THE GENERAL BOARD

United States Forces, European Theater

REPORT

ON

STUDY OF FIELD ARTILLERY GUNNERY

MISSION: Prepare Report and Recommendations on Field Artillery Gunnery Technique Employed in This Theater.

The General Board was established by General Orders 128, Headquarters European Theater of Operations, US Army; dated 17 June 1945, as amended by General Orders 182, dated 7 August 1945 and General Orders 312 dated 20 November 1945, Headquarters United States Forces, European Theater; to prepare a factual analysis of the strategy, tactics, and administration employed by the United States Forces in the European Theater.

File: 353.4/1

Study Number 64

Property of
Office of the Chief
Military History
General Reference Branch

TABLE OF CONTENTS

SUBJECT	PAGE
Part One: Target Location.	1
Chapter 1: Observation.	1
Pre-War Training.	1
Observers	1
Ground Observers.	2
Organization of Observation	3
Artillery Air Observation Posts	4
Observation by High Performance Planes. .	5
Sound	7
Radar	8
Chapter 2: Air Photos	10
Developments in Combat.	10
Field Artillery Requirements.	12
Interpretation.	13
Photos as Firing Charts	13
Chapter 3: Shelling Reports	13
Background.	13
Development	14
Use Made of Shellreps	14
Mortar Reports.	17
Value of Shellreps.	17
Chapter 4: Miscellaneous Sources of Intelligence.	17
Prisoner of War Reports	18
Comparison of Methods of Target Location.	18
Bibliography.	20
Part Two: Fire Direction	21
Chapter 1: Development of Fire Direction. . .	21
Section 1: General	21
Section 2: Background.	21
Section 3: Levels of Fire Direction. . .	22
Section 4: Fire Direction Technique. . .	23
Section 5: Massing of Fires.	24
Chapter 2: Conduct of Fire.	26
Section 1: General	26
Section 2: Observed Fires.	27
Static Observation	28
Forward Observers.	29
Artillery Air Observation Posts. . .	29
Radar Adjustments.	29
Special Observed Fires	30
Section 3: Unobserved Fires.	31
Registrations.	31

SUBJECT PAGE

Corrections. 32
Accuracy 32

Chapter 3: Survey 33

Army and Corps Engineers. 33
Corps Artillery Survey. 35
Division Artillery Survey 35

Chapter 4: Firing Charts and Plotting Equipment 35

Maps. 36
Grid Sheets 36
Plotting Equipment. 36
Bibliography. 37

Part Three: Conclusions and Recommendations. . . . 38

Chapter 1: Conclusions. 38

Chapter 2: Recommendations. 40

Appendices:

1. Standing Operating Procedures for SERENADE 42

2. Standing Operating Procedures for use of the Variable Time Fuze. 48

THE GENERAL BOARD
UNITED STATES FORCES, EUROPEAN THEATER
APO 408

STUDY OF FIELD ARTILLERY GUNNERY

Prepared by:

Brig Gen J. D. Balmer- - - Chief, Artillery Section
Col L. J, Compton- - - - - Executive, Artillery Section
Col B. Hamlett - - - - - - Artillery Section
Col H. H. Critz- - - - - - Artillery Section

Principal Consultants:

Brig Gen J. M. Lentz, 010343, Artillery Commander, XII Corps Artillery.
Brig Gen E. T. Williams, 012818, Artillery Officer, Third US Army.
Col F. J. Brown, 016761, Artillery Commander, 3d Armored Division.
Col C. I. Hutton, 018177, Artillery Commander, 2d Armored Division.
Col R. J. Handy, 017130, Artillery Commander, 1st Armored Division.
Col J. B. Horton, 015150, Commander, Field Artillery Group.
Col J. A. Berry, Jr., 018473, XV Corps Artillery.
Col J. J. Binns, 015207, Commander, Field Artillery Group.
Col J. G. Watkins, 07249, Commander, Field Artillery Group.
Col J. C. Wyeth, 03675, Commander, Field Artillery Group.
Col F. W. Ellery, 018725, Commander, Field Artillery Group, and Assistant Corps Artillery Officer, XII Corps.
Col R. Gott, Executive Officer, XII Corps Artillery.
Col J. R. Winn, 019491, Assistant Corps Artillery Officer, XIX Corps.
Col E. T. Owens, 015488, Executive Officer, 26th Division Artillery.
Col J. P. Daley, 018358, Assistant Artillery Officer, 12th Army Group.
Lt Col U. P. Williams, 019391, Commander, Field Artillery Battalion.
Lt Col G. Ruhlen, 019733, Commander, Field Artillery Battalion.
Lt Col H. L. Sanders, 019445, Commander, Field Artillery Battalion.
Lt Col J. G. Harding, 017613, Commander, Field Artillery Observation Battalion.
Lt Col C. A. L. Dickey, 0308702, Commander, Field Artillery Observation Battalion.
Lt Col B. DeW. Jones, 019081, Commander, Field Artillery Battalion.

