns the rotating head of the panoramic sight until the vertical cross hair is on the designated aiming point.

2. He then reads and announces the deflection, thus: **Deflection, 490.**

The instructor verifies the reading and sees if the sight is accurately directed upon the aiming point.

DUTIES OF NO. 1.

To Open the Breech.

156. No. 1 grasps the operating lever with his left hand and compresses the lever latch. He then draws the lever to the rear and right, thus swinging the block to the right.

To Close the Breech.

157. No. 1 grasps the operating lever with his left hand, pushes the lever to the left, and swings the block smartly to its seat.

To Set Off an Angle of Site.

158. The clinometer of the range quadrant consists of the limb and the micrometer. The limb is graduated in divisions of 100 mils each. The divisions are marked 2, 3, 4, 5; but they are to be read 200, 300, 400, 500 mils. The micrometer is a beveled disk at the upper end of the clinometer level screw. Its periphery is divided

into 100 equal parts, and, as one complete turn of the level screw moves the index of the limb over one division or 100 mils, the least reading of the micrometer is 1 mil.

The graduation 3 (or 300) on the scale corresponds to targets which are on the same level as the gun. Angles of site greater than 300 correspond to targets above the level of the gun and those less than 300 to targets below that level. A variation of 1 mil in the angle of site corresponds to a difference of level of $\frac{1}{100}$ of the range.

To set off an angle of site: No. 1 turns the clinometer level screw so that the index of the limb shows the number of hundreds of the setting, and the index of the micrometer shows the number of tens and units of the setting.

159. No. 1 may be practiced in this duty as follows:

The quadrant being in or out of its socket, the instructor commands, for example: **SITE, 315.**

No. 1 turns the clinometer level screw until the index of the limb is between the graduation marked **3** and the graduation marked **4,** and the index of the micrometer reads **15.**

The instructor verifies the setting.

To Set the Quadrant for Range.

160. The range disk of the quadrant is graduated from 0 to 9,400 yards, the least reading of the scale being 50 yards. A given range is set off by turning the handwheel until the index is brought opposite the designated reading. If a considerable change of reading has to be effected, the slow-motion mechanism is ungeared by drawing out the handwheel. The index is then turned quickly to the vicinity of the desired setting; by releasing the tension on the handwheel the slow-motion mechanism is then thrown in gear and used to effect an accurate setting.

161. No. 1 may be practiced in this duty as follows:

The quadrant being in or out of its socket, the instructor commands, for example: **2550.**

No. 1 manipulates the handwheel, as above described, until the index is brought opposite the designated reading.

The instructor verifies the setting.

To Correct for Difference of Level of Wheels.

162. The quadrant being in its socket, No. 1 centers the bubble of the cross level by turning the level screw.

To Lay the Piece for Range.

163. In indirect laying, the piece is habitually laid for range by No. 1, while the gunner lays for direction only.

No. 1 sets off the angle of site, sets the quadrant for range, corrects for difference of level of wheels, then centers the bubble of the clinometer level by turning the elevating handwheel.

164. No. 1 may be practiced in this duty as follows:

The quadrant being in its socket; and No. 1 sitting astride the seat on the right side of the trail facing the carriage, the instructor commands, for example:

1. **Site, 280.**
2. **5400.**

As the data are announced, No. 1—

1. Sets off the angle of site.
2. Sets the quadrant for range.
3. Corrects for difference of level of wheels.
4. Centers the bubble of the clinometer level by turning the elevating handwheel.
5. Calls **set** when the piece is correctly laid, and takes his post.

The instructor verifies the quadrant settings and the centering of the bubbles.

To Measure the Angle of Site.

165. The angle of sight of any designated target may be measured by sighting directly on the target with the sight set at any convenient range; then setting the quadrant range disk for the same range, turning the clinometer level screw so as to center the bubble of the clinometer level, and taking the reading of the clinometer scales.

166. No. 1 may be practiced in this duty as follows:

Having caused the piece to be accurately laid on the target by means of the sight set at any convenient range, the instructor commands, for example:

1. **5700.**
2. **MEASURE THE SITE.**

At the last command, No. 1—

1. Sets off the range on the range disk.
2. Corrects for difference of level of wheels.
3. Centers the bubble of the clinometer level by turning the clinometer level screw.

4. Calls out the angle of site as soon as measured, thus: **Site 330,** and takes his post.

The instructor verifies the quadrant settings and the centering of the bubbles.

To Fire the Piece.

167. The piece being loaded and laid, the instructor commands **Ready.** At this command No. 1 grasps the firing handle with the left hand. At the command: 1. **No. 1** (or such number), 2. **FIRE,** No. 1 draws the handle smartly downward so as to trip the trigger arm.

NOTE.—It is most important that No. 1 should become habituated to firing with the left hand, as the danger of firing while the hand is on the operating lever is thus obviated.

DUTIES OF No. 2.

To Load the Piece.

168. No. 2 receives a round of ammunition from No. 4 and inserts it in the chamber. While so doing, he stands in the most convenient position to reach the round, which is passed to him on the one side, and to insert it in the chamber on the other. He stands clear of the breech during recoil.

In loading the piece, No. 2 holds the middle of the projectile in his left arm, the base of the cartridge case with his right hand. He inserts the head of the projectile in the chamber and then shoves it smartly forward. The closing of the breechblock insures the proper seating of the projectile.

DUTIES OF NO. 3.

169. No. 3 keeps the range and corrector scales of the fuse setter at the settings ordered, and sets the fuses.

DUTIES OF NO. 4.

170. In time fire No. 4 receives a round from No. 5, places it base downward on the ground, and removes the waterproof cover. He holds each round while No. 3 sets the fuse, and then passes it to No. 2.

In percussion fire, he receives the ammunition from No. 5 and passes it at once to No. 2.

DUTIES OF NO. 5.

171. No. 5 takes the ammunition from the chest and passes it to No. 4.

172. While serving ammunition, Nos. 3, 4, and 5 take the positions best suited to performing their special duties and to securing the maximum protection from the carriages.

173. Nos. 3, 4, and 5 should be trained to perform one another's duties so that in action they may relieve one another from time to time. After being thoroughly instructed in their individual duties, they should be drilled together, it being most important to develop: (1) Accuracy and rapidity in the setting of fuses; (2) a quick and orderly method of passing ammunition from hand to hand.

DUTIES OF NOS. 6 AND 7.

174. Nos. 6 and 7 are practiced, for direct laying, in pointing the piece quickly and accurately upon different objects; and, for indirect laying, in giving the general direction to the piece.

175. For their assistance the upper edges of the top and main shields should be graduated in mils and marked in divisions of 50 and 100 mils. They should also be instructed as to the value in mils of the width of the float and of the trail spade.

176. For direct laying, the instructor commands, for example:

1. **Target, that block house.**
2. **AIM.**

Nos. 6 and 7 point the piece quickly upon the designated object. For this purpose No. 6 takes position at the left trail handspike, No. 7 at the right. No. 6 looks along the line sights and directs the shifting of the trail until the gun is pointed. The instructor verifies the pointing.

177. For indirect laying, the instructor commands, for example:

1. **Add (Subtract), 140.**
2. **AIM.**

No. 6 refers to the shield scale or to the width of the float or trail spade, and assisted by No. 7, shifts the trail through the designated angle.

The instructor verifies the pointing.

To Set the Fuse-Setter Scales.

178. The fuse setter has a range scale and a corrector scale.

The range scale is graduated in yards from 0 to 9700, its least reading being 50 yards.

The corrector scale is graduated uniformly into 50 divisions, numbered 0, 10, 20, * * * 50. Under normal conditions a change of fuse setting by one unit of this scale changes the time of burning of the fuse so as to produce a variation in the height of burst of the projectile of 1 mil. Corrector 30 corresponds theoretically to a height of burst of 3 mils.

179. Increasing the corrector shortens the time of burning of the fuse and hence increases the height of burst of the projectile; decreasing the corrector lengthens the time of burning of the fuse and hence decreases the height of burst of the projectile.

The corrector scale thus affords the means of correcting the observed error in height of burst and adjusting the mean point of burst at the normal height.

180. To set the instrument, the instructor announces the corrector and the range; No. 3 releases the clamp screw, sets the index at the corrector ordered, turns the handle until the range ordered is opposite the index, and sets the clamp.

No. 3 may be practiced in this duty as follows:

The instructor commands, for example:

1. **Corrector, 35.**
2. **5900.**

No. 3 sets off the corrector and range ordered.

The instructor examines and verifies the settings.

After the initial corrector has been given, No. 3 may be practiced in his duties as follows:

Up (Down) 5.
6100.

No. 3:

1. Raises the corrector by 5 points.
2. Sets off the range ordered.

The instructor examines and verifies the settings.

To Set Fuses.

181. To set a fuse, place the fuse setter over the point of the projectile and turn in a clockwise direction until the rotating pin on the fuse engages the notch in the fuse setter; then press firmly down

on the latter and continue to turn in the same direction until the motion is arrested by the stop pin. The fuse is then properly set.

182. Nos. 2, 3, 4, and 5 should be trained together in setting fuses and serving ammunition.

CHAPTER III.—THE GUN SQUAD.

SECTION I. *General Provisions.*

183. As soon as the cannoneers have been instructed in their individual duties, they are taught to work together as a **gun squad.**

184. The efficient service of the gun depends upon the orderly cooperation of the members of the gun squad, as well as upon the skill of the individual cannoneers. The habit of combined effort must hence be acquired.

185. An alert and soldierly manner is exacted of the cannoneers, and they should be taught to perform their duties as briskly, rapidly, and quietly as is consistent with efficient service.

SECTION II.—*Dispositions and Exercises Incidental to the Service of the Piece.*

Composition of the Gun Squad.

186. The cannoneers assigned to the service of a gun section constitute a **gun squad.**

187. For the service of the 4.7-inch field gun, the squad is ordinarily composed of two corporals and not less than seven privates. One corporal is the **gunner;** the other the **caisson corporal.**

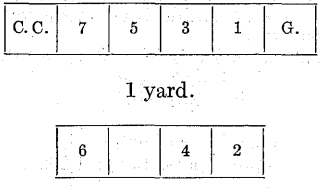
188. The cannoneers assigned to the service of a caisson section constitute a **caisson squad.** It consists of two corporals and such number of cannoneers as may be assigned. The senior corporal is caisson corporal of the **first caisson** of the section; the junior, of the **second caisson** of the section. Instructions prescribed for the gun squad apply also to the caisson squad, with obvious modifications—the senior caisson corporal performing the duties prescribed for the gunner, as far as practicable.

Formation of the Gun Squad.

189. The gun squad is formed in double rank in the following order from right to left: No. 1 on the right of the front rank; No. 2 in rear of No. 1; No. 3 on the left of No. 1; No. 4 on the left of No. 2;

and so on—the odd numbers in the front rank and the even numbers in the rear rank. The gunner is on the right and the caisson corporal on the left of the front rank, both uncovered in the rear rank.

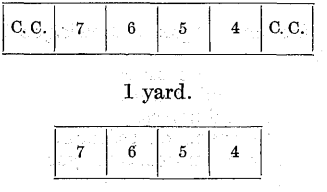
If there is an odd number of cannoneers the highest odd number is covered by the highest even number.



Formation of the Caisson Squad.

190. The caisson squad is formed in double rank, as follows: Nos. 4, 5, 6, 7, etc., of the first caisson, in the front rank in the order named from right to left, covered in the rear rank by Nos. 4, 5, 6, 7, etc., of the second caisson. The senior corporal is on the right and the junior corporal on the left of the front rank, both uncovered in the rear rank.

If there are more cannoneers in the rear rank than in the front rank the highest numbered cannoneer in the rear rank steps into the front rank and is covered by the next highest number.



191. At mounted formations the caisson corporals are ordinarily mounted, and are posted as described in The Battery Mounted.

192. When thoroughly instructed the men are permanently assigned to the duties for which they are best fitted.

To Form the Gun Squad.

193. The instructor indicates the place of formation and commands: **FALL IN.**

The gunner repeats the command and hastens to place himself where the right of the squad is to rest, faced in the proper direction.

The cannoneers move at double time and form in line on the left of the gunner in two ranks.

194. The place of formation is indicated and the command given thus, for example: 1. **In front (rear) of the piece (caisson),** 2. **FALL IN;** or, 1. **On the right (left) of the gun facing toward it.** 2. **FALL IN.**

195. In case the front or rear of one of the carriages is designated the squad falls in at its post (pars. 199 and 200).

To Tell Off the Gun Squad.

196. CALL OFF.

The cannoneer on the right of the front rank calls off **one;** the cannoneer on the right of the rear rank, **two;** the cannoneer on the left of No. 1, **three;** and so on; the gunner and caisson corporal do not call off.

197. In a caisson squad the cannoneers of the first caisson call off first, thus: **Four, five, six,** etc., in order from right to left; followed in the same order by the cannoneers of the second caisson.

198. After having called off, the cannoneers fall in at once in their proper order, if a subsequent formation is ordered.

Posts of the Gun Squad, Carriages Limbered.

199. In front of the piece or caisson. The squad is in line facing to the front, its rear and center 2 yards from the end of the pole or from the heads of the lead horses.

200. In rear of the piece or caisson. The squad is in line facing to the front, its front and center 2 yards from the muzzle, or the rear of the caisson.

201. If no special place of formation is designated, the squad, when formed at the carriages, is posted in front of the leading carriage.

To Post the Gun Squad.

202. The squad is marched to the park, and, on arrival near the carriages, the instructor commands: **SQUAD IN FRONT (REAR) OF YOUR PIECE (CAISSON).**

The gunner marches the squad to the carriage and posts it in the indicated position.

NOTE.—The instructor habitually causes the squad to approach the front (rear) of the carriage which he designates in his command, from the right flank if left in front and from the left flank if right in front.

Posts of the Cannoneers, Carriages Limbered.

203. The gunner and No. 1 opposite the rear of the gun wheels, Nos. 2 and 3 opposite the front of the gun wheels, Nos. 4 and 5 opposite the middle of the connecting pole of the caisson.

Nos. 6 and 7 opposite the rear of the limber wheels of the piece.

Nos. 8 and 9 opposite the front of the limber wheels of the piece.

If the caisson corporal be present, dismounted, he is opposite the end of the pole of the caisson.

The gunner and even numbers are on the right, the caisson corporal and odd numbers on the left, all 2 feet outside the wheels facing to the front.

If numbers higher than No. 9 are present, they are assigned posts by the instructor.

To Post the Cannoneers.

204. 1. **Cannoneers,** 2. **POSTS.** The gunner repeats the command **posts.** The cannoneers leave the ranks, if formed, and move at double time by the shortest practicable routes to their posts at the carriage.

For preliminary instruction, the squads, on entering the park, are first posted with their carriages; the cannoneers are then sent to their posts by the foregoing command. The command is general, however, and is applicable when the cannoneers are in or out of ranks, at a halt or marching, and when the carriages are limbered or unlimbered.

Whenever the carriages hitched are in movement, the gunner and No. 4, if the cannoneers have not been posted, take their posts without command, in order to operate the brakes.

To Operate the Brakes.

205. The brake of the piece is operated by the gunner, who for this purpose may mount astride the gun; that of the caisson is operated by No. 4, who, for this purpose, mounts the caisson chest. They mount and dismount without command.

The chief of section is responsible that the brakes of his carriages are manned and operated at all times in such manner as to afford the maximum assistance to the teams.

206. With the exception noted in the preceding paragraph, the cannoneers are dismounted. In garrison, however, when ammunition is not carried, they may, at the discretion of the instructor, be mounted on the chests for the purpose of training caisson teams in heavier draft. In mounting the cannoneers, care will be taken to place them so that the weight at the end of the pole will not be increased.

To Move by Hand, the Carriages Limbered.

207. To the front: 1. **Piece (Caisson) forward;** 2. **March;** 3. **HALT.**

At the first command, the gunner and No. 1 each procure a picket rope and attach them to the wheel hooks on the right and left piece limber (caisson limber) wheels, respectively, stretching them in the direction the carriage is to be moved. The instructor assigns the necessary number of cannoneers to work at the end of the pole and on the picket ropes. At the command **march,** all working together move the piece (caisson) in the direction indicated. At the command **halt** the carriage is stopped, and all resume their posts.

NOTE.—It will sometimes be found advantageous to attach the middle of a picket rope around the doubletree bolt, drawing the ends out under the doubletree and giving them a half hitch around the end of the pole. By attaching additional ropes to these ends any desired length can be secured, and the piece, or caisson, moved as above described.

208. To the rear: 1. **Piece (Caisson) backward;** 2. **March;** 3. **HALT.**

Executed as in the preceding paragraph except that the ropes are attached to the wheel hooks of the piece (caisson), instead of to the wheel hooks of the limber.

209. In moving carriages by hand the cannoneers should be taught to place themselves alternately on each side of the rope and to take sufficient distance so that they will not interfere with one another. They should be practiced in pulling together. For short distances five men, well placed at a rope, can pull more than a horse.

Whenever the cannoneers are used to assist in moving the carriages hitched, the rope should ordinarily be attached to the piece or caisson wheels instead of the limber wheels.

For short distances, on hard, level ground, the instructor may give directions for moving the carriages without attaching ropes.

Posts of the Cannoneers, Carriages Unlimbered.

210. The gunner, immediately in rear of the cannoneer's seat, on the left side of the trail of the gun.

No. 1, immediately in rear of the cannoneer's seat, on the right side of the trail of the gun.

No. 2, 2 feet in rear of the gunner, covering him.

Nos. 3, 4, and 5, 2 feet in rear of the caisson chest in the order named from right to left.

Nos. 6 and 7, at the ends of the trail handspikes, No. 6 on the left.

The caisson corporal, if present dismounted, 2 feet in rear of the caisson limber chest.

Higher numbered cannoneers, if present, are posted at the discretion of the instructor. Unless otherwise directed, the cannoneers, when not serving the piece, stand at attention at their posts, facing to the front.

211. When serving the piece in either actual or simulated firing the gunner and No. 1 habitually seat themselves on the seats provided for them; the other cannoneers take as much shelter behind the carriages as is consistent with the proper performance of their duties.

To Change the Posts of the Cannoneers.

212. In order to exercise the cannoneers in all duties connected with the service of the piece, the posts of the cannoneers are frequently changed.

213. The cannoneers being at their posts, carriages unlimbered:
1. **Change posts,** 2. **MARCH.**

No. 1 takes the post of No. 2; No. 2 of No. 3; No. 3 of No. 4; No. 4 of No. 5; No. 5 of No. 6; No. 6 of No. 7; No. 7 of No. 1.

214. The gunner should be changed frequently with the caisson corporal, in order that the latter may be thoroughly trained in the duties of gunner.

Disposition of the Carriages Before and After Unlimbering.

215. Before unlimbering: The carriages are either in **section column, louble section,** or **flank column.**

In mergencies the carriages may be unlimbered from any formation. Dispositions to meet exceptional situations should be practiced.

216. When not horsed the carriages are drawn by the cannoneers and the instructor gives the necessary instructions for moving the carriages by the shortest routes into the prescribed positions.

217. After unlimbering: The caisson, the gun carriage, and the caisson limber are in line in that order from left to right, adjacent wheels about 1 foot apart, the caisson trail, the gun muzzle, and the caisson limber pole pointing to the front. The piece wheels are about 1 foot farther to the front than those of the other two carriages to allow for the settling of the spade at the first shot.