THE GENERAL BOARD
UNITED STATES FORCES, EUROPEAN THEATER
APO 408

STUDY OF FIELD ARTILLERY GUNNERY

PART ONE

TARGET LOCATION

CHAPTER 1

OBSERVATION

1. Purpose. To prepare a study on the methods employed in this theater for locating field artillery targets and to evaluate the various methods used and the gunnery technique employed in the neutralization and destruction of these targets.

2. General. The advancement made during World War II in methods of locating enemy installations has been one of the outstanding improvements in artillery technique. Agencies that have proven valuable for this purpose include photo interpretation, sound ranging, air observers, ground observers, prisoners of war interrogation teams, military intelligence interrogation teams, shellrep teams, radar, and intelligence personnel of all echelons. All of these agencies, except radar, were employed in the last war, but in the interim between wars much of the technique was forgotten and few developments were made. The neglect of the important subject of target location was due in large measure to the lack of adequate courses of instruction in our service schools pertaining to Corps and Army artillery. The bulk of target locations were made at Corps level.

3. Pre-War Training. Prior to the participation in combat by United States troops in this war target location was a neglected subject insofar as the field artillery was concerned. Between World War I and World War II gunnery technique was improved progressively but little thought was devoted to the fact that, in order for excellent gunnery to have the desired effect on the enemy, the location of his installations must first be determined by an observer or some other agency or combination of agencies. For years gunnery instructors assigned targets to students at service practice with the standard expression "machine guns in the vicinity of that tree". How to determine that machine guns were in the vicinity of the tree was seldom mentioned. The field artillery was cognizant of the use of various agencies and methods capable of employment in the location of targets; but, since the incentive caused by being "shot at" was lacking, and so much time was employed in teaching officers to shoot properly, little was written or taught on the subject.

4. Observers.

a. The location of enemy installations by observers, both ground and air, was covered in training

literature and received some attention prior to this war. In actual practice, however, artillerymen side-stepped the difficult subject of target location and placed emphasis on developing good shots instead of both observers and shots.

b. Early combat experience in Africa and the Pacific convinced artillery commanders that gunnery methods were sound, but the ability of observers to locate the enemy and to evaluate what they saw left room for much improvement. The field artillery was quick in reflecting these opinions by producing training literature on observation, but the difficulties encountered in teaching officers to shoot continued to be of primary interest and training in observation as a general intelligence agency continued to be neglected.

5. Ground Observers.

a. Ground observers may be classified as fixed or static observers and forward observers. In combat forward observers were often static and could in those cases be classified as fixed. In this report only flash teams from observation battalions and teams manning surveyed observation posts will be referred to as fixed or static observers.

b. Available records do not permit an accurate comparison of the value of fixed or forward observers. Battalion after-action reports and journals indicate that practically all adjustments by ground observers on observed targets were made using forward observer methods, but these do not indicate that the targets were located by forward observers. For a comparison of targets located by various methods see paragraph 26.

c. Artillery commanders are unanimous in the opinion that the number of forward observers must never be less than one per infantry company or combat unit of comparable size.[1,2,3] This includes companies in reserve since their commitment cannot be held up pending the arrival of an artillery observer.[3]

d. Maintaining sufficient forward observers with supported units was a difficult problem for direct support battalion commanders. When observers were furnished on the basis of one per infantry or tank company, it was sometimes necessary to furnish twelve from one artillery battalion. This occurred in spite of the fact that in the infantry division artillery tables of organization forward observers were not included until after the invasion of the Continent--and then only three per battalion. Armored artillery battalions in armored divisions were provided with three forward observers and parties in the table of organization, but the necessity of working with small task forces of both infantry and tanks resulted in an acute shortage of observers in these units also.

e. Another difficulty experienced with forward observers was the problem of furnishing observers for reinforcing infantry when infantry battalions and regiments

were attached to divisions. In order to furnish observers for these attached units, battalion commanders were forced to use inexperienced officers and non-commissioned officers or take experienced officers from other jobs where they were needed. One solution to this problem was found when, during an engagement in April, 1945, a battalion of infantry from the 1st Infantry Division was attached to the 3d Armored Division. By mutual agreement between the division artillery commanders the observers and liaison officers from the 1st Infantry Division Artillery remained with the infantry battalion from the 1st Infantry Division. This allowed the infantry battalion to enter the battle with old friends from the artillery whom they knew and trusted. The artillery commander of the 3d Armored Division stated that this solution was completely satisfactory.

6. Organization of Observation.

a. In the early part of the European Campaign the organization of observation varied according to preconceived ideas of artillery commanders. As these commanders gained experience, standardization of methods became apparent within corps. Between corps there was considerable difference in the organization of observation because of the different manner in which corps organized for combat. For example, in some corps no attachments were made to divisions. In other corps semi-permanent attachments were made. In the first instance, the XII Corps organized observation as outlined in the follow extract from the Corps Artillery Standing Operating Procedure:

* * * * *

E X T R A C T

* * * * *

"Each artillery battalion with a mission to reinforce a direct support battalion furnishes two forward observers if the direct support battalion is being reinforced by more than one battalion; three forward observers if the direct support battalion is being reinforced by only one battalion.

"Forward observers from reinforcing battalions pass to the control of the direct support battalion commander (par. 39, FM 6-20). They each are equipped with a radio and a telephone with at least two miles of wire. The radio has set on it one channel of the reinforced and one channel of the reinforcing battalion. Targets are reported to the reinforced battalion, which designates the battalion, if any, which is to be adjusted by the observer.

"Direct support battalions maintain a forward observer with each infantry company at all times.

"Division organizes its ground observation so as to observe the hostile area to a depth of 4,000 yards to the front and to exposed flanks.

"Each corps group, using at least one observer per battalion, organizes its ground observation so as to observe, in general, the hostile area beyond 4,000 yards, with lateral limits generally as indicated by its mission and by its position area with relation to other groups. The organization of each group includes facilities for at least one base for high burst registration. Flank groups are responsible for the Corps flanks.

"An artillery unit operating with a separate tank battalion, sends a forward observer to observe from the observer tank in Headquarters Company. Communication is from the SCR 508 in the tank to the SCR 608 at battalion fire direction center. The common contact channel may be used (par. 60c).

"Priority in selecting OP's is direct support, flash, division general support, Corps." 9

* * * * *

In the XIX Corps, where semi-permanent attachments were made to divisions, requirements consisted of having each corps battalion of a reinforcing group establish static observation posts to cover the zone of its fire possibilities. In addition each group headquarters was required to maintain at least one observation post. Normally a group having a general support mission and not reinforcing the fire of a division was required to have only one observation post for registration of all its battalions. The use made of forward observers was dictated by the division artillery commander.

b. In divisions there was a standard organization of observation dictated by the needs of the supported arm. This organization consisted of the assignment of forward observers on the basis of one per infantry or tank company and in slow moving situations, the addition of from one to two static observation posts per battalion. Observers from direct support battalions were not assigned zones of observation but were coordinated by battalion liaison officers to obtain maximum observation in the zone of advance or defensive sector of supported units.

7. Artillery Air Observation Posts.

a. Since this subject is covered in detail in Theater General Board Study No. 66, "Organic Field Artillery Air Observation", this report will not attempt a complete analysis.

b. A study of available data justifies the statement that the field artillery air observation post was one of the most valuable agencies available for locating enemy installations. In comparing the number of locations made by air observation posts with other agencies a wide variation is found among units. Statistics support the statement that not less than ten percent of all observed targets were located by air observation posts, and in many instances this may be increased to 50 percent.

c. Organization of air observation posts followed a general trend in all units in spite of minor variations. Commanders are almost unanimous in the opinion that air observation posts must be capable of operating under either centralized control of corps, division, or group or decentralized to battalions.[2,3,4] Observers were either permanently assigned this duty or rotated with forward observers. The majority of the artillery commanders favored permanent assignments and in support of this the War Department authorized flying pay to personnel designated as artillery air observers.

d. It was learned through experience that observers were much more efficient if assigned sectors of observation.[1,3,5] It was a policy in most divisions for division artillery to assign sectors of observation. This did not preclude reporting and firing on targets outside the assigned sector but did give the observer an area of primary responsibility. The number of observers in the air at one time in any unit depended on the intensity of action or rapidity of movement. However, it was standard practice in all divisions to have at least one plane in the air whenever weather conditions permitted.