The interval of 1 foot may be increased to permit wide movements of the trail if they are anticipated, but effort should be made to preserve the protection of the shields.

218. In active service, and in instruction simulating service conditions, the teams are placed under cover in the vicinity of the position; if no cover is obtainable in the vicinity, they are placed in line in rear of either flank at such place as the instructor may designate.

When the tactical situation requires it the caisson limber, and if deemed advisable, the gun limber also, may be sent to the rear with the teams.

219. On occasions of ceremony, or when a post is not designated, the caisson limber is placed directly in rear of its caisson, the heads of the lead horses 25 yards in rear of the caisson, facing to the front. The piece team is placed on the right of the caisson team, 2 yards from and abreast of it.

To Unlimber and Prepare for Action.

GENERAL RULES.

220. 1. On account of the extreme difficulty of man-handling heavy field matériel, the teams will be used to draw the guns and caissons to the positions they are to occupy in firing, unless the necessity for concealment demands the placing of the carriages by hand. In the latter case a sufficient number of cannoneers with drag ropes should be employed at each carriage in turn to move it promptly to its proper position.

2. In order to avoid unnecessary strain on the piece wheels and increased difficulties of draft, the gun should usually be left in its traveling position as long as practicable. For moving short distances over smooth ground, however, the gun may be in its firing position.

3. In unlimbering to fire to the front the caisson establishes the position.

4. In unlimbering to fire to the rear the piece establishes the position.

5. In preparing the piece for action, the gunner and even numbers work on the left (gunner's) side of the trail, the odd numbers on the other side.

6. In pushing the gun into the firing position, the cannoneers work on a maneuvering bar placed against the rear face of the breech; in returning it to the traveling position, they work on the bar placed first against the front clip, then, to complete the movement, against the front face of the recoil lug.

7. The cannoneers report to the instructor if any parts of the matériel are not in working order.

DUTIES IN DETAIL OF THE CANNONEERS AT THE COMMAND FOR ACTION.

221. The gunner and No. 1:

1. The gunner commands 1. **Piece,** 2. **HALT,** and sets the brake when the piece reaches its position. The gunner and No. 1, working together, remove the breech section of the gun cover, raise the top shield, and lower the apron.

2. Remove the spring rod yoke, placing it clear of the recoil lug, and remove the traveling lock bolt.

3. Carefully wipe off and oil the clips and guide rails.

4. Place the maneuvering bar across the rear face of the breech. At the command, 1. **Ready,** 2. **HEAVE,** given by the chief of section, assist in pushing the gun to the firing position.

5. Replace the spring rod yoke.

6. The gunner releases the elevating and traversing lock, removes the hood from the sight standard, takes the sights from their cases and places them in their sockets.

No. 1 removes the quadrant from its case and places it in its seat; operates the breech; examines the bore, breech block, and chamber, cleaning with waste any parts requiring it; and equips himself with a lanyard.

7. Take posts at the carriages unlimbered.

Nos. 2 and 3:

1. As soon as the piece reaches its proper position, No. 2 unhitches the off horse, No. 3 the near horse of the wheel pair; they then fasten the traces in the forward hip straps of the harness. No. 3 disengages the pole and commands: **DRIVE ON.**

2. Release the trail prop chain, dismount the extension rail from its carrier, remove the muzzle section of the gun cover, and place the extension rail in its firing position.

3. No. 2 adjusts the front sight in the firing position near the breech of the gun; No. 3 removes the muzzle cover. Both then take posts.

4. At the command, 1. **Ready,** 2. **HEAVE,** given by the chief of section, they work on the maneuvering bar and assist in pushing the gun to the firing position.

5. Working opposite each other, assist in raising the trail from the pintle, and set the trail prop.

6. Assist in lowering the trail to the ground. No. 3 hooks up the trail prop chain and procures the hand-fuse setter.

7. Take posts at the carriages unlimbered.

Nos. 4 and 5:

1. No. 4 commands, 1. **Caisson,** 2. **HALT,** and sets the brake when the caisson reaches its position. Nos. 4 and 5 unlimber the caisson and lower the prop. No. 4 commands: **DRIVE ON.**

2. Lower the caisson apron and open the caisson chest.

3. As soon as the caisson limber reaches its proper position, No. 4 unhitches the off horse, No. 5 the near horse of the wheel pair; they then fasten the traces in the forward hip strap of the harness. No. 5 disengages the pole and commands: **DRIVE ON.** Both then take posts near the breech of the gun.

4. At the command, 1. **Ready,** 2. **HEAVE,** given by the chief of section, they work on the maneuvering bar and assist in pushing the gun to the firing position.

5. No. 4 turns the pintle bolt lever 90°. Then, both working opposite each other nearest the spade, assist in raising the trail from the pintle; they then adjust the spade in its firing position.

6. Assist in lowering the trail to the ground, and open the caisson limber chest. No. 5 procures the cartridge hook.

7. Take posts at the carriages unlimbered.

Nos. 6 and 7:

1. Assist in removing the gun cover.

2. Assist Nos. 2 and 3 in placing the extension rail in its firing position.

3. Take posts near the breech of the gun.

4. At the command, 1. **Ready,** 2. **HEAVE,** given by the chief of section, they work against the maneuvering bar and assist in pushing the gun to its firing position.

5. Assist in unlimbering, working at the end of the limber pole.

6. Working at the trail handspikes, assist in lowering the trail to the ground. They then open the caisson limber chest.

7. Take posts at the carriages unlimbered.

To Fire to the Rear.

222. The carriages being in double section: **ACTION REAR.**

The Piece: If marching, the piece halts. The gunner sets the brake; No. 2 unhitches the off wheel horse; No. 3 unhitches the near wheel horse, disengages the pole from the yoke, and commands, **DRIVE ON.** The piece team moves 10 yards straight to the rear and halts.

The Caisson: The caisson inclines sharply away from the piece, and by an about toward it, takes its prescribed position. When the caisson reaches its position, No.4 commands, 1. **Caisson,** 2. **HALT,** and sets the brake. No. 4 unlatches the pintle, No. 5 lowers the prop; Nos. 4 and 5 raise the connecting pole from the pintle, and No. 4 commands **DRIVE ON.** Nos. 4 and 5 lower the apron and open the doors of the caisson chest. The limber, moving at a walk, makes a left about, goes straight to the rear until it clears the heads of the lead pair of the piece team, when it makes a second left about and comes up on the right of the gun. No. 4 commands, 1. **Limber,**

2. **HALT,** when the axle of the limber is approximately in prolongation of the axle of the caisson. No. 4 unhitches the off wheel horse. No. 5 unhitches the near wheel horse, disengages the pole from the yoke, and commands **DRIVE ON.** The caisson team makes a left about and moves up abreast of the piece team.

Teams. When the caisson team arrives abreast of the piece team, they take their prescribed positions. To take posts in rear of the carriages the teams move out together at a walk. They incline well to the right, move to the rear about 50 yards, execute a left about, and halt so that the heads of the lead horses of the caisson team will be 25 yards in rear of the caisson limber. The piece team is on the left of the caisson team, 2 yards from and abreast of it.

223. The carriages being in section column: **ACTION REAR.** Executed as prescribed in the preceding paragraph except that the caisson inclines to the left and takes its position by a right about.

To Fire to the Front.

224. The carriages being in double section: **ACTION FRONT.** Executed as in **action rear** except that the caisson halts, and the piece moves forward, obliques away from the caisson, makes an about toward it, and takes its prescribed position.

225. The carriages being in section column: **ACTION FRONT.** Executed as in **action rear,** except that the caisson halts and the piece inclines to the left and takes its prescribed position by a right-about.

To Fire to the Flank.

226. Being in flank column or in double section, the carriages are usually marched by the flank, and the command **action front** or **action rear** is then given.

If the carriages are in flank column with the piece on the side toward which fire is to be directed, the movement may be executed as follows: **ACTION RIGHT (LEFT).** The carriages wheel toward each other, the teams keeping to the left in passing. The piece halts as soon as it completes the change of direction; the caisson halts when it reaches its prescribed position. The movement is then completed in accordance with the principles laid down in the preceding paragraphs.

To Move by Hand the Carriages Unlimbered.

227. 1. **Piece** (Caisson) (Caisson limber) **forward** (backward). 2. **March**, 3. **HALT.**

The piece: 1. The gunner and No. 1 each procure a picket rope and attach them to the wheel hooks on the left and right piece wheels, respectively, stretching them in the direction the carriage is to be moved. Nos. 2, 3, 4, 5, 6, and 7 work at the trail. Other cannoneers in sufficient number are assigned places at the ropes.

2. At the command **march**, all working together, move the piece in the direction indicated.

3. At the command **halt**, the cannoneers stop the carriage, replace the ropes, and resume their posts.

The caisson: Executed as explained for the piece, except that Nos. 2, 3, 4, and 5 work at the connecting pole of the caisson.

The caisson limber: Executed as explained for the piece, except that Nos. 2, 3, 4, and 5 work at the end of the pole.

To Resume the Order for Marching.

228. The carriages being unlimbered and prepared for action: **MARCH ORDER.**

DUTIES IN DETAIL OF THE CANNONEERS.

The Gunner and No. 1.

1. The gunner replaces the sights, secures the hood over the sight standard, traverses and depresses the piece to zero, and fastens the elevating and traversing lock. No. 1 removes the quadrant and puts it in its case, replaces the lanyard in the trail box, releases the brake if set.

2. After the trail has been raised, they remove the spring-rod yoke, and raise the rear traveling lock leg.

3. Place the maneuvering bar against the front clip of the gun; at the command: 1. **Ready**, 2. **HEAVE**, given by the chief of section, they assist in pushing the gun about 2 feet toward the traveling position; then change the maneuvering bar to the front face of the recoil lug. At the command: 1. **Ready**, 2. **HEAVE**, again given by the chief of section, they assist in completing the change to the traveling position.

4. Secure the lock bolt, replace the spring-rod yoke, and carefully wipe off with dry waste the clips and guide rails.
5. Lower the top shield, raise the apron, and replace the breech section of the gun cover.
6. The gunner takes post at the right caisson wheel, facing toward the end of the connecting pole; No. 1 takes the corresponding position at the left caisson wheel.

Nos. 2 and 3.

1. Spring to the trail, and working opposite each other assist in raising the trail; set the prop, No. 3 releasing the trail prop chain. No. 3 returns the hand fuse setter to the tool box.
2. Assist in raising the trail and in limbering. No. 3 hooks up the trail prop chain.
3. At the command: 1. **Ready,** 2. **HEAVE,** given by the chief of section, they work against the maneuvering bar and assist in pushing the gun about 2 feet toward the traveling position. When the gunner changes the bar to the front of the recoil lug, Nos. 2 and 3 remain at the muzzle and at the command: 1. **Ready,** 2. **HEAVE,** again given by the chief of section, they push against the muzzle, and assist in completing the change to the traveling position.
4. No. 2 adjusts the front sight in its traveling position. No. 3 puts on the muzzle cover. They then dismount the extension rail and secure it in its carrier.
5. Replace the muzzle section of the gun cover.
6. No. 2 takes post at the singletree of the off wheel horse of the piece, 2 feet outside the wheel, facing toward the end of the pole. No. 3 takes the corresponding position at the singletree of the near wheel horse.

Nos. 4 and 5.

1. Spring to the trail, and, working opposite each other nearest the spade, assist in raising the trail. Remove the spade key and replace the spade in its traveling position.
2. Assist in raising the trail and in limbering. No. 4 manipulates the pintle bolt lever.
3. At the command: 1. **Ready,** 2. **HEAVE,** given by the chief of section, they work against the maneuvering bar and assist in pushing the gun to the traveling position.

4. Close the caisson chest and raise the caisson apron.
5. Close the caisson limber chest.
6. No. 4 takes post at the singletree of the off wheel horse of the caisson, 2 feet outside the wheel, facing toward the end of the pole. No. 5 takes the corresponding post at the singletree of the near wheel horse.

Nos. 6 and 7.

1. Spring to the trail handspikes and assist in raising the trail.
2. Working at the end of the pole, they assist in limbering.
3. At the command: 1. **Ready,** 2. **HEAVE,** given by the chief of section, they work on the maneuvering bar and assist in pushing the gun to the traveling position.
4. Assist Nos. 2 and 3 in dismounting the extension rail and securing it in its carrier.
5. Assist in replacing the gun cover.
6. No. 6 takes post on the left of No. 3; No. 7 on the left of No. 5.

NOTE.—Before the gun is returned to the traveling position, the elevating and traversing lock bolt should be pushed home, otherwise difficulty will be encountered in securing the traveling lock bolt.

In pushing the gun to the traveling position, care should be exercised to avoid jamming the recoil lug against the rear traveling lock leg, thereby bending the latter and rendering it impossible to insert the lock bolt.

To Hitch and Limber.

229. 1. **Limber,** 2. **MARCH.**

The cannoneers, if not already there, take posts as prescribed in the preceding paragraphs.

If the teams are in rear of their carriages, they move out together, inclining well to the right. The piece team wheels to the left so as to move across the end of the pole of the piece. When the wheel driver is nearly in line with the pole, he commands: 1. **Team,** 2. **HALT.** The drivers then swing the team to the left, the off wheel horse being made to step over the pole. No. 3, assisted by No. 6, places the pole in the neck yoke and hitches the near wheel horse. No. 2 hitches the off wheel horse. When hitched the team straightens out and tightens the traces.

After moving far enough to the front the caisson team wheels to the left so as to move across in front of the caisson limber. It is

halted at the command of the wheel driver, and swung to the right. No. 5, assisted by No. 7, places the pole in the neck yoke and hitches the near wheel horse. No. 4 hitches the off wheel horse. When the team has been hitched and has straightend out and tightened the traces, No. 4 commands: **DRIVE ON.** Nos. 4 and 5 hasten to the front of the caisson. No. 4 releases the brakes; Nos. 4 and 5 then place themselves with their backs toward the chest, No. 4 on the right, No. 5 on the left of the connecting pole. At the command **drive on,** the caisson limber moves to the front, makes a left-about, and is brought back so as to move across in front of the caisson, the right wheel passing within about a foot of the lunette. When the axle of the limber is nearly in line with the connecting pole of the caisson, No. 4 commands: 1. **Limber,** 2. **HALT.** The limber is then swung to the left, the wheels turning equally in opposite directions, and is halted in front of the caisson. With Nos. 2 and 6 assisting at the right wheel, and Nos. 3 and 7 at the left wheel, the caisson limber is then backed to its position. Nos. 4 and 5 raise the connecting pole of the caisson and place the lunette over the pintle. No. 4 latches the pintle. No. 5 secures the prop in its traveling position. The gunner and No. 1 assist in limbering the caisson by working at the right and left caisson wheels respectively. All the cannoneers take their posts at the carriages limbered.

If the teams are posted on the flank, they approach the carriages in section column and separate as they reach the vicinity of the carriages, the piece team passing along the rear, the caisson team along the front of the position. Each team proceeds to its own carriage and is hitched as prescribed above.

To Leave the Park.

230. At the conclusion of the instruction in the park the instructor causes the carriages to be properly cared for, forms the squad, marches it to the battery parade ground, and dismisses it.

231. In the instruction of several squads, the instructor causes the squads to be formed in front or rear of the carriages, faces them to the right or left, and commands: 1. **Close,** 2. **MARCH.** The leading squad stands fast, the others close on the leading squad. The squads are then marched to the battery parade ground and dismissed.

SECTION III.—*The Service of the Piece.*

General Provisions.

232. 1. The individual duties of the cannoneers in loading, laying, fuse setting, etc., are performed as prescribed in **The Cannoneer.**

2. In firing instruction, a target or aiming point is designated, the firing data announced, and the operations of setting sights and fuses, loading, pointing, and firing the piece are habitually performed just as in actual firing.

3. The instructor utilizes every means at his disposal to simulate as nearly as possible the conditions which obtain when service ammunition is used.

4. It is always advisable to dig a semicircular trench for the trail spade as soon as the position has been occupied.

5. In all cases instruments are set and the operations of setting fuses, laying, and loading are performed as rapidly as possible after the necessary firing data have been announced.

The announcement of the range as a command is the indication that all the data have been announced, and is the signal for loading. In fire at will, the command **fire at will** is the signal for loading.

The instructor in all cases gives the command or signal for firing, or for commencing the fire.

Methods of Laying.

233. There are two methods: **Direct** and **Indirect.**

234. Direct laying consists in bringing the line of sight upon the part of the target which the fire of the gun is intended to reach. In this case the gunner lays the gun for direction by means of the deflection scale of the panoramic or peep sight, and for range by means of the range scale. When direct laying is to be employed, the target is announced in the command, thus: **Target, that blockhouse.**

235. Indirect laying consists in taking some well-marked aiming point, generally outside of the target, and setting off a deflection such that when the line of sight is brought upon the aiming point the gun will be properly directed upon the target. In this case the gunner lays for direction only, and No. 1 lays for range by means of the quadrant.

This method of laying is the rule in all cases when the gunner can not clearly see through the sights the part of the target which the fire of his gun is intended to reach. As quadrant elevation is used, the angle of site of the target must be measured and set off on the quadrant.

When indirect laying is to be employed, the aiming point, and not the target, is announced in the command, thus: **Aiming point, that white church steeple.**

To Load and Lay.

236. Direct laying: The piece being unlimbered and prepared for action, the cannoneers at their posts, the instructor commands, for example:

(Time fire.)	(Percussion fire.)
1. **Target, that column of infantry.**	1. **Target, that stone house**
2. **Deflection, 10.**	2. **Deflection, 6398.**
3. **Corrector, 27.**	3. **Shell.**
4. **5200.**	4. **4400.**

The cannoneers proceed to the performance of their respective duties as soon as the necessary data have been announced.

The **gunner:** 1. Lays for range and direction as prescribed in paragraph 151. If the piece has to be moved through a large angle to bring it on the target, he commands: 1. **Trail,** 2. **RIGHT (LEFT),** (par. 244).

2. Calls **ready** as soon as the piece is loaded and laid.

No. 1: 1. Sets the brake as soon as the piece has been given the general direction.

2. Opens the breechblock, closing it as soon as No. 2 has inserted the round.

3. Grasps the firing handle with the left hand when the gunner calls **ready.**

No. 2: Receives a round from No. 4 and inserts it in the chamber.

No. 3: In time fire, keeps the fuse-setter scales set at the range and corrector ordered, and sets fuses.

No. 4: 1. Receives a round from No. 5; in the case of percussion fire, passes it at once to No. 2; in the case of time fire, holds it while No. 3 sets the fuse, and then passes it to No. 2.

No. 5: 1. Takes a round from the chest and passes it to No. 4.

Nos. 6 and 7: Give the general direction to the piece.

237. Indirect laying: The piece being unlimbered and prepared for action, the cannoneers at their posts, the instructor commands, for example:

(Time fire.)	(Percussion fire.)
1. **Aiming point, that clock tower.**	1. **Aiming point, that windmill.**
2. **Deflection, 2630.**	2. **Deflection, 715.**
3. **Site, 305.**	3. **Site, 296.**
4. **Corrector, 27.**	4. **Percussion**[1] (or, **shell**).
5. **5400.**	5. **7600.**

The cannoneers proceed at once to the performance of their respective duties as soon as the necessary data have been announced.