8. Observation by High Performance Planes.

a. High performance aircraft were used in all corps to supplement and extend observation facilities organic to field artillery units. The operational technique employed was basically the same in all armies and was referred to as ARTY/R (Artillery Reconnaissance).

b. Initially requests for ARTY/R were processed through G-2 air and G-3 air channels as described in paragraph 10 below, but as the importance of ARTY/R became apparent, army artillery officers were given specific allotments of daily air sorties for ARTY/R missions. In making allotments to corps it found that an automatic daily allocation of several ARTY/R missions to each corps facilitated planning. The practice of holding several missions in reserve at army level for impromptu calls allowed flexibility in meeting sudden demands for missions.

c. Missions may be classified as follows:

(1) Search missions which consisted of directed search for profitable targets within the fire possibilities of the corps.

(2) Observation of prearranged concentrations consisting of observing and reporting the overall effect of a prearranged concentration on a definite target.

(3) Adjustment mission consisting of locating and adjusting bracket fire on a specific target.

(4) Registration mission which consisted of adjusting a single gun by bracket methods on a clearly defined base point or check point.

d. Pilots were briefed for all missions by ground liaison officers. Briefings for artillery fire missions were generally unsatisfactory because of the time element involved in getting information back from the corps Fire Direction Center to the Photo Reconnaissance Group. For this reason corps artillery commanders usually preferred search missions rather than prearranged.[3,5,7] Briefing by radios after the plane was in the air at times proved successful for artillery missions.[7] The following extract from a report on the Brest operation is an excellent commentary on the briefing of pilots.

* * * * *

E X T R A C T

* * * * *

"REPORT ON THE ARTILLERY WITH THE VIII CORPS IN THE REDUCTION OF BREST.

22 August - 19 September 1944.

"SECTION IV SPECIAL ARTILLERY SUBJECTS.

"6. Arty/R.

* * * * *

"b. Briefing of Pilots.

(1) It was initially planned to have an officer from the Corps Arty headquarters go to the air base daily with data for the briefing of pilots on all targets planned for the following day's missions. This proved impractical due to the movement of the base field for the TAC/R (Tactical Reconnaissance) Group from RENNES to a field near PARIS, a point too remote to permit these daily contacts. As a result, it became necessary to brief the pilots while in the air.

(2) Pilots reported in by radio, having been previously instructed on the location of the ground radio set, which was further identified by panels displayed on request from the pilot. Pilots were also furnished with a map showing the locations of the batteries to be used for Arty/R adjustments to help in determining the Gun Target line, each battery being identified by a code letter.

(3) Targets were designated to the pilot in the air by map coordinates and description, including references to prominent terrain features in the vicinity. Little difficulty was experienced

in directing the pilot to any desired point, and this method proved to have the great advantage that the target of the most importance at the time the pilot reported in for the mission could be given priority, which would not have been possible under a system of briefing a day in advance of the missions.

(4) Certain points which facilitate briefing pilots in the air are worthy of specific mention;

(a) A gunnery officer in the fire direction center should, if possible, have an air photo of the target area with the suspected target location marked on it, to make description of and references to prominent terrain features easy and accurate.

(b) Target areas should be studied by the gunnery officer and briefing notes prepared well in advance to avoid delay while the plane is circling the target area.

(c) A prearranged map coordinate code should be agreed upon to permit advising the pilot of the location of the adjusting battery. The system of plotting the batteries at the start of the operation is not effective, as it is impossible to predict the displacements which will be necessary as the attack develops."[7]

* * * * *

e. The amount of general intelligence on target location obtained from observers in high performance aircraft cannot be determined accurately since general intelligence often came to the artillery from G-2 sources. The number of missions fired by high performance aircraft in comparison to other means of observation was very low (see paragraph 26, this report, for an example); however; in most instances the adjustments, registrations, etc., made by high performance aircraft could not have been performed by any other existing agency.[3,4,5]

9. Sound.

a. Theater Board Report "Field Artillery Observation Battalions" contains a complete analysis of this subject. In view of this fact this report will not contain detail.