The **gunner:** 1. Lays for direction only, as prescribed in paragraph 153. If the piece has to be moved through a large angle to bring it on the target he commands: 1. **Trail,** 2. **RIGHT (LEFT),** (par. 244).

If the aiming point is in rear, the chief of section goes in front of the piece and causes Nos. 6 and 7 to move the trail so as to direct a side face of the rotating head of the panoramic sight on the aiming point. The gunner then lays accurately for direction.

2. Calls **ready** as soon as the piece is loaded and laid. (The fact that the piece is laid for range is indicated to him by No. 1 calling **set.**)

No. 1: 1. Sets the brake as soon as the piece has been given the general direction.

2. Opens the breechblock, closing it as soon as No. 2 has inserted the round.

3. Lays the piece for range as prescribed in paragraph 164.

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[1] Percussion indicates percussion shrapnel.

4. Calls **set** as soon as the piece is correctly laid for range.
5. Grasps the firing handle with the left hand when the gunner calls **ready.**

The duties of Nos. 2, 3, 4, 5, 6, and 7 are as prescribed in the preceding paragraph.

238. It is most important that the gun squad should be drilled persistently and under all possible conditions in their combined duties in the service of the piece, the elements of which are set forth in the two preceding paragraphs. The several duties to be performed are there outlined; the readiest and most effective way of combining them, so as to insure mutual cooperation, is attained by practice and experience.

To Fire the Piece.

239. The piece being loaded and laid, the instructor commands: **1. No. 1** (or, **such number**), 2. **FIRE.**

No. 1 fires the piece as prescribed in paragraph 167.

As soon as the piece is fired, No. 1 opens the breechblock so as to eject the cartridge case. The cartridge cases are allowed to drop on the ground and are stored when convenient.

240. When using drill cartridges, No. 2 receives the cartridge as soon as it is ejected and passes it to No. 5, who returns it to the chest.

241. The gunner and No. 1 usually remain on the seats during the firing of the piece.

When the ground is particularly unfavorable for the engagement of the trail spade, the instructor may caution: **With the lanyard.** In this case, the gunner and No. 2 step clear of the wheels; No. 1 engages the hook of the lanyard in the eye of the firing handle, steps clear of the wheel, and stands at attention, facing to the front, the end of the lanyard grasped in the left hand; at the command **fire,** he draws the lanyard toward him with a sharp jerk. The gunner and No. 1 then resume their seats and No. 2 resumes his post.

To Reload and Re-lay.

242. If the instructor desires to fire again at the same target, he makes such changes as may be necessary in the firing data by commands similar to those in paragraphs 236 and 237, except that the deflection may be changed by adding or subtracting the required number of mils without the necessity of announcing the new deflec-

tion. Changes in the corrector will be made by indicating the amount and direction of the change. For example:

(Direct laying, time fire.)	(Indirect laying, time fire.)
1. **Up 5.**	1. **Add 200.**
2. **5300.**	2. **3700.**

The piece is loaded, laid, and made ready for firing as soon as the data are announced.

To Change from Direct to Indirect Laying.

243. If, on account of lack of visibility of the target or other causes, it becomes desirable to pass from direct to indirect laying, the instructor commands, for example:

1. **Aiming point, that lone tree.**
2. **MEASURE THE DEFLECTION AND THE SITE.**

The gunner measures and announces the deflection as explained in paragraph 155.

No. 1 measures and announces the angle of site as explained in paragraph 166, using the range at which the range scale of the sight is set.

The instructor then gives the necessary commands for loading and laying as explained in paragraph 237.

To Shift the Trail.

244. If it becomes necessary to move the trail to the right or left, either because the limit of traverse is reached or in order to fire at a target in a new direction, the instructor commands: 1. **Trail,** 2. **RIGHT (LEFT).**

The gunner repeats the command and traverses the piece until the azimuth pointer is at the middle of its scale. If following a target moving across the range, he traverses the muzzle of the gun as far as possible in the direction opposed to the movement of the target. For example, if the target is moving to the left, he traverses the muzzle as far as possible to the right. No. 1 releases the brake, Nos. 6 and 7 spring to the trail handspikes, Nos. 1 and 2 to the right wheel, Nos. 3, 4, and 5 to the left. Under the direction of the gunner, they turn the carriage until the line of sight comes approxi-

mately on the target or aiming point. Whenever necessary, additional cannoneers may be directed to assist. As soon as the trail has been properly shifted, the gunner calls **POSTS;** No. 1 sets the brake and all the cannoneers quickly resume their posts.

To Change Target.

245. To fire at a new target by direct laying, the instructor commands: **CHANGE TARGET.** He at once points out the new target. To fire at a new target by indirect laying, he announces the new deflection or the correction of the old deflection.

For example:

(Direct laying.)	(Indirect laying.)
CHANGE TARGET, THAT BATTERY.	**DEFLECTION, 2500;** or, **ADD (SUBTRACT), 120.**

If the change of direction is such as to require it, the gunner commands: 1. **Trail,** 2. **RIGHT (LEFT),** and causes the piece to be prepared for firing in the new direction, as explained in paragraphs 176 and 244. For indirect laying, he at once sets off the new deflection, so that he may be able to direct the line of sight on the aiming point.

If the change of position is such as to make it necessary, and time admits, the caisson and caisson limber are then moved to their normal positions by the side of the gun.

The instructor then announces the remaining firing data, and the piece is loaded, laid, and fired, as previously prescribed.

The gun squad should be frequently practiced in the important exercise of changing target.

To Discontinue and to Resume the Fire.

246. To suspend the fire, the instructor commands, or signals: **CEASE FIRING.** The signal for **cease firing** is a long blast on the whistle; or, the arm raised and held vertical until the signal is obeyed.

The loading and firing are discontinued. No. 1 opens the breech. If a round is in the breech, No. 2 removes it and passes it to No. 4.

The fuse is set at **safety** and the round returned to the chest. The cannoneers remain at ease.

247. To resume the fire, the instructor gives the necessary commands for resuming the interrupted method of fire, or for taking up a new one.

Special Methods of Fire.

248. The methods of fire usually employed to produce effect upon a target are: **Continuous fire** and **Volley fire. Fire at will** is a special method of fire adapted to the close defense of the gun.

CONTINUOUS FIRE.

249. In continuous fire, rounds are fired at regular intervals until cessation of the fire is ordered.

The firing data are determined by a previous fire for adjustment, and the same data are used for all the rounds, unless the instructor, during the progress of the fire, announces new data.

If, during the progress of the fire, the instructor announces a change in the data, the change is effected for the next round after the announcement is made and without interrupting the continuity of the fire.

250. The target or aiming point being well understood and the firing data established, the instructor commands, for example:

1. **Continuous fire.**
2. **4700.**

The piece is loaded, laid, and made ready for firing continuously with the same data, the instructor giving the command for firing in each case. He gives the command so that there will be the desired interval between shots. When he desires the fire to cease he commands: **CEASE FIRING.**

VOLLEY FIRE.

251. In volley fire each piece fires a designated number of rounds as rapidly as is consistent with accurate laying and orderly service of the piece.

The firing data are determined by a previous fire for adjustment; the same data are used for all the rounds of the volley.

252. The target or aiming point being well understood, and the firing data established, the instructor commands, for example:

1. **Three rounds.**
2. **5800.**

The piece is at once loaded and laid for the first round, as prescribed in paragraph 236 or paragraph 237, but the firing does not commence until the instructor commands: **Commence firing.** At this command the gunner commands: 1. **Ready,** 2. **FIRE.** At the second command No. 1 fires the piece. The operations of setting fuses, loading, laying, and firing are then carried on continuously until the specified number of rounds has been fired, the command for firing being given by the gunner as soon as the piece is loaded and laid.

To avoid mistakes, No. 4, as he passes each round to No. 2, calls out the range and the number of the round in the volley, thus:

5800.....One.
5800.....Two.
5800.....Three.

253. The examples given above of commands appropriate in the cases of volley fire are on the assumption that the firing data have been completely established by previous fire and that the instruments are all set at the readings last used. If this is not the case, or if it is desired to make changes in the data last used, then the necessary data are announced in the command (par. 242).

Fire at Will.

254. This method of fire is used for the close defense of the guns. Time fire is the rule, the fuses being set at zero. If possible to foresee the necessity, a number of fuses are set at zero in anticipation of their use. Direct laying is employed.

255. The instructor commands, for example:

1. **Approaching cavalry.**
2. **FIRE AT WILL.**

The gunner sets the sight at 1,000 yards; No. 3 sets the fuse setter scales at zero range and corrector 30; the piece is promptly loaded and laid. At the instructor's command: **Fire,** the gunner commands: 1. **Ready,** 2. **FIRE;** at the second command, No. 1 fires the piece. The operations of setting fuses, loading, laying, and firing are then carried on continuously, the command for firing being given by the gunner as soon as the piece is loaded and laid. The

firing is continued until the instructor commands: **Cease firing,** or until the target disappears from view or actually reaches the gun. In the latter event the cannoneers shelter themselves behind the carriages and defend themselves with the pistol.

256. With fuses set at zero, an elevation of the piece corresponding to a range of about 1,000 yards gives a favorable distribution of the shrapnel bullets, and, with fuses thus set, accurate laying is not essential; it is sufficient to keep the gun pointed roughly at the target by the use of the peep sight.

Moving Targets.

257. Direct laying is the rule. The instructor commands, for example:

1. **Moving target, that squadron of cavalry.**
2. **Deflection, 10.**
3. **Corrector, 27.**
4. **4400.**

The gunner causes the piece to be directed upon the head of the target, or, if the target is moving across the plane of fire, then somewhat in front of it; in the latter case the gunner first traverses the muzzle as far as possible in the direction opposed to the movement of the target.

The piece is loaded and laid as prescribed in paragraph 236. As soon as the line of sight is brought on the target the gunner commands **ready,** but continues to keep his gun laid on the target until the command for firing is given by the instructor.

As soon as the piece has been fired the gunner resumes following the target. When the limit of traverse is reached, he commands: 1. **Trail,** 2. **RIGHT (LEFT),** causes the piece to be directed ahead of the target, and traverses the muzzle to the opposite limit of traverse.

The instructor causes other single rounds to be fired by announcing such changes in the data as may be necessary and by giving the command for firing.

258. To employ volley fire the instructor commands, for example:

1. **Two rounds.**
2. **3900.**

At the instructor's command **fire** the fire is executed as described in paragraph 252, the gunner keeping the line of sight directed upon

the target, and the operations of loading, laying, and firing being carried on continuously and rapidly until the required number of rounds has been fired.

259. In the attack of large moving targets, indirect laying may be employed. The procedure is then only a special application of **changing targets** (par. 245). The B. C. telescope is used. It is sighted on the aiming point at zero deflection, and the lower limb of the instrument clamped; the upper limb is then swung around upon the target, or, if the target is moving across the range, the telescope is directed at a sufficient angular distance ahead of the target to allow time for loading and laying the piece. The piece is sighted on the aiming point with the deflection at which the telescope is set, corrected for the distance from telescope to gun and for the movement of the target. Just before the target appears on the vertical cross hair in the field of view of the telescope, the command for firing, or for commencing the fire, is given by the instructor.

The telescope is then set ahead in deflection by an amount depending upon the rate of travel of the target, and the piece is laid and fired as before.

260. The travel of the target during the time of flight usually involves variations in range and in deflection. Corrections for range due to time of flight may be neglected. Corrections for deflection vary with the angle which the line of travel of the target makes with the line of fire, with the rate of movement of the target, with the range, and with the velocity and direction of the wind.

A rough rule of thumb for ranges not greater than 5,000 yards neglecting the effect of wind may be stated as follows: If the target is moving toward the left add 10 mils; if moving to the right make no allowance. The drift will compensate approximately for the movement of the target toward the right.

261. As targets will ordinarily remain exposed to view in the open but a short period of time, great skill in serving the piece and a high order of fire discipline are required to attain quickly an effective fire upon such targets. The squad is accordingly frequently practiced in simulated fire at targets moving at various angles to the plane of fire and at different rates of speed. Mounted detachments, the caissons of a battery, or any vehicles which happen to appear on the terrain may be utilized for targets.

Service of the Piece with Reduced Numbers.

262. In order to accustom the squad to maintaining the service of the piece when its strength is reduced by casualties in action, the instructor causes certain cannoneers to fall out and assigns their duties to the cannoneers who are retained, as follows:

Cannoneers retained.	Distribution of duties.						
	G	1	2	3	4	5	6
G, 1, 2, 3, 4, 5, 6	G	1	2, 7	3	4	5	6
G, 1, 2, 3, 4, 5	G	1	2, 7	3	4, 6	5	.....
G, 1, 2, 3, 4	G	1	2, 7	3	4, 5, 6	.....	.....
G, 1, 2, 3	G	1	2, 4, 7	3, 5, 6	.....	.....	.....

CHAPTER IV.—THE FIRING BATTERY.

SECTION I.—*General Provisions.*

263. 1. **The firing battery** comprises the guns and caissons of the first five sections of the battery, with the personnel and animals assigned to their immediate service. It is under the direct command of the captain.

The instruction of the firing battery is carried on both in the battery park and during mounted exercises over all forms of terrain available. In this instruction the captain is assisted by such officers, noncommissioned officers, and men as he may assign for the purpose.

2. The formations, dispositions, exercises, and duties in the service of the piece prescribed for a single squad apply, with obvious modifications, to the firing battery.

3. The guns and caissons are unlimbered and placed in line, the carriages of each section being arranged as prescribed in paragraph 217. The interval between the wheels of adjacent pieces is about 20 yards. If the caissons of the fifth section are present, one is placed on each flank of the battery either on the line of the guns at about 20 yards interval from the nearest piece, or in rear of the line

under cover, with or without limbers, as the captain may direct. The teams are posted as prescribed in paragraphs 218 and 219.

4. For instruction of the firing battery in the park, the battery is marched to the park and there formed into the necessary gun and caisson squads.

SECTION II.—*Duties in General of Officers and Noncommissioned Officers.*

264. Captain:

Commands the battery, and, as a rule, conducts the fire.

Lieutenants:

(*a*) **Chiefs of gun platoons:**

1. Command platoons.
2. Make sure that the target or aiming point is correctly identified and that the guns are laid in accordance with the data announced.
3. Supervise the service of their guns.
4. For direct laying, assign to each gunner his special part of the target, and make changes in deflection to adjust the distribution.
5. For indirect laying, if the target is visible to the chiefs of platoon, they may be directed to adjust the distribution by the command: **Distribute the fire.**
6. In addition to these duties, the senior chief of platoon with the firing battery acts as **executive officer.** When necessary, he repeats the firing data. He supervises the fire discipline of the battery and provides for the immediate security of the guns.

(*b*) **Reconnoissance officer:**

1. Supervises the work of the chief of the fifth section, the signal detail, the battery scouts and auxiliary observing parties.
2. Supervises the services of information and security.
3. Assists the battery commander in observing the battle field and in noting changes in the tactical situation.

(*c*) **Commander of the combat train:**

1. Commands the combat train.
2. Maintains communication with the firing battery and with the ammunition column.
3. Provides for the security of the combat train.

First sergeant:

1. Assists the captain.
2. Before unlimbering, reports to the captain or to the executive officer for instructions as to posting the teams; posts the teams.
3. Keeps the captain informed as to the ammunition supply and attends to the replenishment of ammunition.
4. Maintains communication with the teams.
5. Provides for the security of the teams.

Sergeants:

1. Command sections.
2. Make sure of identification of their parts of the target or of the aiming point.
3. Supervise the service of their guns.
4. The chief of the fifth section has charge of the battery commander's telescope. He assists the captain in the determination of firing data and in the observation of targets or terrain.

Gunners:

Perform the duties prescribed in The Cannoneer and The Gun Squad.

Signal corporal:

1. Commands the signal detail.
2. Has charge of the telephones, flags, and megaphones, and, by daily tests, insures their serviceable condition.
3. Maintains such systems of communication as may be needed.

Battery scouts:

1. Assist the captain or reconnoissance officer in reconnoitering the route and the position.
2. Mark the route.
3. Act as messengers.
4. Mark the positions of the guns.
5. Assist in the observation of targets or terrain.
6. Perform the duties pertaining to the service of security and information.

Caisson corporals:

1. Assist the first sergeant with the teams.
2. Act as agents between the elements of the subdivided battery.

Posts. The specific posts of the various officers and noncommissioned officers are as described in The Battery Mounted. During the instruction they post themselves where they can best perform the duties assigned to them. In action they post themselves so as to obtain shelter and concealment when that will not interfere with the performance of their duties.

SECTION III.—*Methods of Obtaining Distribution of Fire.*

Individual Distribution.

265. Individual distribution is obtained by assigning to each gunner a definite part of the target to attack. Direct laying is always employed.

If the target has clear and well-defined limits, then each chief of platoon, without special indication from the captain, assigns to each of his guns that portion of the target corresponding to its relative position in the battery. He indicates clearly to the gunner the part of the target on which he is to lay.

If the target has ill-defined limits the captain first explains to the chiefs of platoon the exact front which the battery is to attack.

Collective Distribution.

266. Collective distribution is obtained by assigning a common aiming point to the pieces and giving them deflections which vary from right to left in regular progression. The fire may thus be distributed to any degree desired by the captain. Indirect laying is always employed.

The right piece is given a deflection such that when its line of sight is directed upon the aiming point the piece will be directed on the right section of the target. This deflection is increased (or diminished) for each of the other pieces by a correction which, applied in arithmetical progression, will cause the fire to be evenly distributed over the front of the target assigned to the battery.

This correction is called the **deflection difference.**

267. When a common aiming point is used, the right piece is habitually taken as the directing piece.

268. The lines of fire of the several pieces thus collectively directed are called the sheaf of fire. By announcing the deflection

of the right piece and the deflection difference, the initial data for forming the sheaf are furnished.

Example: The deflection of the right piece is determined as 2980, and the deflection difference as **plus** 10.

The captain commands: 1. **Deflection 2980;** 2. **Open by 10.**

The right piece (No. 1) is given deflection 2980.

The right center piece (No. 2) is given deflection 2990.

The left center piece (No. 3) is given deflection 3000.

The left piece (No. 4) is given deflection 3010.

The line of sight of each piece is then brought on the common aiming point.

269. To open or close the sheaf the officer conducting the fire may command, for example: **Open by 2;** or, **Close by 3,** in which case the amount of the increase or decrease in deflection is applied in arithmetical progression to the deflections already set off in the same manner as the deflection difference is applied to the deflection of the right piece in the initial formation of the sheaf.

Example: The sheaf having been formed as in paragraph 268, the captain decides to open the sheaf 6 mils, and commands: **Open by 2.** The first piece does not change the deflection; the second piece adds 2 mils; the third piece adds 4 mils; and the fourth piece adds 6 mils.

The sheaf may be opened or closed, if desired, on another than the right piece.

Example: The captain desires to close the sheaf on the third piece, and commands: **On third piece, close by 5.** The first piece adds 10; the second piece adds 5 ; the third piece does not change the deflection; the fourth piece subtracts 5.

Individual corrections may be applied to the deflections.

Example: The captain commands: **First piece add 5, third piece subtract 10.** The designated pieces apply the corrections given; the others do not change their deflection.

270. To shift the entire sheaf without changing the deflection difference, he may command, for example: **Add 40;** or, **Subtract 15,** in which case each piece increases or diminishes its deflection by the amount stated. Or, he may announce a new deflection and the old deflection difference.

271. To shift the entire sheaf and at the same time change the deflection difference, he may announce a new deflection and a new deflection difference.

Example: Having used a deflection of 3070 and a deflection difference of +10, the captain desires to shift the sheaf 110 mils to the right and to close the sheaf by 6 mils.

He commands: 1. **Deflection 2960;** 2. **Open by 8.**

Or, he may command, **Subtract 110; Close by 2,** in which case each gunner first reduces the deflection reading on his sight by 110; the new deflection difference is then applied in the usual way.

272. To change the corrector, the amount and direction of the change are indicated; for example, **Down 5;** or, **Up 3.**

Thus the captain, having used a corrector of 28 and a range of **6000,** and desiring to lower the height of burst by 3 mils, may command: 1. **Down, 3;** 2, **6000.**

SECTION IV.—*Communication of Firing Data to the Guns.*

273. The firing data comprise:

(For direct laying.)	(For indirect laying.)
1. The deflection.	1. The deflection of the right piece.
2. The corrector.	2. The deflection difference.
3. The range.	3. The angle of site.
	4. The corrector.
	5. The range.

274. In addition to the firing data, there must be communicated to the guns:

1. The target, or aiming point.
2. The method of fire.
3. The projectile to be used.

275. The foregoing information will habitually be communicated in the following order:

1. **Indication of target or aiming point.** Thus: "Target, that battery" (direct laying), or "Aiming point, that steeple" (indirect laying).

2. **Method of fire.** Thus: "Battery from the right" (battery salvo); "Battery, 2 (or so many) rounds" (battery volleys); "Right from the left" (salvo from the right platoon fired from left to right); "Left, 1 (or so many) rounds" (volley from the left platoon).

3. **Deflection and deflection difference.** Thus: "Deflection, 5"; or "Deflection, 3390, close by 5."

4. **Angle of site.** Thus: "Site, 315."

5. **Kind of projectile.** Thus: "Corrector, 35" (indicating time shrapnel) or "Percussion" (indicating percussion shrapnel) or "Shell."

6. **Range.** Thus: "3000."

276. Before the commencement of the fire, the foregoing information, or such of it as is necessary in the particular case, must be communicated to the guns. But during the progress of the fire those elements which are to remain unchanged are not repeated from command to command, except that in all methods of fire, except **fire at will,** the range is always announced as the indication that all changes in the data have been made and that the guns should be loaded.

Instead of announcing the changed range the command may be given by announcing increments or decrements of range. Thus: **400 (200) MORE (LESS).**

277. Each cannoneer proceeds with his duties as the data are announced. He calls upon his chief of section or chief of platoon for data of which he is uncertain. He reports, as soon as it is discovered, every mistake in applying the firing data.

278. Chiefs of platoon and section repeat only those elements of the firing data for which a cannoneer may call. They report, as soon as it is discovered, every mistake in applying the firing data.

279. If the target or aiming point can not be clearly designated in the command the captain may direct: **Chiefs of platoon report.** They hasten to the captain, receive the necessary information, return to their platoons, and indicate to their chiefs of section and gunners the aiming point or that portion of the target assigned to each gun.

280. For the first salvo or volley of each series the captain gives the preparatory command or signal for commencing the fire. The executive repeats this command or signal when the guns are laid and ready to fire.

If given verbally, the command is: **Fire.** The signal is made as follows: Raise the hand above the head, then make an energetic motion downward.

The captain gives the preliminary command or signal for firing the first salvo or volley so that the firing will commence at the desired moment. He may give it immediately after announcing the necessary firing data, or after an interval, as the circumstances require.

For salvos or volleys after the first, the command or signal **fire** is given by the executive as soon as the pieces are ready.

If the captain desires to hold the fire at any time, he cautions, before announcing new data: **At my command;** in which case the pieces are not fired until he commands or signals: **Fire.**

The captain or executive having given the command or signal for firing, the command of execution, except in the case of salutes, is then given by the chief of section or gunner as the case may be.

The chief of section gives the command of execution in *continuous fire* and in all cases of fire **by battery, by platoon,** or **by piece.** Thus: 1. **No. 1** (or **such number**); 2. **FIRE.**

The gunner gives the command of execution for firing in **volley fire** and **fire at will.** Thus: 1. **Ready** 2. **FIRE.**

In those cases in which the gunner gives the command of execution, the chief of section, at the command of the captain or executive officer, cautions **fire.**

In the case of salutes the captain gives the command of execution. Thus: **No. 1** (or **such number**); 2. **FIRE.**

SECTION V.—*Fire for Adjustment and Fire for Effect.*

281. Fire for adjustment has for its principal object the determination or verification of the firing data.

Fire for effect has for its object the destruction or the neutralization of the target.

Fire for Adjustment.

282. The captain adapts his method of adjustment to the circumstances of the particular case with which he has to deal. The nature of the target, the facilities for observation of fire, the possibility of producing great effect by a rapid method of fire, and the husbanding of ammunition are all considerations which enter into the matter.

Either time or percussion fire may be employed. That kind is generally used which is to be used in the subsequent fire for effect. But, due to accidents of the ground, etc., adjustment with time fire, using low bursts, is frequently advantageous, even though percussion fire is to be used in the fire for effect.

The following are the methods of fire usually employed in adjustment:

1. **By battery salvo.**
2. **By platoon salvo.**

283. By battery salvo:

The captain commands, for example:

(Direct laying.)	(Indirect laying.)
1. **Target, that line of infantry.**	1. **Aiming point, that stone monument.**
2. **Battery from the right.**	2. **Battery from the left.**
3. **Deflection, 10.**	3. **Deflection, 3650.**
4. **Corrector, 27.**	4. **Close by 12.**
5. **3000.**	5. **Site, 306.**
	6. **Corrector, 27.**
	7. **5600.**

The pieces are loaded and laid as prescribed in paragraph 236 or 237.

As each gunner commands **ready**, his chief of section faces the executive officer and raises the right hand.

When all the pieces are seen to be ready, the command or signal **fire** is given.

The chief of section on the indicated flank commands: 1. **No. 1 (No. 4)**; 2. **FIRE.**

The pieces are fired in turn from the flank indicated by command of their chiefs of section, the intervals between the shots being about three seconds. An exceptional method of adjustment is:

By battery volley:

The captain commands, for example:

(Direct laying.)	(Indirect laying.)
1. **Target, that line of infantry.**	1. **Aiming point, that stone monument.**
2. **Battery, 1 round.**	2. **Battery, 1 round.**
3. **Deflection, 10.**	3. **Deflection, 3650.**
4. **Corrector, 27.**	4. **Open by 12.**
5. **3000.**	5. **Site, 306.**
	6. **Corrector, 27.**
	7. **5600.**

Executed as prescribed above except that upon the command or signal **fire** from the executive, each gunner causes his piece to be fired as prescribed in paragraph 252.

The chiefs of platoon, for direct laying, make the changes in deflection necessary to bring the line of fire of each of their guns upon its target. For indirect laying, when so directed they adjust the distribution.

284. For succeeding salvos or volleys, the captain makes such corrections as are necessary. For example, the captain may command:

(Direct laying.)	(Indirect laying.)
1. **Down 5.**	1. **Subtract 20.**
2. **3000.**	2. **Open by 2.**
	3. **3700.**

The pieces are loaded, laid, and fired as previously prescribed.

285. When the fire for adjustment is to be by platoon, the designation may be made by message to the battery before the occupation of the position or by command as follows: **Right (Left) from the right (left).** In the case of indirect laying, the right piece of the adjusting platoon is habitually taken as the directing piece of the battery.

The pieces which do not take part in the firing are kept laid with the firing data last announced and all preparations are made by them to take up the fire when ordered.

286. By platoon salvo:

The captain commands, for example:

(Direct laying.)	(Indirect laying.)
1. **Target, that battery.**	1. **Aiming point, that smoke-stack.**
2. **Right from the left.**	2. **Right from the right.**
3. **Deflection, 6398.**	3. **Deflection, 2860.**
4. **Corrector, 27.**	4. **Close by 7.**
5. **4300.**	5. **Site 297.**
	6. **Corrector, 27.**
	7. **6800.**

An exceptional method of adjustment is:

By platoon volley:

The commands are the same as for **platoon salvo,** substituting for the second command: 2. **Right (left), 1 round.**

The pieces of the designated platoon are loaded, laid, and fired, and the distribution is adjusted, as indicated in paragraph 282.

When it is desired to change from platoon fire to fire by battery the captain commands: **Battery from the right (left);** or, **Battery, 1 (or so many) rounds.**

287. Another exceptional method of fire employed in adjustment is:

By piece:

The captain designates the piece to be used. It is loaded, laid, and fired as prescribed in paragraphs 236 and 237.

Fire for Effect.

288. The firing data having been verified to the extent required by the circumstances, the captain passes to **fire for effect.**

He employs the method of fire best adapted to the circumstances of the case with which he has to deal.

The usual methods of fire for effect are:

1. **Battery salvos.**
2. **Volley fire.**
3. **Continuous fire.**

An exceptional method is:

4. **Fire at will.**

289. Battery salvos.

Executed as prescribed in paragraphs 283 and 284.

290. Volley fire.

A **volley** consists in the discharge by each piece of a designated number of rounds, fired as explained in paragraphs 254 and 255.

291. To fire a volley the captain commands, for example:

1. **Two rounds.**
2. **6100.**

The pieces are at once loaded and laid for the first round. Each chief of section, as soon as he has satisfied himself that any changes ordered in the firing data have been made, looks toward the executive, and at the latter's command or signal **commence firing,** cautions: **Commence firing.** Each gunner then proceeds to fire the

number of rounds specified in the command, as explained in paragraph 252.

292. If the captain desires to make changes in the firing data from volley to volley, he announces the new data in the commands.

293. If the target has considerable depth, the area within which the target has been located may be searched by progressively increasing or diminishing the range from volley to volley; the fire is then said to be **by volleys at successive ranges.** The range difference between volleys is determined by the captain according to the circumstances of the case; for example, range, density of fire which it is desired to obtain, etc.

294. Continuous fire.

In continuous fire the pieces are fired in regular order from one flank of the battery to the other at such intervals of time as the captain may designate, and the fire is kept up until he orders its cessation. If the order of fire has been established by previous fire, the same order is maintained. If it has not been thus established, the fire is from right to left, unless the captain cautions **from the left.**

295. The captain commands, for example:

1. **Continuous fire.**
2. **Interval, 15 seconds.**
3. **2700.**

Each chief of section faces his chief of platoon when his piece is ready, and at the latter's signal gives the command for firing. The chiefs of platoon cause the pieces to be fired in the appropriate order at the interval given in the command. As soon as fired each piece is at once loaded, laid, and made ready for the next round.

The captain observes the fire and makes such changes in the firing data as may from time to time be necessary.

296. Fire at will.

When this method of fire is ordered each piece executes a rapid individual fire, as explained in paragraph 255. Each piece is laid on the part of the target opposed to it.

The captain commands, for example:

1. **Approaching infantry.**
2. **FIRE AT WILL.**

The chiefs of section look toward the executive and at his command or signal **fire,** they caution: **Fire.** The gunners then proceed with rapid individual fire, as explained in paragraph 255.

Chiefs of platoon and section are careful to see that fuse setters are set at corrector 30 and zero range.

Moving Targets.

297. The pieces may be directed upon a zone which it is evident the target will have to cross and upon which the fire has been previously adjusted. In this case they are made ready for firing by volleys, the fire being opened at the command or signal **commence firing** as the target draws near to the selected zone.

298. To adjust the fire upon a target in motion, salvos or volleys are used, depending upon the nature of the target and the speed and direction of its movement. For large, slowly moving targets salvos may be used. For targets moving rapidly, volleys should be used.

The fire for effect is by volley fire.

SECTION VI.—*Change of target.*

299. A change of target is executed by the battery as explained for a single piece in paragraph 245, the necessary changes in firing data being communicated as heretofore prescribed.

The chiefs of platoon see that the pieces are quickly directed upon the new target. If the new target is at such an angular distance from the old as to make firing from the old line dangerous, the pieces are moved by hand under direction of the chiefs of platoon so as to establish a line from which firing in the new direction will be safe. This movement is generally pivoted on one of the center pieces. As soon as their pieces are directed on the new target, the chiefs of platoon report: (**Such**) **platoon on the target.**

300. If circumstances require it, the captain may command, for example:

1. **No. 1** (or **such number**), or 1. **Right** (left) **platoon;** 2. **CHANGE TARGET.**

In this case only the indicated piece or platoon changes its direction.

SECTION VII.—*Replacement of Ammunition.*

301. The ammunition chests of the firing battery should, if practicable, always be filled before occupying a position.

If a position is prepared for occupation for a considerable time, additional ammunition may be brought up from the combat train and stored at suitable places near the guns.

The caissons of the gun sections are ordinarily refilled during lulls in the action from the caissons of the fifth section.

Movements of the carriages are habitually made under cover, if possible, and during lulls in the action.

302. Replacement from caissons of the fifth section: The captain commands: **Draw ammunition from the fifth section.** The chiefs of section and cannoneers of each platoon hasten to the nearest fifth section caisson. The gunner remains with the caisson of his section. The chiefs of the right and left sections in each platoon place themselves in rear of the right and left sides, respectively, of the designated caisson; their cannoneers form in single file behind them and receive from them in turn one round each, which they take to their sections and turn over to the gunner. The gunner puts the rounds in the chest.

Cannoneers present with the fifth section caissons assist in carrying the ammunition, under direction of the nearest chief of platoon. The chiefs of platoon supervise the replacement of ammunition and command: **POSTS**, as soon as it is completed.

SECTION VIII.—*Replacement of Casualties.*

303. Firing instruction is frequently practiced with reduced personnel, certain officers, noncommissioned officers, and privates being directed to fall out as representing casualties in action. If the captain does not give special instructions as to the replacement of these individuals, the following obtains:

The captain is replaced by the senior lieutenant; or, temporarily, by the senior assistant at his station.

A platoon commander is replaced by his senior chief of section.

A chief of section is replaced by a sergeant from the combat train at the first opportunity. In the meantime the chief of platoon will give special attention to the section in which the casualty has occurred.

A gunner is replaced by the best instructed man available; or, temporarily, by the chief of section.

The cannoneers of a gun squad perform additional duties, as prescribed in paragraph 262, until substitutes can be obtained.

The first sergeant has general charge of the replacement of casualties and whenever necessary sends to the combat train for substitutes.

In action, if casualties become excessive, the service of one or more guns may be temporarily discontinued, their cannoneers

being sent to assist at others so as to have, if possible, a gunner and three men for the service of each piece. But the fire of the battery must not cease so long as there are men to serve any of its guns.

CHAPTER V.—PREPARATION AND CONDUCT OF FIRE.

SECTION I.—*Preparation of Fire.*

1. DUTIES OF OFFICERS.

304. Due to the extensive use of cover brought about by the efficiency of modern firearms, the targets of artillery are apt to be concealed from view a great part of the time, and, when visible, to remain so but a short time. To find out where the enemy is and to secure the information which will enable the guns to open prompt and effective fire have hence become duties of the first importance. **Before the commencement of the action and through all its phases** this information must be sought. Preparation must be made on the tactical side for posting the guns where they will be most effective, and on the technical side for securing the data which will permit fire to be opened promptly on all the positions in which the enemy is known to be or which he is expected to occupy.

Duties devolving upon officers prior to and during an action are set forth in Part VI. Those duties which particularly affect the technical preparation of fire are especially emphasized here.

305. The higher artillery commanders are concerned especially with:

1. Procuring by all possible means definite information as to the position of the enemy, or as to the positions liable to be occupied by him.

2. Selecting positions for the different units of artillery and causing reconnaissance officers to determine the necessary firing data for these positions.

3. Assigning each unit its particular duty or task, designating, when appropriate, those units for **immediate action** and those to take position **in observation** or **in readiness.**

4. Formulating clearly in their minds the terms or methods which they will employ in the designation of objectives (targets, aiming points, registration marks, etc.).

5. Providing each subordinate commander and keeping him provided with all available information, technical and tactical, which will assist him in the performance of his duties.

For this purpose he organizes the service of information and communication so that information as to positions and movements of the enemy and of our own troops may, on the one hand, be quickly obtained and, on the other, be quickly transmitted.

306. Battery commanders are concerned especially with:

1. Examining the target assigned and endeavoring to determine clearly its nature, its extent, and its relation to surrounding objects.

2. Examining the ground assigned his battery for its position; and locating the guns so that if direct laying is to be used the targets may be seen, and if indirect laying is to be employed the projectiles will clear any intervening obstacle.

3. Studying the terrain in the neighborhood of the target; locating, if possible, any ravines, hollows, or obstructions which would hide the fall of projectiles, and deciding whether it will be necessary or preferable to adjust the fire upon some particular part of the target rather than upon the whole front.

4. Selecting a suitable observing station for himself and posting auxiliary observing parties, if practicable, so that they may assist in the observation of fire.

5. Deciding upon the method of laying, and selecting an aiming point if indirect laying is to be used.

6. Deciding whether the adjustment is to be by time or percussion fire, and whether by platoon or by battery.

7. Determining the firing data to be used.

307. The time available for the performance of the foregoing duties depends entirely upon the nature of the action. In some cases they must be performed with the utmost celerity, in others the opportunity is afforded for deliberate and complete preparation before opening fire. **Every effort must be made to reach the position in advance of the moment for action, and thus gain the opportunity to appreciate the situation and make the necessary dispositions for the prompt opening of effective fire.**

2. GUN POSITIONS.

308. Positions are defined as **masked** or **unmasked,** according as they afford concealment or not.

When no concealment is afforded, the guns are said to be in an **unmasked position,** and the fire is referred to as **unmasked fire.**

When concealment is afforded, the guns are said to be in a **masked position,** and the fire is referred to as **masked fire.**

The degree of concealment varies. Thus:

(*a*) If the guns are posted so that through the sights the hostile position can just be seen over the mask, they are said to have **sight defilade;**

(*b*) If they are posted where a dismounted man can just see the hostile position over the mask, they are said to have **dismounted defilade;**

(*c*) If where a mounted man can just see the hostile position over the mask, to have **mounted defilade;** and

(*d*) If so that the flash of the gun will be concealed, to have **flash defilade.**

309. The hostile position against which we defilade may be the target to be attacked; preferably, however, defilade is taken against the highest position which the enemy's observing parties can occupy.

310. Artillery may be posted for **immediate action, in observation** (unlimbered), or **in readiness** (limbered).

When posted for **immediate action** the guns are unlimbered and fire is opened as promptly as possible upon the indicated targets. The position may be masked or unmasked.

When posted **in observation** the guns are unlimbered and all preparations made for opening at the desired moment upon the existing or expected targets. The position is usually masked.

When posted **in readiness** the guns are not unlimbered. They are held under cover near a position for possible immediate action, but so that they can be moved quickly to another locality if the development of the tactical situation so requires. In the meantime the immediate tactical situation is studied, positions in the neighborhood for posting the guns to meet different eventualities are selected, and preparations are made for occupying the selected positions and for promptly opening fire upon the existing or expected targets.