b. In June 1939 "B" Battery of the 1st Field Artillery Observation Battalion was activated. Prior to

that time the 1st Field Artillery Observation Battalion consisted of a headquarters and one letter battery. This unit was the only observation battalion in the United States Army until 1940 when two other battalions were activated. With this background and sound equipment judged by civilian experts in seismography to be ten years behind commercial products used by oil companies, successful observation battalion commanders should be given credit for an outstanding performance.

c. Proof that sound played an important role in target location is found in abundance in numerous reports and records.[8] As an example, under static conditions sound ranging averaged 750 locations per battalion per month on active fronts. Many of these locations were recognized and reported as roving self-propelled guns, but confirmation by other sources of intelligence indicates that sound ranging located the majority of enemy batteries with reasonable accuracy. In one representative corps 100 sound locations were subsequently inspected and the average error of location was determined to be 156 yards. An analysis of results to be expected, had all these locations been accepted as accurate and fired on, was made by this corps artillery and it was determined that 51 percent would have received effective fire.

d. Sound locations were seldom accepted by corps counterbattery sections as accurate enough to warrant counterbattery fires. However, sound locations proved invaluable in confirming locations determined by other intelligence. The coordination between sound and photo locations permitted very accurate locations of enemy batteries. This coordination also eliminated dummy positions which were accepted occasionally by the photo interpreter teams.[3,5,9]

10

10. Radar.

a. The use of radar as a means for locating ground targets was tested in combat by the XV and XX Corps. The following extract from IMMEDIATE REPORT NO. 90 (Combat Observations), file 370.2 (G-3), 1 November 1944, 12th Army Group is an example of what was accomplished.

* * * * *

E X T R A C T

* * * * *

"I USE OF RADAR FOR LOCATING GROUND TARGETS

"Comments of Officers of XV Corps Artillery and AAA units:

"1. General. The 214th AAA Bn has experimented with the use of radar to locate moving ground targets at night, with some apparent success. The experiment was initiated by Lt Col Carl W. Kietzman, CO 214th AAA Gun Bn and Capt Richard C. Matlack, Bn Radar O.

"2. Introduction to experiment. The idea was suggested when it was noted that convoys of US vehicles showed up in the range scope of the SCR 584. At the time, the set was located on a high hill and had an axial line of sight on the highway along which the vehicles were moving. As they came over a high point some 5000 yards away they showed up as moving pips on the range scopes. The pip movements showed up for 100 to 200 yds before being lost among fixed target pips, caused by trees and bushes.

"3. Installation. Based on this experience and in accordance with the line of sight characteristics of radar, an installation was made in the XV Corps area, overlooking enemy territory. The set was placed as close as possible to the enemy positions in order to get the maximum response from the moving vehicles, which ordinarily show up quite weak on the scope. The position selected was in full view of the enemy. For this reason it was decided to fortify the position and to operate only at night.

"4. Operation.

"a. The intention was to locate enemy movement on the roads and pass on the information to XV Corps which had set aside certain bns of arty to fire on the targets found. The radar was to report the location and direction and speed of travel and the arty was to compute the point to fire on, then drop a time on target (TOT) shoot on it.

"b. The most successful method of detection found was to point the parabola at a high point on an axial highway and watch for pip disturbance to occur at the range to the road. Aximuth and range were determined from a map. A vehicle moving through the beam would cause the pips already present from fixed targets to suddenly move up and down and then stop after the vehicle had passed. In some cases when a disturbance was noted the pip causing the reaction could be noted changing in range for a short distance.

"c. Since positive detection depends on noting a change in range, the method employed limited the search to roads which were axial to the radar. When disturbances of the pip occurred, it was noted that the tracking current meter of the auto-track unit oscillated violently and swung more than normal, so it was used as an aid in detecting movement.

"5. Results. The operation was begun on 22 October and by 29 October movement had been detected on three roads and one cross road. In the five nights that it was possible to operate, a total of twelve fire missions were sent in on these targets. There was a distinct change in the pace of traffic after the firing in each case, and it was believed that some vehicles were halted as a result of it. As an example, the cross road was watched for several nights and when movement was detected it was shelled. Four nights later the cross road was again checked and no movement was detected. A switch

was then made to a dirt road, where movement was detected and fired upon. This movement also ceased.

"6. Conclusions.