311. When a position for masked fire is to be occupied, it is necessary to make sure that the projectiles from each gun will clear the mask and reach ground which is occupied or is expected to be occupied by the enemy.

If the guns are already in position and the **mask is not more than 300 yards in front,** then the guns may be given the elevation and angle of site corresponding to the nearest expected position of the enemy, and a glance through the bores will tell whether the projectiles will clear the mask.

In the general case, however, this information should be obtained before the guns arrive, so as to preclude indecision and delay in posting them. It is necessary first to decide what is the shortest range at which we must be prepared to strike the enemy and what is the minimum angle of site to be used. We can then decide whether from the contemplated position of the guns the projectiles will clear the mask and reach the desired range. If they will not, then we must quickly find the place from which they will.

To solve the problem, we determine the height of trajectory in mils at the mask and then compare this with the height of the mask in mils.

312. The sliding scale on the B. C. ruler may be used to determine the height of trajectory at the mask as follows:

1. Determine (*a*) the distance from guns to mask, (*b*) the difference of level in mils between guns and target, (*c*) the range to target.

2. Move the sliding scale on ruler until graduation indicating difference of level between guns and target is opposite that indicating distance to mask; then opposite graduation indicating range to target we will find **height of trajectory** (*h*) in mils at the mask.

3. Determine the height of the mask in mils. If it is less than *h*, the projectile will clear the mask; if not, move backward or forward until a point is reached where it is less.

The sliding scale on the ruler also permits us to tell at once the minimum range at which we can fire and still clear the mask.

313. A convenient method for determining the distance from a mask to the position at which the projectiles will clear the mask is as follows:

First. Determine the height of the mask in yards.

Second. Divide six [1] times this height by the distance in hundreds of yards from the mask to the target.

The result will be the distance in hundreds of yards from the mask to the gun, so that the trajectory will clear the mask.

If it is desired to limit the dead space to a definite distance, this distance in hundreds of yards should be chosen as the divisor, instead of the range from mask to target.

Another rule of thumb is the following:

If the height of the mask in mils at the position of the guns is less than twice the number of hundreds of yards from mask to target, the trajectory will clear the mask.

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[1] For ranges greater than 2,500 yards, this multiplier may be taken as 5 instead of 6.

3. SELECTION OF OBSERVING STATIONS.

314. The officer conducting the fire should choose his observing station so that he can see all the territory assigned to him to cover, properly observe the fire of his guns, and promptly communicate with them.

To facilitate the quick transmission of orders and the proper exercise of command, the station should be as near the guns as the conditions permit.

Removal from the neighborhood of the guns may often be avoided by using elevated observing stations such as trees, buildings, etc., or a specially prepared ladder or tower.

When the observer is in immediate proximity to the guns, it is usually advisable for him to take post on their windward flank.

315. When masked fire is to be employed, the posting of the batteries is often greatly affected by the necessity of securing good observing stations. The commander of an isolated battery may have a wide latitude in the selection of his observing station. But when the guns of a battalion or regiment must be posted in the same general locality, observing stations on the flanks of interior batteries and at considerable distances therefrom are generally impracticable; for, even if the entire available front is not needed for the guns, observing stations on the flanks of interior batteries may unduly restrict the field of fire of adjoining batteries.

The batteries must hence be posted so as to take the best advantage of natural observing stations, and artificial stations must be erected where natural ones are lacking.

316. If the station is in immediate proximity to the guns or is apt to be subjected to the enemy's searching fire, suitable protection from hostile fire should, whenever possible, be provided for the observing officer.

4. SELECTION OF AIMING POINTS.

317. When indirect laying is to be employed, the selection of a suitable aiming point calls for special attention. The aiming point should be:

1. Surely visible from the emplacement of each gun;
2. Distinctive and easily picked out;
3. At a considerable distance from the guns; and
4. Preferably near the normal to the line of guns.

If any doubt whatever exists as to the visibility of the aiming point it is always best, before the guns come up, to go to the point where each gun is to be placed and make sure that the aiming point will be visible through the sights from that point.

Some object which quickly attracts the eye should be selected; and, if possible, it should be the only object of its kind in the vicinity, so that doubt, hesitation, and mistakes may not arise, either in the designation of the aiming point or in finding it quickly after looking away. If it has appreciable width, its outline should be such that each gunner would naturally lay upon the same part of the object; otherwise the particular part to be used should be clearly indicated.

A distant aiming point is preferable, for the more the aiming point is removed from the guns the more are errors in calculation of parallax minimized; but it is not desirable to take inconspicuous aiming points. Usually points not less than 2,000 yards distant will be found most suitable.

A point in rear or in front of the guns and near the normal to their front is always to be preferred, provided it is at least 1,000 yards distant.

318. If the distant aiming point is apt to be obscured by mist or smoke, then a secondary aiming point should be established. A stake may be put up for the purpose. The guns having been oriented on the target by means of the distant aiming point, the sights may, when necessary, be turned upon the new aiming point (as in par. 154) and the latter used in subsequent fire.

319. If an aiming point visible from all the guns and from the observing station can not be found, then some expedient must be devised for directing the guns upon their targets.

For example, the B. C. telescope may be used as a temporary aiming point; stakes may be set up directly in rear of each gun, etc. (par. 348).

320. The special advantage of a common aiming point for all the guns is that the officer conducting the fire may then most readily vary the distribution and shift the direction of his fire.

The fire having been directed upon one target, he may shift it to another by increasing the deflection if the shift is toward the left, by decreasing it if the shift is toward the right.

5. DESIGNATION OF OBJECTIVES.

321. Targets and aiming points should be designated in a concise and unmistakable manner. Officers should exercise themselves in describing objectives of all kinds, in all available forms of terrain, and

should accustom those under them to the terms and methods employed in the description. Practice of this character should habitually form a part of firing instruction, and should also be included in the instruction of scouts and agents.

322. If the objective is distinct and clearly defined it may be designated directly, as, for example:

That battery near Monument Hill.
Cavalry in the field to our right front.
The lone tree near the schoolhouse.

323. If the objective is indistinct, poorly defined, or masked, the following methods are appropriate:

(*a*) Select a conspicuous object, preferably near the middle of the sector of observation, and announce it as the **reference point** for that sector; refer all objectives in that sector to this point by suitable coordinates; for example, by their angular distances from the reference point and their distances from the point of observation, together with any necessary additional information regarding the objective, as its nature, shape, color, etc.

Examples:

1. Reference point, the church steeple to our right front.
2. Two hundred mils to the right.
3. At 3,000 yards, a bare knoll.
4. Just to the right of this knoll, a battery unlimbered.

Or:

1. Reference point, the windmill near the schoolhouse.
2. Two handbreadths to the left.
3. At 3,500 yards, the beginning of a woods.
4. From this point cover the edge of the woods, 100 mils to the left.

(*b*) Cause a **panoramic sketch** of the terrain to be prepared and copies to be furnished the commanders concerned. On such a sketch important landmarks and military objectives should be marked and named or numbered so that ready reference is assured. The position from which the sketch is made should always be unmistakably noted thereon, otherwise it is generally valueless. Moreover officers should clearly appreciate the limitations of such a sketch in the hands of a person somewhat removed from the point at which it was made.

(*c*) When no permanent reference point has been selected, or when the objective is too distant from the selected point for convenient reference, the procedure is as follows:

Describe the **relative position** of the objective and its **characteristics.** The relative position is fixed by giving the approximate direction and distance of the objective, and its situation with respect to some prominent and readily identified feature of the landscape. The characteristics of the objective are usually its nature, shape, color, etc. Thus:

1. Indicate the general direction of the objective.
2. Designate the most prominent object in its general direction.
3. State the angular distance between this auxiliary object and the objective.
4. Describe the objective, as above indicated.

Examples:

1. To our right front.
2. At 3,000 yards, a large stone house, square, two-storied, with a cupola on top.
3. Five hundred mils to the right of the cupola.
4. At 2,500 yards, a battery of artillery in position just to the the left of the large orchard.

Or:

1. To our left rear.
2. At 4,000 yards, a line of hills with three plainly marked and well-wooded valleys.
3. Two handbreadths to the left of the left valley.
4. On the sky line of the hills, a lone tree, low and bushy.

Or:

1. Straight to our front.
2. At 3,500 yards, a farm house in a grove of trees on a ridge.
3. Commencing at 500 mils from the left-hand tree of the grove, toward the left.
4. Cover 100 mils of the crest line toward the left.

324. When it is necessary to send information to persons at a distance, the objectives should, whenever the identification would be facilitated thereby, be marked on a map or on a hasty position or place sketch. A panoramic sketch in this case is usually or no value. Great care should be taken to select a reference point which can be surely identified by the person to whom the information is sent, and the objective should be referred to this reference point by rectangular coordinates.

If the objective is designated by verbal or written message, directions should be indicated by the points of the compass. Such

expressions as **right, left, front,** and **rear,** should not be used, as they are invariably confusing and liable to misinterpretation.

Example:.

1. Reference point, the lone tree on Point Lookout.
2. Two hundred yards west and four hundred yards north, a clump of trees.
3. In the south edge of this clump of trees, a battery.

It is important to remember that objects often present a very different appearance when viewed from widely separated positions. For this reason it is desirable to select as aiming points, objects having a uniform outline and hence presenting the same appearance from whatever angle they are viewed.

If a courier be used to transmit messages of this nature, he should be required, if practicable, to keep the reference point and the objective in view while passing from one station to another.

325. In the occupation of a position the aiming point and the expected targets should, if practicable, be clearly described and pointed out to the officer commanding the guns.

326. Angular distances may be measured by means of the B. C. telescope, the B. C. ruler, or by handbreadths. With the hand held vertically, palm outward, arm fully extended to the front, average widths of the fingers taken at the second joints are approximately as follows:

	Mils.
First finger	40
Second finger	40
Third finger	35
Little finger	30
First, second, and third fingers	115
First, second, third, and little fingers	150
Thumb	40

Each individual should determine these values for himself.

6. DISTRIBUTION OF FIRE.

327. In time fire a 4.7-inch gun battery may be expected to cover effectively about 150 yards of front, allowing for normal lateral dispersion when several salvos are fired.

If the target is greater than about 150 yards in width the front should be divided into sectors and these sectors attacked in turn.

328. In percussion fire the nature of the target and its extent of front determine whether converging or distributed fire is to be employed. If the target consists of artillery in position each gun may be assigned a corresponding gun to attack, or several guns may be converged upon each opposing gun, depending upon the amount of artillery available.

7. DETERMINATION OF FIRING DATA.

329. The necessary data are:
1. The deflection, and for indirect laying the deflection difference.
2. The angle of site (in the case of indirect laying).
3. The corrector (in the case of time fire).
4. The range.

The Deflection.

330. For direct laying in time fire, no initial deflection correction will ordinarily be made at the shorter ranges. Such corrections as are seen to be necessary will be made as a result of observation of the points of burst. But in percussion fire and at the longer ranges in time fire it may be advisable at times to make a deflection allowance to overcome the effects of wind and drift.

The correction for drift is always additive; that for wind may be either additive or subtractive, depending upon the direction of the wind. The value of each correction is first roughly estimated; they are then combined to secure the resultant correction.

The following rough rules may be of assistance:
1. The drift in mils$=N^2$;
2. The correction for wind$=NW$;
3. Correction in mils for wind and drift$=N(N\pm W)$; in which N is one-half of the range in thousands of yards and W is one-eighth of the component of wind velocity across the range in miles per hour.

If the target is moving across the plane of fire, a further correction in deflection must be made to allow for the travel of the target during the time of flight. A rough rule for determining the value of this correction is given in paragraph 260.

331. For direct laying, the initial deflection setting may be determined with sufficient accuracy by the foregoing rules.

It may occur when direct laying is used that the gunner, on account of smoke, haze, or the natural indistinctness of the target, is unable

to locate it again quickly after looking away. If these conditions render it probable that delay or inaccuracy will thus be occasioned the captain should be prepared at any moment to change from direct to indirect laying, as explained in paragraph 243.

332. When indirect laying is to be employed there must also be determined the deflection setting which will cause each piece to be directed upon its target when its line of sight is directed upon the aiming point. For this purpose it is necessary to determine **the deflection of the right piece,** and **the deflection difference.**

The Deflection Difference.

333. The principles involved in the determination of the deflection difference are best explained by assuming the target to be visible from the guns. Elementary instruction is best conducted, moreover, with the guns placed so that this will be the case, as a check may then be had on the computations made.

334. If the guns of a battery at normal or other equal intervals are, with zero deflection, laid accurately upon the same part of a target—for example, its right edge—and the lines of sight are then all directed upon a common aiming point, the deflection readings will be found to increase or decrease from right to left by a common difference. This common difference in deflection is termed the **convergence difference.** It is the deflection difference necessary to produce converging fire, being positive if the deflections increase from right to left, negative if they decrease.

335. The convergence difference may thus be measured directly if the guns are in position and the target can be seen through the sights. But the data should, in the general case, be obtained before the guns come up. Moreover, when indirect laying is to be employed the target is not usually visible from the guns. Direct measurement of the convergence difference is not then feasible in the usual case. By computation, however, its value may quickly be determined, as follows:

(*a*) Determine the parallax of the aiming point and the parallax of the target.

(*b*) The convergence difference is equal to the parallax of the aiming point diminished **algebraically** by the parallax of the target. It is additive if this algebraic difference is positive, subtractive if it is negative.

336. By the parallax of the target or aiming point is to be understood the angle subtended at the point in question by the width of a platoon front at the battery. Its value in mils is quickly calculated by dividing the width of the platoon front in yards by the number of **thousands of yards** in the distance from the battery to the point whose parallax is sought. Thus, if the distance to the target is 6200 yards and the width of the platoon front is 25 yards, the parallax of the target is 4. In the result, fractions are disregarded, the nearest whole number being taken as the value of the parallax.

If the aiming point is to the rear of the battery, its parallax is negative.

If the line from the position of the guns to the point whose parallax is sought is considerably oblique to the normal to the battery front, then a correction for **obliquity** is applied to the parallax. The necessary correction may be obtained from the table on the B. C. ruler. (See Handbook, 4.7-inch Gun Matériel.) If the obliquity is less than 400 mils, no correction is necessary. In using the table of parallaxes on the B. C. ruler it should be noted that the values are computed for a platoon front of 20 yards. If the platoon front be 25 yards the values of the parallaxes in the table must be increased one-fourth.

Refinements in the computation of parallax are uncalled for. With a little experience the values of the parallaxes of objects at the usual artillery distances are immediately appreciated; thus: for a platoon front of 25 yards: 10 at 2500, 8 at 3000, 7 at 3500, 6 at 4000, 5 at 5000, 4 at 6000, and 3 at 8000 yards. The integral number which comes nearest to the true value of the parallax is taken, the choice as between a higher and lower number being decided immediately in favor of the lower number, if a little obliquity exists.

337. Assuming the guns to be converged upon the right edge of the target, their fire may be evenly distributed over the whole front of the target if we retain the same aiming point for all the pieces and the same deflection for the right piece, but increase the deflection of each of the other pieces by an amount necessary to cause its line of fire to be directed upon its appropriate part of the target. The common difference in deflection necessary to effect this distribution is termed the **distribution difference.** Its value is obtained by dividing the front of the target, expressed in mils, by the number of guns in the unit firing. It is always additive, provided the right

gun is directed upon the right section [1] of the target, and the difference is applied in arithmetical progression to the deflection of the right piece, to determine the deflections of the other pieces in turn from right to left.

338. The algebraic sum of the convergence difference and the distribution difference is the **deflection difference.** If converging fire is to be used, the distribution difference is zero and the deflection difference is therefore equal to the convergence difference.

339. The following nomenclature may be used to designate the terms referred to above:

DD	Deflection difference.
CD	Convergence difference.
F	Front of target in mils.
P	Parallax of aiming point.
T	Parallax of target.
X	Number of guns in unit firing.

340. Using this nomenclature, the relations brought out in the foregoing discussion may be expressed as follows:

Rule I. The convergence difference is equal to the parallax of the aiming point diminished algebraically by the parallel of the target; or, CD=P−T.

Rule II. For converging fire the deflection difference becomes the convergence difference; or, DD=P−T.

Rule III. For distributed fire the deflection difference is equal to the convergence difference increased algebraically by the distribution difference; or, DD=P−T+F/X.

A special case of distributed fire is **parallel fire.** If the lines of fire are parallel they are directed upon points just a platoon front apart. Therefore, in Rule III, F/X=T and DD=P. Hence we have

Rule IV. For parallel fire the deflection difference is equal to the parallax of the aiming point; or, DD=P.

341. The foregoing rules afford a method of determining the **deflection difference** necessary to produce either converging or distributed fire. If the pieces have a common aiming point and the

[1] In shrapnel fire the right piece is directed, not upon the right edge of the target, but upon a portion of the target about 15 yards within the right edge. Each gun is supposed to cover a section 30 yards wide, this being about the effective width of the shrapnel sheaf.

right piece is given a deflection which will cause its line of fire to be directed upon the right section of the target the desired convergence or distribution may be secured by giving the other pieces the deflection of the right piece increased (or diminished) by as many times the deflection difference as there are platoon fronts between the right piece and the piece considered.

Rule IV affords the quickest and readiest means of distributing the fire, since, to determine the deflection difference, we have only to estimate the distance to aiming point and compute the corresponding parallax. For the attack of targets having about the same front as the unit firing, the approximate amount of distribution is thus promptly obtained. If, after opening fire, the distribution appears too great or too small, then it may be promptly adjusted by modifying the deflection difference.

The Deflection of the Right Piece.

342. If possible, the angle (A) from aiming point to target is measured at or near the position of the right piece.

If, however, the target can not be seen from the vicinity of the guns, then the observer posts himself where he can see the target, measures the angle, and transforms it for use at the guns.

343. This transformation may be effected by the parallax method.

This method is used to the best advantage when the observing station is in prolongation of the line of guns and not more than 400 or 500 yards away. The necessary computations can be made mentally very quickly after facility has been gained.

344. To illustrate the method let us assume that the observing station is on the right flank of the guns, in prolongation of their front, and at a distance of n platoon fronts from the right piece.

At the observing station the angle A from aiming point to right section of the target is read by means of the B. C. telescope or ruler. This angle may be considered as the deflection necessary to cause an imaginary piece at the observing station to be directed upon the right section of the target; the actual right piece, n platoon fronts away, may be converged upon the same part of the target by increasing (or diminishing) the deflection of the imaginary piece by n times the convergence difference. The process is then altogether similar to that before explained for causing convergence in an established line of guns. We have then

Rule V. The deflection of the right piece is equal to the angle from aiming point to target, as measured at the observing station, increased algebraically by as many times the convergence difference as there are platoon fronts in the interval between observing station and right piece; or, $D=A\pm n\,(P-T)$.

If the observing station is on the right flank, n is positive in the foregoing formula, negative if it is on the left flank.

345. If the observing station is not on the prolongation of the line of guns, but is in advance or in rear of that line, the distance from the observing station to the line joining the right piece and the target, measured on the perpendicular to that line, must be taken as the interval between the observing station and the right piece.

In the latter case the data secured will probably be only approximately correct; but the error in direction should not be great, and errors both in direction and distribution should be readily corrected at the second salvo.

346. The parallax method thus outlined gives great facility in transforming the deflection, not only from an observing station to a battery, but from battery to battery along a line of guns having a common aiming point. A great variety of special cases will be met in practice, but if the possibilities of the method are fully grasped, some adaptation will usually afford a solution. By constant practice in the solution of all sorts of cases readiness in the use of the method is to be obtained. The great advantage of the method is that it permits a rough approximation of the direction from gun to target to be quickly furnished. The approximation should be close enough to permit the first salvo to be observed; errors in the adjustment may then be quickly recognized and corrected.

347. Having determined **the deflection of the right piece** and **the deflection difference,** the deflections of the other pieces from right to left are obtained by applying the deflection difference in arithmetical progression to the deflection of the right piece.

348. In unfavorable country it may require considerable ingenuity to direct the guns upon the target when indirect laying is to be used. The following are given as examples of expedients which may be employed in such cases:

Example 1: The guns are in a depression and all view of the surrounding country is cut off. No natural aiming points are available. The battery commander, mounted on an observing tower, can see the target provided his tower is placed in rear of the third piece.

Solution.—The battery commander places his tower in rear of third piece, and looking over the line of metal directs the gun upon its appropriate part of the target.

He causes the gunner of the third piece to turn his panoramic sight upon the sights of each of the other pieces in turn and to read off the corresponding deflections. These deflections are increased or diminished by 3200 in each case, according as each is less than or greater than 3200. The resulting deflections are set off on the sights of the respective pieces and they are then laid, using the sight of the third piece as an aiming point. **Parallelism** of the lines of fire is thus secured.

The direction of each piece may then (par. 154) be referred to an individual aiming point consisting of a stake driven directly in front or in rear of the piece, or to a common aiming point consisting of a stake placed preferably at a considerable distance to the right rear of the battery.

Example 2: Suitable aiming points can be seen from the guns, but none of them are visible from the observing station, which, on account of the lay of the ground, must be placed about 400 yards to the flank of the guns.

Solution.—The battery commander decides to designate his B. C. telescope as a temporary aiming point. He determines the deflection of the directing piece as follows:

(*a*) Sets the telescope at 3200, directs it upon the sight of the directing piece, and clamps the lower limb; unclamps the upper limb, directs the telescope on the target, and reads the angle.

(*b*) Measures or estimates the interval in yards between telescope and gun, divides this amount by the number of thousands of yards in range to target, and thus procures the parallax of the target for the interval between telescope and gun.

(*c*) Adds this parallax to the angle measured by the telescope if the telescope is on the left of the gun, subtracts it if the telescope is on the right.

The result is the deflection to be used by the directing piece, the telescope being the aiming point.

Setting off this angle on the sight of the directing piece and using the B. C. telescope as an aiming point, the piece is laid on the target. The direction of this piece may then be referred to any suitable aiming point in front or rear of the guns (par. 154). By computing the deflection difference in the usual way, the deflection to be given the other pieces may then be determined.

Example 3: The target can not be seen from the guns; the guns can not be seen from the observing station; there is no aiming point that can be seen from both observing station and any one of the guns.

Solution.—At the observing station, by means of a magnetic compass, locate an aiming point on the magnetic meridian through the station; measure the deflection from this point to the target and correct it for the displacement from the directing gun (par. 345).

Similarly, establish the magnetic meridian through the sight of the directing piece,[1] and lay this piece with the announced deflection.

Example:

Aiming point: The magnetic north (south).

Deflection: 1420.

The other pieces are laid by the methods previously explained.

A method which may be employed when all others fail is as follows: Run a *random line* from the directing piece in the general direction of the target until the mask is cleared; the error in the direction of this line is measured as soon as a point is reached from which the target can be seen, and the direction of the random line is corrected accordingly. The directing gun is then laid along the corrected random line, and the other pieces are laid by the methods previously explained.

The Angle of Site.

349. The determination of the correct angle of site will, in general, result in a saving of time and ammunition and in the production of greater effect during fire for adjustment.

If the target is visible from the position of the guns, the angle of site may be measured at that position; if it is not visible from there, the angle of site may be measured at the observing station and transformed, if necessary, for use at the guns.

In emergencies the angle of site may often be estimated with sufficient accuracy by referring the site of the target to some point in the terrain or to a distant horizon whose angle of site has already been determined.

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[1] Care must be taken to keep the compass at a sufficient distance from the guns so that the compass needle will not be deflected by them; otherwise large errors may result.

350. If the observing station and the guns are approximately at the same level and at about the same distance from the target, the angle measured at the observing station is used without change at the guns.

351. If the observing station and the guns are at a different level, but at about the same distance from the target, the angle measured at the observing station is corrected as follows: Estimate the difference of level in **yards** between observing station and guns; convert this difference into **mils** by dividing by the number of thousands of yards in range to target and apply the result with the proper sign as a correction to the angle of site of the target as measured at the observing station.

Example:

Angle of site measured at observing station..... = 320 mils.
Estimated height of observing station above guns... = 30 yards.
Range to target (measured or estimated)..... =4,300 yards.

$$\text{Correction} = +\frac{30}{4.3} = +7 \text{ mils.}$$

Angle of site at guns=320+7=327 mils.

352. If the observing station and the guns are not at about the same distance from the target, the angle of site is computed as follows: Determine the difference of level in yards between observing station and guns (L_g) and between observing station and target (L_t).[1] Determine the difference of level in yards between gun and target by taking the sum of the foregoing differences if the observing station is at a level intermediate between the gun and target by taking their difference if the observing station is above or below both the gun and target. The result is affected with a positive sign if the gun is below the target, with a negative sign if the gun is above the target; it is then converted into mils by dividing by the number of thousands of yards in the range. Applying this correction with the proper sign to 300, we have the angle of site at the gun.

[1] This difference may be determined by measuring by means of the B. C. telescope the difference of level in mils, and converting this difference into yards by multiplying it by the number of thousands of yards in the distance from observing station to gun or target.

Example:

Difference of level between observing station and gun, in mils ..... (S_g) =−40
Difference of level between observing station and target, in mils ..... (S_t) =+10
Distance from observing station to guns, in yards..... (BG)= 600
Distance from observing station to target, in yards.... (BT)=5400
Distance from guns to target, in yards..... (R) =5600

$$L_g = -40 \times .6 = -24$$
$$L_t = 10 \times 5.4 = 54$$

$$\text{A. S.} = 300 - \left(\frac{L_g - L_t}{\frac{R}{1000}} \right) = 300 - \left(\frac{-24-54}{5.6} \right) = 300 + 14 = 314.$$

353. If a broad target situated on a hillside sloping sharply at right angles to the plane of fire is to be attacked, it will generally be necessary to vary the angles of site by a common difference from one flank of the line of guns to the other. The value of this common difference may be determined by finding the difference in angle of site between the two flanks of the target and dividing this difference by the number of guns firing.

354. An error in the angle of site has the effect of raising or lowering the trajectory by the amount of this error and, hence, of giving the projectile a greater or less horizontal range than that expected from the setting used on the range scales of the quadrant and the fuse setter. A change in the angle of site does not change the range to point of burst in air. The trajectory may be brought upon the target by correction of the angle of site or by diminishing or increasing the range setting. In the latter case the fuse will then be set for a range other than the true range to the target, its time of burning will be too short or too long and the projectile will burst too high or too low, as the case may be. Modifications of the corrector or of the angle of site will in general be necessary to bring the mean point of burst to the desired height. If the error has been small, it may be readily overcome by a proper use of the corrector.

Heights of burst varying greatly from those expected may be due to large changes in range or to changes in atmospheric conditions.

However, when the approximate corrector setting is known, heights of burst which are apparently abnormal may usually be attributed to an erroneous angle of sight. If the error has been great, delay may result in the adjustment of height of burst by the use of the corrector. In such a case, it may be advisable to change the angle of site. In general the best results will be obtained by changing that element which is believed to be wrong.

If the range has been determined by range finder or other accurate methods, the use of a correct angle of site will greatly increase the probability of early effect upon the target.

The Corrector.

355. The corrector setting should be such as will cause the mean point of burst during fire for effect to be about 4 mils high at the shorter ranges, about 5 mils at mid ranges, and about 6 mils at long ranges. During fire for adjustment the corrector setting should be such as to give about an equal number of bursts in air and on graze.

Corrector 30 is supposed to give an approximately correct height of burst for fire for effect under normal condition. But, due to variations in powders and fuse compositions and to atmospheric conditions, the most suitable corrector must be determined in each individual instance. Hence at the commencement of fire a trial corrector must be taken, and as the fire progresses this must be modified, if necessary, to secure the desired adjustment of the height of burst. This trial corrector is such as is suggested by previous experience with the ammunition in use and with local atmospheric conditions.

A change of 1 mil in the corrector should produce a corresponding change of 1 mil in the mean height of burst, raising it if the corrector is increased, lowering it if the corrector is decreased.

Except when the mean height of burst established at one range is normal, the corrector used will not give the same height of burst at ranges differing greatly from that range.[1]

[1] If the mean height of burst determined at one range varies considerably from the normal, the approximate corrector to be used at other ranges may be obtained as follows: Multiply the difference between the normal corrector 30 and the corrector just established by the ratio of the new range divided by the old. Add this correction to 30 if the corrector previously determined is greater than 30; subtract it from 30 if the previous corrector is less than 30.

This merely a rule of thumb. If the ratio of the new time of flight divided by the old be used instead of the ratio of the ranges, the new corrector thus determined should usually be fairly accurate.

The Range.

356. The initial range may be determined by means of a range-finding instrument, by the B. C. telescope and a measured base, by the use of maps, by sound, or by estimation. Every auxiliary means the use of which the time available permits should be employed to assist in the measurement of the range, since upon its correct predetermination success in producing prompt effect depends. In many cases an officer must rely upon his own estimate of the distance.

Summary of Operations.

357. In determining the data for indirect laying, the following is a summary of the operations usually necessary when an observing station on the flank of the guns must be taken and a suitable one can be found within 400 or 500 yards of the guns:

1. Select an observing station from which a good view of the target and its surroundings may be obtained, which is as close to the guns as the conditions permit and which is as nearly as possible on the prolongation of their front.

2. Select an aiming point which is surely visible to all the guns, whose direction is as nearly normal to the front of the guns as possible and whose distance from them is preferably not less than 2,000 yards.

3. Set up the B. C. telescope at the observing station, measure the angle from aiming point to target, and while the telescope is on the target measure the angle of site and the front of the target in mils. If time does not admit of the setting up of the B. C. telescope, the B. C. ruler may be used for the necessary measurements.

4. Measure or estimate the distance to aiming point and target and compute the parallaxes of each. Correct the parallax of the aiming point for obliquity if the line from right gun to aiming point makes an angle greater than 400 mils with the normal to the front of the guns.

5. Determine the convergence difference by Rule I, estimate or measure the distance to right piece, and apply Rule V for the determination of the deflection of the right piece. The distance is always measured or estimated to the **right** or directing piece.

6. Determine the deflection difference by Rule II, III, or IV.

7. Correct the angle of site, if necessary, for difference of level between observing station and guns, adopt the corrector which previous fire has shown to be the most suitable, and take the range as measured or estimated.

8. OBSERVING THE TERRAIN; SECTORS OF OBSERVATION; FORMING THE SHEAF; PREPARATIONS FOR FIRING.

358. In preparation for definite and imminent phases of an action, certain bodies of artillery may be ordered to **observe** the enemy in designated portions of the terrain and be ready to bring him under immediately effective fire.

If possible, the position of the enemy is clearly pointed out; but if his exact position within a certain area has not been determined the area may be divided up into sectors and a sector assigned to each important group of artillery. In the former case the firing data are determined for the known position of the enemy; in the latter case, for prominent features of the terrain within the sector assigned.

With a view to gaining readiness for instant action, the guns may be laid upon the target or upon some selected feature of the terrain and the sheaf formed so as to provide for the desired distribution.

359. To **form the sheaf,** an aiming point is selected, a deflection is given the right piece which will cause it to be directed upon the right section of the target or upon the registration mark, and a deflection difference is employed which will suffice to distribute the fire over the known or expected front.

If the position of the enemy is known and all necessary data have been obtained, the pieces may be at once loaded.

If the exact position in which the enemy will appear is not known, then on his appearance the necessary corrections in range and direction must be quickly estimated (or measured) and set off. The correction in range is obtained by estimating the target's distance from the selected registration marks; the correction in deflection by measuring, by means of handbreadths or the B. C. ruler, the angle from the registration mark to the section of the target which is to be attacked by the directing piece. The circumstances of the case must decide whether the pieces are to be loaded before the target appears.

360. Trenches should be dug for the trails wide enough to permit them to be shifted through the probable arc of fire.

The safe arc of fire may be taken as 45° on either side of the normal to the battery front, the presumption being that the guns are well aligned. In all cases, however, it is the duty of chiefs of platoon and section to see that their pieces are not fired when pointed at a dangerous angle with respect to other pieces.

361. The initial opening of the sheaf depends upon the nature of the expected target and the circumstances of the action.. Thus, if the enemy's artillery is the expected target, a parallel formation of the sheaf may be preferable, while if lines of infantry are to be attacked a more open formation may be appropriate.

If, in order to assist our own infantry, the artillery is called upon to repress the activity of a long line of hostile infantry in position, each battery may be required to act over a wide front. Good judgment and great versatility in the employment of fire are called for under such circumstances, in order that the desired results may be obtained without undue expenditure of ammunition in the earlier phases of the attack. Means may be employed to keep the entire hostile line under the menace of fire, single guns being freely used to repress special activity of the enemy in the sections assigned to such guns.

SECTION II.—*Conduct of Fire.*

1. GENERAL PROVISIONS.

362. Conduct of fire consists in employing the technical means necessary to cause fire of the desired nature to be brought to bear upon the target.

The officer charged with the conduct of fire must be the master of the fire of his guns; must be able to turn the fire promptly upon any target at will and to regulate its intensity and distribution as circumstances require. The attainment of this condition requires complete familiarity with the weapons at his disposal, skill and quick decision in their use on the part of the officer, and thorough fire discipline on the part of the organization concerned.

363. Conduct of fire is ordinarily the function of the battery commanders, while fire direction is the function of the higher field artillery commanders.

364. In the general case the higher field artillery commanders assign duties to their subordinates, specifying clearly and as succinctly as possible the tasks to be accomplished by each; they exercise supervision over the expenditure of ammunition, giving such

special directions as may be necessary to insure the same being used to the best advantage to meet the requirements of the various phases of the action; they assist their subordinate commanders by keeping them supplied with all attainable information which will aid in the adjustment or employment of fire; but they refrain from interfering in the details of conduct of fire or the service of the guns, interposing only when it is perfectly obvious to them, after careful observation of the fire, that the desired results are not being attained.

365. Cases may exceptionally arise where it will be necessary for the higher field artillery commanders themselves to conduct the fire of a part of their commands. Suitable tactical dispositions should be sought to avoid such cases, which are most likely to occur in close country where targets visible to the higher commanders may not be visible from the stations of subordinate commanders.

366. If the battery commander is separated from the guns the executive receives and, if necessary, repeats the firing data.

The station of the executive is established near the guns, in a location from which he can most readily exercise his functions and communicate with the station of the battery commander.

If the battery commander is sufficiently close to his battery, communication is had without the intervention of the executive.

The executive supervises the fire discipline of the battery and the guns are fired at his command or signal **commence firing.**

2. PRINCIPLES GOVERNING THE CONDUCT OF FIRE.

367. The fire of artillery comprises in principle a fire for adjustment followed by a fire for effect.

The preliminary adjustment may be dispensed with only when the necessary data have been determined by previous fire or when the range is very short.

By skillful preparation of fire, however, the time required to secure adjustment may be greatly abridged, and the ability may be gained to strike a vulnerable enemy by surprise with fire which is from the outset effective.

Fire for Adjustment.

368. Adjustments of three kinds are called for, viz:

1. In direction.
2. In height of burst (in case of time fire).
3. In range.

The adjustment in direction involves bringing the sheaf of fire to bear on the desired front of target. Modifications of **deflection** setting are hence called for.

The adjustment in height of burst involves the determination of a **corrector** setting which will cause the mean point of burst to be at the normal height.

The adjustment in range involves the determination of a **range** setting which will cause the mean trajectory to pass through the target, or, if this is not practicable, the range settings corresponding to the front and rear limits of a zone which surely contains the target.

369. By observing the points of burst or fall of projectiles and judging their relative positions with respect to the target, the modifications in the deflection, corrector, and range settings requisite for adjusting the fire upon the target are determined.

370. In the general case, fire for adjustment immediately precedes fire for effect.

If the circumstances permit, however, advantage may be taken of lulls in the action to secure at least a rough adjustment upon localities in which the enemy is known to be or near which he is expected to appear. Such a fire is termed **fire for registration.** The data are thus secured for opening promptly an effective fire upon an enemy appearing at or near the positions upon which the fire has been registered; by minor modifications in these data a quick adjustment on the target may be secured. The registration is usually effected upon prominent features of the terrain (termed **registration marks**) near which the enemy is known to be or is expected to appear.

Fire for registration, however, should never be used in action, except when the presence of our artillery has been revealed by previous firing.

371. The adjustment is effected upon the target itself, if practicable.

In many cases, however, the target itself will not be visible to the officer conducting the fire, though its approximate position may be known. Thus the target may consist of troops concealed behind a ridge, or behind a wall or hedge, or in the edge of a village, a forest, or a field of standing grain.

Some prominent feature of the terrain in or near the enemy's known position—as, for example, a tree, a house, a mass of rock, etc.—is then selected as a registration mark, and by means of scouts, aerial observers, or any available means, the enemy's location with

respect to this mark is determined within the narrowest possible limits.

The fire is then adjusted upon the registration mark, and the area within which the target has been located is searched by the subsequent fire.

372. During the adjustment the fire may be either concentrated or distributed. If observation is difficult, concentration upon the most prominent part of the target is usually called for; if observation is easy and the front to be attacked is not great, the fire should be distributed from the beginning.

If several batteries are adjusting simultaneously upon a single broad target, then it is generally best for each to concentrate during the adjustment upon the corresponding part of its section of the target—for example, the windward flank.

373. The choice of the projectile to be used depends upon the nature of the target and its situation.

During fire for effect, time fire is, as a rule, employed against animate targets, percussion fire against inanimate targets.

374. The range may be most accurately determined from the observation of percussion bursts. Frequently, however, irregularities or the nature of the ground prevent the observation of percussion bursts; so that bracketing between low-time bursts is to be regarded as a usual method.

For adjustment of time fire, fuses should be set from the commencement of the fire with a corrector which will give low bursts and a large percentage of bursts on graze. The opportunity is thus given to observe both bursts in air and bursts on graze. The visibility of the former is little affected by the profile of the ground and the state of the soil, and, taken in connection with the latter, they enable the observer to determine quickly the irregularities of the ground in front and in rear of the target. Moreover, considerable effect may be produced during the adjusting series, and, by a small change in the corrector, passage to fire for effect may be quickly effected.

375. The method of fire to be employed in adjustment depends upon the nature and situation of the target and upon the method of laying.

Against stationary targets—for example, inanimate targets, or troops intrenched or otherwise immobilized—or in registration of fire, the adjustment in range, in height of burst and in distribution is usually secured by salvos.

Against slowly moving targets, also—for example, large bodies in column of route, or wagon trains—the adjustment is usually secured by salvos.

Against rapidly moving targets—for example, cavalry charging, or artillery changing position—the adjustment is secured by volleys with direct laying, by volleys or salvos with indirect laying.

Against transient targets—for example, infantry in action in the open, or infantry marching in small bodies, or machine guns firing—the adjustment is usually secured by salvos.

376. In deciding upon the unit to be employed in adjustment the captain should consider the nature, size, importance, and range of the target to be attacked, the conditions of observation, the firing data already determined by previous fire, the supply of ammunition, the tactical situation.

Fire by battery has the advantages of increasing the chances of observation of more than one round of the salvo; when the range has been determined by range finder, of increasing the probability of obtaining, at the first salvo, both shorts and overs and effect on a wide front of the target.

Fire by platoon has the advantages of simplifying observation of bursts with respect to range, distribution, and height of burst and of saving time in the launching of each salvo.

At long ranges, and in other cases where the observing station is at a considerable distance from the guns, it may at times be advisable to begin the adjustment with a single gun. The adjustment in direction is thus obtained without running the risk of losing the entire salvo. But, owing to the natural dispersion in range, a single gun should not be used for the determination of brackets smaller than 400 yards even in time fire; and at least two guns should ordinarily be used in finally establishing the limits of the bracket to be used in the fire for effect.

377. It may be necessary in some cases to assign special targets to certain pieces or to certain platoons. In such cases the chief of section or the chief of platoon conducts the fire of his gun or guns, unless the captain gives other instructions.

378. The target having been inclosed within a bracket of suitable depth, the adjustment is continued, during fire for effect, by constant observation with a view of discarding ranges obviously ineffective, of confining the fire to ranges which appear to be effective, and, at the same time, of making such corrections in height of burst, deflection, and distribution as will perfect the adjustment or meet

changes in the location or formation of the target. It is to be expected that targets having mobility will not remain immobilized under effective fire. The captain should, therefore, be ready to adapt his adjustment to changing conditions at the target. With shrapnel it will seldom be advisable to spend sufficient time and ammunition to justify remaining at a single range during the delivery of fire for effect.

Fire for Effect.

379. In time fire, the short and long limits of the bracket determined during the initial adjustment should be considered as inclosing an area to be covered during fire for effect by volleys fired at successive ranges. This can be accomplished either by opening fire for effect at a short range and using successive increments, or at a long range and using successive decrements until a range short of the target is obtained. Thus the target will be covered at one or more of the ranges used and the officer conducting fire may be able to form an opinion as to which are the most effective ranges.

Every target attacked will present its own problem which must be solved by the captain according to existing conditions and not by adherence to any fixed rule.

Time shrapnel fire is effective only when the projectiles burst short of the target and not too high.

The time required to produce the requisite effect and the expenditure of ammunition may both be greatly reduced if, by reconnaissance, the enemy's positions are well determined and if, by auxiliary observers pushed well to the front and flank, information is obtained which will assist in the adjustment of fire.

The searching of areas is never to be resorted to unless it can be definitely determined that the enemy is actually located within the area selected, and unless he would evidently exercise a material influence upon the progress of the combat if left undisturbed by fire.

3. OBSERVATION OF FIRE.

380. The officer conducting the fire should be posted where he can observe not only his immediate target, but as much as possible of the terrain liable to be assigned him to attack. Unembarrassed by details of the service of the guns, he should devote himself to

observing and correcting the fire and adapting its employment to meet the requirements of the situation. He should train himself to form accurate and quick estimates and to act on them with decision and boldness.

381. To overlook ground which is invisible to the officer conducting the fire, as well as for the purpose of assisting generally in the adjustment of fire, free use is to be made of auxiliary observing parties.

382. Such parties occupy the most favorable observing stations which the conditions of the combat admit. Preferably they are as near the enemy as possible. If near the guns, they are posted usually on the flanks and in elevated positions, if possible; for example, in the tops of trees, on buildings, on artificial towers, etc.

383. Their special duties are to signal information which will assist in the adjustment of fire and to keep the artillery commander informed of movements of the targets or of our own troops which would affect the employment of fire.

384. With respect to the adjustment of fire, they indicate whether the direction is **right, left,** or **correct.**

If large errors in range are made, an observer on the flank of the guns will not usually be able to separate the errors in range from those in direction; the observer therefore signals the direction as **right** or **left,** as it appears to him, and the officer conducting the fire, knowing the position of the observer, would deduce the sense of the salvo, volley, etc., in range. If the observer is to the right of the line of fire, shots striking **short** of the target appear to be to the **left,** while those striking **over** appear to be to the **right;** and vice versa if he is on the left of the line of fire.

385. With respect to movements of the enemy, the observer reports especially: If the enemy abandons his position; if he shifts to the right or left, front, or rear, to escape effective fire; if additional hostile troops enter the sector assigned to the guns.

386. With respect to our own troops, the observer makes such reports as to their movements and situation as will enable the artillery commander best to assist them with the fire of the guns.

387. Arrangements should, moreover, be made with advanced troops of the other arms for the transmission of information which will assist in the adjustment of fire and for the indication as to when fire should be commenced or discontinued.

388. Sure and definite means of communication must be established between the artillery commander, his observing parties, and

advanced friendly troops. If time admits, telephone communication is provided; but visual signaling must always be relied upon to a greater or less extent.

389. For observation of fire, for study of the terrain, and for the quick recognition of objectives, good field glasses are indispensable. All officers, agents, signalers, and scouts of field artillery should be equipped with suitable glasses.

390. At the commencement of the fire it is usually best to watch for the burst of the shots with the unaided eyes, for if a large error is made the bursts may not appear in the field of view of a telescope or field glass. After the bursts have been located the glasses may be quickly brought into play, if necessary, and the relative position of the smoke with respect to the target noted.

After the fire has been approximately adjusted, the points of burst are observed by the aid of field glasses or the telescope, and all the indications carefully noted which assist in the determination of their relative positions with respect to the target.

Observation of Errors in Direction.

391. Errors of direction and of distribution may be measured by means of the B. C. telescope, the ruler, or by hand breadths. Small errors may usually be estimated with sufficient accuracy by eye.

The measurement or estimation of these errors may best be made when the observer is near the line joining guns and target; viewed from the flank, the error in direction is complicated with that in range.

Observation of Errors in Height of Burst.

392. The height of any particular burst may be measured by means of the B. C. telescope. The mean height of a salvo may also be estimated with considerable accuracy, if the bursts as they occur are noted with respect to the horizontal lines in the field of view of the telescope, and an average is then made.

The observer must also be trained to estimate by eye the height of a single burst or the mean height of a salvo.

393. When the mean point of burst is at the height appropriate during the adjustment (from zero to 1 mil), about one-half to one-fourth of the shrapnel may, on account of errors of the fuse, laying, etc., be expected to burst on graze.

A check is thus afforded on the adjustment of the height of burst, provided a considerable number of rounds fired with the same fuse-setting are observed.

394. When indirect laying is used, groups of bursts which are apparently abnormal frequently indicate an error in the angle of site. When this error is considerable, steps should be taken at once to make the necessary correction in the angle of site; otherwise data obtained from firing at that target will be of little assistance in firing upon others.

395. In the adjustment of time fire not only the height but also the burst interval is important, for projectiles bursting too far in front of the target and those bursting in the air above it produce little or no effect. The burst interval is correct when both the range and the height of burst are correctly adjusted. Indications that such is the case are: (1) That the bursts on graze bracket the target; (2) that the mean height of burst in fire for effect is between 4 and 6 mils (par. 355); (3) that fragments from the time bursts strike the ground both in front, and in rear of the target, and that the pattern made by these fragments (as revealed by the dirt and dust knocked up) is close and dense rather than greatly extended; (4) that obvious effect is produced upon the target.

If doubt exists as to the burst interval, it is best to diminish the corrector and get a group of low bursts and bursts on graze.

Observers posted well to the flank of the line of fire may be of the greatest assistance in determining and correcting errors in the burst interval.

Observation of Errors in Range.

396. It is rarely possible from a position near the guns to estimate with accuracy the amount of the error in range. Such estimates are usually too small and cause delay through an effort to adjust the fire by making timid and insufficient changes in the range.

Attention should rather be concentrated on deciding, from careful observation of each shot, upon the sense of a series of shots fired with the same data, and on quickly inclosing the target with fire which is surely short and fire which is surely over. By gradually narrowing the bracket thus determined an effective adjustment may be secured.

A salvo or volley is termed **short** if all of the observed bursts are short; **over** if all of the observed burts are over; **bracketing** if half of the observed bursts are short and half are over; **mixed** if the

majority of the observed bursts are over and the minority are short, or **vice versa.**

The range of a bracketing salvo is approximately that of the target. The range of a mixed salvo is somewhat long if the majority of the shots are over, somewhat short if the majority of the shots are short.

If the sense of a shot can not be definitely decided upon it is doubtful and should be disregarded.

The observer should train himself to decide quickly upon the sense of each shot as **short, over,** or **doubtful,** and upon the sense of each group of shots as **short, over, bracketing, mixed,** or **doubtful.** It may be necessary, however, to allow time for the smoke to form and reveal its relative position with respect to the target.

In time fire of high explosive shrapnel each air burst is followed by a percussion burst of the head. This ammunition therefore affords opportunity to obtain more information than does the common shrapnel or shell. But observations of the impact of the high explosive head are of doubtful value when the height of burst is more than 6 mils. Care should also be taken to distinguish the impact burst of the head from a graze burst of the whole projectile.

397. If the observer is at a considerable elevation above the target, or the target is on ground sloping toward the observer, the sense of a salvo (**short** or **over**) may usually be recognized readily by noting the relative position with respect to the target of bursts on graze or fragmental hits from bursts in air.

398. But if the target and its vicinity can not be seen from a superior elevation, if the ground near the target is at about the same elevation as the observer, or if the ground in front or rear of the target can not be viewed, the deductions as to the sense of the salvo are to be formed especially from the manner in which the puffs of smoke from the bursts appear with respect to the target.

399. A burst on graze causes a column of smoke and dirt to be thrown up from the ground. In the case of a common shrapnel, this column is relatively small and fugitive; in the case of a high-explosive shrapnel or shell, it is large and remains visible for some time.

400. A burst in air produces a ball of smoke which ordinarily remains together for some time.

The bullets and fragments from a burst in air knock up a considerable amount of dirt and dust if they strike dry soil; on wet soil splashes of mud are knocked up by the shrapnel case and large fragments. Information obtained from the observation of the effect thus produced is reliable when it is observed as **over;** it is of doubtful value when observed as **short** unless the burst is **low.**

401. If the target is silhouetted against the smoke of the burst, the latter may always be considered as **over,** whether the burst occurred in air or on graze.

402. If the target is obscured by the smoke of the burst, the latter may be considered as **short;** but, in the case of a burst in air, the burst must be low in order to warrant this conclusion.

403. If the target is indistinct and of about the same color as the smoke, it may be less visible against the smoke as a background. A burst beyond the target may, for this reason, sometimes seem to obscure the target and hence be judged **short,** when it is in reality **over.** On the other hand, some targets become very much more visible if projected against a smoke background.

404. If the wind is blowing up or down the range, a decision should be formed quickly as to the relative position of the smoke with respect to the target. But if the wind is blowing across the range, it may be better to wait until the smoke has drifted across the front or rear of the target. To secure this result it may be desirable to direct the fire for adjustment at the windward flank of the target.

405. It is necessary to study carefully the ground near the target and locate ravines or hollows which might catch and hide the bursts of projectiles. The smoke from such bursts is apt to rise and reveal itself after a time, but false deductions may be drawn from it. Thus the smoke from a burst **short** of the target may have become so much dissipated by the time it appears that the target may be seen through it and the impression produced that the target is silhouetted against the smoke. Moreover, if a strong cross wind is blowing, the smoke, when it appears, will probably be at some distance to the flank of the actual point of burst, and erroneous conclusions as to the direction of the salvo may thus be reached. Such false deductions may be avoided, however, if the lay of the ground is appreciated and taken into consideration.

406. In adjusting fire upon a crest great care must be taken to reach this crest and not be deceived by a crest parallel to it, but short of it. In rolling country such an intermediate crest is often present, and it may merge itself into the background formed by the higher ground in its rear, and hence escape detection, while, as a matter of fact, there may be a broad valley or depression between the two crests. Shots which strike on the near side of the intermediate crest may be erroneously taken as establishing the short limit of the bracket, while shots which pass over the intermediate crest, burst low or on graze in the valley between the two and are lost, may be

erroneously considered to have cleared the farther crest, and hence may be taken as establishing the long limit of the bracket. Such deceptions may be avoided by obtaining bursts in air on the line joining the observer and the crest. If the ball of smoke is cut in two by the crest and the crest is clearly defined against it, the burst is **over,** while if the crest is concealed by the smoke the burst is **short.** The short bursts may often serve to reveal the existence of the intermediate crest by causing the latter to be silhouetted against the smoke.

407. The existence of unexpected ravines and hollows may sometimes be deduced from the fact that while bursts in air are seen, the points of impact of the fragments with the ground are not revealed by the dust and dirt knocked up.

408. If the sun is shining, information as to the sense of a burst in air may often be obtained by observing the shadow on the ground of the ball of smoke produced by the burst. The height of the burst and the position of the sun must, however, be taken into consideration.

409. If the sense of the bursts is **doubtful,** circumstances must decide whether to repeat the salvo or to change the firing data for the next salvo.

If smoke or the fire of other batteries have interfered with observation, a salvo concentrated upon some prominent part of the target may be of assistance.

If the doubt was occasioned by the fact that the bursts were in air and high it may be well to merely diminish the corrector for the next salvo. The sense of such salvos may often be determined, however, by observing the points of impact of the shrapnel cases.

If a salvo is lost, the projectiles have probably burst in a ravine or behind some intervening cover. If the smoke of the bursts does not rise and become visible after a few seconds, the lay of the ground will determine whether to increase or diminish the range or merely to increase the corrector so as to obtain visible bursts in air. Definite information may generally be most quickly obtained in such cases by securing time bursts just above the level of the crests or other cover.

4. RULES OF FIRE.

Minor Changes in Adjustment.

410. The points of burst of a series of shots fired with the same data, even from a single gun, will vary in range, in direction and in height of burst, due to variations in ammunition, matériel and at-

mospheric conditions, and to inaccuracies of the personnel. Hence dispersion is to be normally expected and minor changes in firing data should not be based on the observation of a single shot. To obtain a close adjustment, changes should be made only after the observation of several shots fired with the same data.

Adjustment of the Direction.

411. When direct laying is employed the platoon commanders make such changes in deflection as may be necessary to bring the fire of their guns to bear upon the proper portion of the target. The direction and the distribution are thus simultaneously adjusted by the same correction.

412. When indirect laying is employed the officer conducting the fire adjusts the sheaf both in direction and in distribution.

To throw the sheaf to the right, decrease the deflection; to throw it to the left, increase the deflection.

To open the sheaf, increase the deflection difference algebraically; to close the sheaf, decrease the deflection difference algebraically.

If the platoon commanders are able to observe the fire, they adjust the distribution when so directed (par. 264, *a*).

413. To overcome observed errors in direction, the error is measured or estimated in mils and a corresponding correction in deflection is applied in the appropriate sense. The correction is habitually applied in even multiples of 5 mils until approximate adjustment in direction is secured, when a correction of less than 5 mils may, if necessary, be made.

414. If salvos or shots are lost, one or more high-bursting shrapnel fired from the directing piece will permit the determination and rectification of any error in deflection.

Adjustment of the Height of Burst.

415. Conclusions are to be formed from the observation of a group of shrapnel having the same fuse setting, the average height of the bursts being considered.

Hence battery salvos afford the quickest and most reliable means of adjusting the height of burst.

416. When the angle of site is correct, if all the bursts of the first salvo or volley are on graze the corrector should be increased at least

5 mils for the next salvo. If the bursts are not only on graze but are below the target the corrector should be increased accordingly, using a multiple of 5. If, after increasing the corrector, grazes are still obtained, the corrector should be increased by similar changes from salvo to salvo until air bursts are obtained.

If all the bursts of the first salvo are on graze considerably above the target the corrector should not be changed for the next salvo.

417. If the bursts obtained on any salvo are too high for observation of the smoke balls as to range, their mean height is measured or estimated and a change in the corrector is made sufficient to bring the bursts to the target.

If the bursts are in air **below,** the corrector is raised sufficiently to bring the bursts to the bottom of the target.

When the target has been bracketed for height of burst intermediate corrector settings are used for more accurate adjustment.

418. If the bursts of a salvo are partly in air and partly on graze, the corrector may be kept unchanged during the adjusting series or until the observation of a considerable number of rounds has shown that too large a proportion are bursting either in air or on graze.

419. If one-fourth of the shrapnel fired burst on impact the average height of burst may be considered to be about 1 mil;[1] if one-half burst on impact, about zero; if three-fourths burst on impact, about 1 mil below. In fire for effect if the mean height of burst is adjusted approximately at the normal height (par. 355) not more than one shrapnel in twelve should burst on impact.

420. When indirect laying is employed, an error in the angle of site will cause a corresponding and equal error in height of burst. As the cause of the latter error will probably not at first be known, it will be necessary to attempt the adjustment of the height of burst by changing the corrector, as explained in paragraphs 416 and 417. If the error in height of burst is not great, it may readily be allowed for in this way; but if it is seen that the necessary correction will exceed the limits of the corrector scale, then the total correction which has been applied to the corrector must be transferred in the same sense to the angle of site, and a return to a corrector setting near the normal must be made.

At medium ranges a change of 4 mils in the angle of site produces a change of about 100 yards in horizontal range; hence, if the angle of

[1] The proportion of impact bursts corresponding to a mean height of 1 mil varies from about $\frac{1}{8}$ at short ranges to about $\frac{1}{4}$ at long ranges, according to data available at present (1914). More extended service practice may modify these figures.

site has to be materially altered, the adjustment of the range will have to be begun anew.

At medium ranges an error of 4 mils in the corrector produces a change of about 100 yards in range to point of burst in air.

The foregoing emphasizes the importance of measuring the angle of site as accurately as possible, in the first place. It also shows that, when the firing data for indirect laying are passed from a battery in action to one just about to take part, not only the range, but also the corrector and angle of site which have been used with that range in securing the adjustment must be communicated.

Adjustment of the Range.

421. The range is determined or verified by bracketing; that is, by inclosing the target between rounds or salvos which, fired at a known difference of range, strike, one short of and one beyond the target.

If the first salvo is **short,** the range is increased; if **over,** it is decreased; and salvos are fired successively increased or decreased in range, as the case may be, until the target is bracketed. The change in range from salvo to salvo in this process of finding the first bracket is usually taken as 400 yards. In cases in which the range has been carefully predetermined, a change of 200 yards in range may be employed.

Having bracketed the target, the size of the bracket may be successively reduced by halving the last bracket obtained; that is, by firing at the mean of the last two bracketing ranges. The extent to which this reduction in the size of the bracket should be carried is dependent upon the nature of the target and the circumstances of the case.

422. If the target is surely included within the limits of the bracket finally accepted, it may be reached more or less effectively by subsequent fire. The first consideration, then, is to determine that fire at a certain range is surely short of the target, and that fire at another and longer range is surely over the target. A second but very important consideration is to reduce the difference between these two bracketing ranges as much as practicable; that is, to obtain the smallest bracket compatible with the circumstances of the case.

423. During the bracketing process if effect upon the target or a bracketing salvo is observed, that range should be taken as the ap-

proximate range of the target; and fire for effect should be opened at an appropriate range. If the adjustment of the distribution and of the height of burst have not been completed, bold changes with the view to adjusting them should be made, the rate of fire for effect being reduced, if necessary, to permit this adjustment.

If doubt is occasioned by the fact that other batteries are firing on the same target, the salvo with projectiles of the opposite type from those in use by the other batteries will usually be readily recognizable.

Percussion Fire.

424. Percussion fire is principally employed for the destruction of material objects, such as walls, buildings, obstacles, artillery matériel, etc. Such fire is termed **fire for demolition.** A close adjustment in range is required.

For the destruction of artillery matériel or other targets of low relief, the usual procedure is to obtain a 100-yard bracket and to fire enough rounds at the limits of this bracket to determine definitely that fire at the near limit is short and that fire at the farther limit is over. This bracket having been established, **continuous fire** is begun at the mid-range of the bracket. When observation of a number of rounds has indicated that the mean point of burst is **short** or **over,** the range is changed by 25 yards in the appropriate sense. Changes of less than 25 yards should not be made.

Percussion fire is considered adjusted when it is evident that effect is being produced upon the target and when the number of **shorts** is practically equal to the number of **overs.**

Time Fire.

425. Time fire is employed for the attack of animate objects. The nature of the target, the tactical situation and the conditions affecting observation of fire determine the limits within which the range may be found.

426. The minimum bracket possible of determination depends upon the accuracy of the gun. The establishment of a bracket narrower than the 50 per cent zone is difficult.

The bracket to be used depends upon the tactical situation and conditions of observation.

427. Against stationary targets—for example, artillery in position, or immobilized troops—a bracket of 100 yards should ordinarily be sought.

Against targets moving slowly or capable of slow motion only—for example, heavy artillery, troops in defiles, convoys—a bracket of 200 yards should be attempted.

Against transient targets—for example, infantry in action or in small bodies that can quickly disperse or seek cover, or machine guns firing—a bracket of 200 yards is usually the narrowest that should be attempted.

Against troops moving or likely to move rapidly in the direction of the range—for example, mounted troops not confined by the terrain—it is usually advisable to bracket by changes of 600 yards in range and to attempt no narrowing of the bracket thus obtained. If the target is approaching and the long limit of the bracket has been last determined it is often advisable to verify the short limit in order to make sure whether or not the target has passed out of the bracket. If the target is withdrawing and the short limit of the bracket has been last determined, it is often advisable similarly to verify the long limit. The range finder may be used to determine quickly whether a moving target is approaching or withdrawing.

428. Having obtained the desired bracket no time should be lost in making the area thus inclosed untenable for any hostile force. The adjustment should be continued during fire for effect. Effective ranges should be repeated and those obviously ineffective should be discarded.

Ranges may be considered effective when it is evident that effect is being produced upon the target; when the great proportion of bursts in air are short of the target and at the proper mean height; when the shrapnel cases are seen to strike at or near the target; when dust, if seen at all, is knocked up by the bullets both in front and in rear of the target.

429. To search an area of any desired depth, volleys or salvos are fired at successive ranges differing by constant increments or decrements. The range for the first salvo or volley is usually that corresponding to the short limit of the bracket. The first range differences should usually be 100 yards, but when the area has been narrowed as a result of observation, they may be reduced to 50 yards.

430. If the area to be searched is not deep and the slope not great, a mean value of the angle of site may be taken, and a corrector used which will give low bursts at the near limit of the area if the slope is

away from the guns, and bursts slightly above the normal if the slope is toward the guns. This method will always be used if rapidity is desired. For searching long and steep slopes, however, it is better to use the angle of site of the near limit of the area to be searched and vary the corrector from volley to volley or salvo to salvo, increasing it if searching up the slope or decreasing it if searching down the slope.

431. If the ground either in front or in rear of the target can not be seen, or if the target is totally masked, every effort must be made to determine as accurately as possible the distance of the target from some feature of the terrain which is visible to the officer conducting the fire, and which may be used as a registration mark for the adjustment of fire. Thus, if a target is behind a crest the distance of the target from the crest line is to be determined; if the target is masked by trees and is so situated that the ground in rear of the target can alone be seen, some feature of the ground in rear of the target may be taken as the registration mark and the distance determined from it.

In such cases the fire is adjusted on the registration mark chosen and then shifted so as to search the area within which the target has been located. It is most important to have observers posted so that they can observe the fire and assist in its adjustment.

432. No burst should be sensed unless the officer conducting the fire obtains from it information sufficient to form the basis for a definite opinion. If there is any doubt in his mind, the burst should be sensed as **doubtful.** Having once sensed a burst as **short** or **over,** the captain, whenever the tactical situation or the conditions of observation demand it, should not hesitate to base a limit of the bracket on such sensing. But, whenever time or the conditions of observation permit, the limits of the bracket, particularly the short limit, should be based upon the sensing of more than one burst.

5. APPLICATION OF FIRE.

433. In service, the fire of field artillery must be adapted to meet the requirements of many and ever-varying conditions. An infinite variety of concrete problems is afforded, and each problem will have its own best solution. Therefore great flexibility in the employment of fire is called for.

These Regulations set forth principles which are the bases of action and rules which may serve as guides in the average case; but they must not be looked to for ready-made solutions of the problems

which arise in service. Having thoroughly grasped the possibilities of the gun and its equipment, an officer must so prepare himself that he will be able to recognize at once the means to be employed in any concrete case and be capable of putting such means into effect. Every latitude is allowed him in the choice of a method of fire and in its adaptation to the special case in hand. By constant practice in peace in employing fire, simulated or otherwise, to meet the requirements of a great variety of tactical situations, officers may prepare themselves to use their guns to the best advantage in war.

434. The special characteristics of the different methods of fire provided for in the text are outlined below.

435. Continuous fire is adapted especially to the demolition of material objects and to the attack of personnel inactive and more or less fixed in position and protected from fire.

The fire may be as rapid or as slow as desired, thus permitting the expenditure of ammunition to be exactly regulated to meet the requirements of the case.

Close adjustment in range is sought; but if the conditions of observation are such as to preclude this, the smallest practicable bracket is obtained and its depth searched by successive changes in the range.

436. Volley fire is adapted especially to the attack of personnel that are more or less vulnerable. The special characteristic of this method of fire is its great flexibility. The number of volleys to be fired, their range difference (if any), the number of rounds in each volley, are all in the hands of the officer conducting the fire. By suitable manipulations of the sheaf he may readily shift the fire from point to point of the terrain, as necessity may require, and by adapting the bursts of fire to meet the crises of the action he may utilize the ammunition to the best advantage.

437. Salvos are adapted especially to securing the adjustment of fire. They may also be used for producing effect, and especially with the idea of obtaining at the same time additional information on which to base a closer adjustment of the fire. They are employed according to the principles of volley fire.

438. Fire at will is employed solely for the close defense of the guns.

Against a slowly moving enemy, such as infantry, the fire should be commenced when he has arrived within about 400 yards of the gun; against a rapidly moving enemy, such as cavalry, when he has arrived within about 800 yards; the purpose in both cases being to

surely establish a fire-swept zone through which the enemy must pass in order to reach the guns.

439. Against infantry in position and more or less protected by entrenchments the fire should be carefully adjusted. As our infantry advances to the attack the intensity of the fire should be regulated to suit the necessities of the case, being slow or ceasing entirely while the enemy is concealed or inactive, rising to great intensity when the crises of the action develop and the enemy exposes himself to meet them. Continuous fire is indicated for the ordinary phases of the action, volleys for the crises, the object being to assist our own infantry; by inflicting as much damage as possible upon the enemy; by destroying his morale; by forcing him to keep under cover; and by preventing effective fire upon his part.

440. Against artillery in position the first object is to gain the ascendancy over it by inflicting as much damage as possible upon the personnel. Immediately effective fire is particularly demanded if the enemy can be attacked at a disadvantage, as, for example, while limbering or unlimbering. Obtaining a bracket as small as practicable, searching the depth of the bracket, carefully observing the fire and securing as promptly as possible an accurate adjustment, are the means to be ordinarily employed in attacking the personnel.

Due to the difficulty, however, of reaching effectively the personnel of batteries provided with shields and posted in masked positions, the struggle between evenly matched artilleries will often be long drawn out. If the enemy's artillery is temporarily overmatched, it may suspend its fire and shelter its personnel; but it must be expected to renew the struggle as soon as the pressure upon it is relieved. The aim must be to gain the superiority of fire by suitable concentration of effort on the part of our own artillery; the opportunity may then be gained to destroy the enemy's matériel by well-adjusted shell fire.

441. A slowly-moving target such as infantry, or mounted troops impeded in their march, may be quickly bracketed by salvos and then attacked by searching fire.

While infantry in march formation may be thus attacked, immediate deployment on their part should be anticipated, and the officer conducting the fire should be prepared to reach them, probably behind cover, with a well-distributed fire.

Infantry moving to attack in deployed lines or in line of small columns may be met by volleys successively reduced in range as the infantry approaches. If their formation is in line of small columns,

the fire should be distributed so that a piece or platoon may bear upon each of the small columns.

At close ranges infantry will probably endeavor to advance by successive rushes from cover to cover. Such rushes may be met by volleys previously prepared for upon selected positions, evidently in the immediate path of the enemy. If the positions occupied by important bodies of the enemy during the intervals of advance are well defined, accurately adjusted fire may be brought to bear upon such positions, and the ground between successive positions may be covered by searching fire when important movements of the enemy from one position to another are attempted.

442. In the case of a rapidly approaching or withdrawing target, fire should be adjusted upon the target itself if practicable. A bracket of 600 yards will ordinarily be quickly obtained and volley fire at successive ranges will be opened. The initial range for effect should be one toward which the target is moving, an ample allowance being made for the motion of the target.

A target having once been brought under effective fire, its subsequent movements may be followed by volleys varying in range and direction, according to the rate and direction of march of the target.

If adjustment upon the target is impracticable, some point or area may be selected which the target is expected to pass. In this case a broad bracket of the point or area is determined and fire for effect is opened when the target enters it.

443. The application of the methods of fire previously explained should be practiced by the solution of theoretical and practical problems.

6. REGISTRATION OF FIRE.

444. Artillery already in position may take advantage of lulls in the progress of an action to register its fire upon positions in which an enemy is known to be or in which he is expected to appear.

445. The purposes of fire for registration are:

(a) To determine the firing data for reaching certain prominent features of the terrain, such as crests, plainly marked trees, houses, etc.

(b) To gain thus the ability to open immediately effective fire upon a target appearing at or near these prominent features of the terrain.

446. Registration of fire is especially appropriate for artillery to which definite sectors of observation have been assigned, as the necessary firing data may thus be most readily obtained.

If the position of the enemy within the sector is definitely known—as, for example, that he is behind a certain crest or in the edge of a certain piece of woods—the fire is directed upon some prominent landmark at or near the enemy's position as a registration mark, and the data thus secured in advance for opening prompt and effective fire.

If, however, the enemy's position within the sector has not been located, the artillery commander proceeds in a systematic way to secure the data which will enable him to reach promptly and effectively any part of the sector. He studies the terrain, decides upon the limits in width and depth of the area to be registered, notes the specially prominent features of the terrain within these limits, and by actual firing directed upon these natural features secures the data which will enable him to reach promptly any target appearing in their vicinity.

PART IV.

MOUNTED INSTRUCTION.

447. See Drill Regulations for Field Artillery (Horse and Light), Part IV.

Necessary changes in distances and intervals due to the increased length of carriages and teams should be made. The length of the piece hitched with team of 4 pairs, the gun in its traveling position, is about 19 yards; that of the caisson hitched with team of 4 pairs is about 18 yards. The distance between carriages in section column should be about 4 yards.

The interval between carriages in line and flank column is about 21 yards. The radius to be used in making the wheels and the abouts is not fixed, but varies with the degree of draft from 6 to 12 yards; it should be sufficiently large to permit the team to make the movement with ease, all the pairs keeping in draft.

When it becomes necessary to increase or decrease distances or intervals, the changes should be made very gradually.

The usual maneuvering gait is the walk; the trot is exceptional. The gallop is not used for teams or carriages hitched.

Owing to the difficulty of obtaining precision of maneuver with the heavy field artillery guns, movements into firing positions should, when practicable, be successive rather than simultaneous.

The disposition of the harness in the field is as follows:

The piece team: The neck yoke is placed as a support under the end of the pole. The wheel traces are detached from the collars only, and laid back on the doubletree.

The remainder of the harness of the wheel horses is placed on the bucket brackets of the limber, the off harness on the right.

The harness of the near wheel swing horse is placed on the pole next to the doubletree, arranged as follows: The saddle with its attachments over it, the blanket across the saddle, the bridle and collar over the blanket. The off wheel swing harness is placed next, then the lead swing and the lead harness in the same order. The traces of the wheel swing, lead swing, and lead harness, folded once, are placed across the saddle.

The caisson team: The pole prop is placed under the end of the pole. The harness of the caisson team is arranged as for the piece team except that the harness of the wheel horses is placed on the doubletree, the off harness on the right. The neck yoke is placed on the limber.

PART V.

FIELD ARTILLERY INFORMATION SERVICE.

448. See Drill Regulations for Field Artillery (Horse and Light), Part V.

PART VI.

ARTILLERY IN THE FIELD.

449. See Drill Regulations for Field Artillery (Horse and Light), Part VI.

With obvious modifications due to the decreased mobility and the greater power and range of the 4.7-inch gun as compared with the 3-inch gun, everything prescribed in "Artillery in the Field" for organizations armed with the 3-inch matériel is, in the main, applicable to organizations armed with the 4.7-inch gun.

Owing to their lack of mobility, these organizations will ordinarily operate with infantry only. They will normally be assigned to field armies as field army troops; but when the occasion demands they will be detached for service with the infantry divisions.

The principal rôle of the 4.7-inch gun is to attack the hostile artillery, intrenchments which are beyond the power of the lighter matériel, and targets which are beyond the range of those guns. A secondary rôle is to attack the hostile infantry.

The shrapnel of the 4.7-inch gun is effective up to extreme range for the fuse—about 9,500 yards. Its use is consequently of value in forcing the enemy to deploy at long range, thus delaying his advance; in following him with long-range fire in the pursuit; in protecting the withdrawal of friendly troops in the early stages of retreat; in covering the approaches to bridges and defiles; in attacking bodies of hostile troops at long range.

Its shell is used against fieldworks, matériel, and localities which are too strong for successful attack by the 3-inch matériel.

The 4.7-inch gun batteries should as a rule be posted toward the center of the position, as their great range enables their fire to cover a great extent of terrain toward either flank. Generally they should not be placed in position until the action has progressed sufficiently to indicate clearly where they may be most effectively used against the hostile artillery. Occasions may arise, however, where it may be necessary to bring them into position and open fire at the outset of the action in order to check the hostile advance at long range; or to obtain superiority of fire over the hostile artillery, so that the friendly light artillery may be advanced to positions within effective range of the hostile lines.

In many cases they will be posted in rear of the line of the lighter guns; but the nearer the heavy guns are to the hostile lines, the greater are the chances for their effective employment in oblique and flanking fire.

Thorough reconnoissance is of great importance both on the march and on the battle field. On the march, reconnoissance well ahead of the artillery column is essential so that bridges may be examined and strengthened when necessary, the best routes selected, and repairs made to roads in order that the march may not be impeded. On the battle field, careful reconnoissance of positions, observing stations, and the terrain to be covered by the fire of the guns, is requisite so that they will be placed in position where their fire may be used with the maximum effect. On account of their lack of mobility, changes

of position require much time. Errors in the selection of firing positions and observing stations should therefore be avoided by careful reconnoissance before deciding upon their location. Regimental and battalion commanders should therefore be ordered to the front as soon as it seems probable that the heavy guns will be needed, so that they may become thoroughly conversant with the tactical situation and may make at the earliest moment such reconnoissance as the situation may require.

On the march the heavy guns will usually follow the infantry of the main body of the division to which they are attached. When their early use is anticipated, they may march nearer the head of the main body.

The principal uses of the heavy field guns in the attack are:

1. To attack the enemy's artillery, thus covering the deployment of the light field guns and that of the infantry.
2. To attack intrenchments and material objects which are beyond the power of the lighter guns.
3. To assist by their long-range fire in enveloping and flanking movements.
4. To bring to bear upon the enemy oblique or enfilade fire not attainable by the guns of shorter range.
5. To oppose the enemy's counter attacks, and to cover the movements of friendly infantry and light artillery in meeting such attacks.

The principal uses of the heavy field guns on the defensive are:

1. To cause the deployment of both the hostile artillery and infantry at long range.
2. To attack the hostile artillery.
3. To support counter attacks and offensive returns made by the defense.
4. To cover by fire the intervals between points of support in the defensive lines.
5. To assist in the repulse of the infantry assault.
6. If the attack be repulsed, to assist in the pursuit by long-range fire.
7. If the attack be successful, to cover the withdrawal of the friendly troops.

PART VII.

CARE OF HORSES AND HORSE TRAINING.

450. See Drill Regulations for Field Artillery (Horse and Light), Part VII.

PART VIII.

CEREMONIES.

451. See Drill Regulations for Field Artillery (Horse and Light), Part VIII.

Organizations armed with the 4.7-inch gun pass in review at a walk.

Each gun squad marches in rear of its piece, and each caisson squad in rear of the leading caisson of its section. (Par. 200, and last section of par. 204.)

PART IX.

BUGLE CALLS.

452. See Drill Regulations for Field Artillery (Horse and Light), Part IX.

APPENDIX.

LETTER CODE, FIELD ARTILLERY.

[For use with General Service Code or semaphore hand flags.]

In the several branches of Field Artillery such additional abbreviations may be used as are necessary for the equipment now in use.

[To be memorized.]

AD—Add.
AA—All the guns.
AL—Draw ammunition from limbers (ammunition mules).
AKT—Draw ammunition from combat train.
AP—Aiming point.
AS—Angle of site.
BL—By battery from the left.
BR—By battery from the right.
CF—Cease firing.
CT—Change target.
D—Deflection.
DR—Diminish range.
DI—Diminish (by).
F—Commence firing.
I—Increase (by).
IN—Interval.
IR—Increase range.
JI—Report firing data.
KR—Corrector.
KD—Corrector down.
KU—Corrector up.
KF—Continuous fire (interval).
KS—Continuous fire, sweeping (interval).
L—Left.
MD—Measure deflectiou.
MO—March order.
MPF—Mark a platoon front.
MT—Moving target.
O—What is the (RN, D, etc.)?
OV—Over.
PA—Limber (pack).
PL—By platoon from the left.
PR—By platoon from the right.
PS—Percussion shrapnel.
RN—Range.
RPA—Right platoon adjust.
RT—Right.
S—Subtract.
T—Target.
V—Volley fire (rounds).
VV—Volley fire at successive ranges.
Z—Short.

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[Use blank spaces for additional phrases as required.]

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