"a. The limited results of the operation were partly due to the wet weather. When it was wet it was difficult to pick out moving echoes from fixed echoes. When fixed targets, such as hills, trees and bushes were wet the pips from them were accentuated and 'bounced' much more than when dry. This made it difficult to distinguish the 'bouncing pip' caused by the vehicle from the pips caused by the fixed targets. When one was detected it soon became lost in the fixed echoes.

"b. It was felt that the use of radar for locating ground targets has definite possibilities and the effectiveness of our field artillery might be increased by the use of small portable radar sets. Experiments are being continued with new sets with a narrower pulse width."

* * * * *

b. In another report from the XV Corps the following statement is made:

"Experience has indicated that accuracy of target location by radar in a properly surveyed position varies from 10 to 50 yards, depending upon the wind, the amount of moisture in the air, experience of the operator and nature of the target. The upper limit was seldom executed except under adverse conditions of weather. During the period 21 January to 13 March 1945, radar located 34.43 percent of the observed targets."

CHAPTER 2

AIR PHOTOS

11. Pre-War Development. With the development of good cameras with which large areas could be photographed without undue distortion, air photos became a subject of much interest to the field artillery. Most of the interest shown by the field artillery, however, was in the use of air photos as firing charts or for use in producing photo maps. The value of air photos in intelligence work was recognized, but training in the use of air photos for locating targets was not emphasized in field artillery training.[1]

12. Developments in Combat.

a. Early in the African Campaign it became apparent that facilities for securing air photos for firing charts were entirely inadequate. It also developed that we were not trained or equipped to make proper use of the photographs available for intelligence purposes. Our failure to make efficient use of air photos was magnified by the fact that the British in the same theater were making excellent use of them in their intelligence work. During the Sicilian Campaign definite steps were

made in improving this situation. By the time plans were under way for the invasion of France, artillery commanders were definitely sold on the value of air photos in locating targets and had initiated intensive training to assure successful use of this intelligence agency.

b. In general, the method for processing air photos adopted by our army paralleled that used by the British. There were variations in different armies and corps but the following procedure was used generally:

(1) Requisitions for photographs were made by division or corps artillery S-2 to the division or corps G-2. The division G-2 passed his request to corps G-2 air and he in turn made requests on the army G-2 air. At army priorities were established and requests made on the supporting air unit through the combined operations section of the army tactical air command. The staff reconnaissance section of the tactical air command coordinated and prepared plans for the employment of tactical reconnaissance and photo reconnaissance units. These plans were then transmitted to the reconnaissance group for execution. Note that priorities within the army units were established by the army commander and overall air and ground priorities by the air commander.

(2) Results of missions performed were reported to the staff reconnaissance section where they were disseminated immediately to the G-2 (air) section, A 2 section, tactical air command and the air force involved. Pilots returning from tactical reconnaissance and photo reconnaissance missions were interrogated by army ground liaison officers with the reconnaissance group. Urgent information was telephoned by the ground liaison officer direct to corps needing the information. Detailed reports were also phoned as soon as they could be assembled. They were followed by a written report for confirmation.

(3) First priority photos in limited quantities, usually three prints, were generally delivered by courier to corps. Deliveries could be made in eleven hours after photo reconnaissance planes had landed.[11] Quantity production could be accomplished in 24 hours. Reports indicate that these times were seldom attained.[12]

(4) Priority prints when delivered to corps were usually distributed two to the corps G-2 interpreters and one to the

corps artillery. There was no established basis for distribution of routine quantity production of photographs, but a close coordination between corps and division G-2's and artillery S-2's usually provided the artillery with a fair share of the prints available. The "fair share" actually provided little air corps photography forward of corps insofar as the artillery was concerned. That which was provided forward of corps was too old to be of any use except in static situations.[1, 3, 12]

(5) Ground liaison officers assigned to group headquarters and each squadron were responsible for briefing pilots reference the ground situation and information desired by ground force units.

(6) As an example of the number of officers and men required for an army photo center, the Third Army Photo Center consisted of 25 officers and 50 enlisted personnel. The center was located at the airfield occupied by the 10th Photo Reconnaissance Group. They performed interpretation of air photos required by units of the army, including 1st, 2d, and 3d phase photo interpretation reports. In addition they distributed photos furnished by the 10th Photo Reconnaissance Group to Third Army, its corps and divisions.[2]

13. Field Artillery Requirements.

a. Both vertical and oblique photos proved essential for use by the field artillery.[1, 3, 5, 6, 12]

b. Two types of verticals were used generally; (1) basic coverage of the battlefield with scales from 1/10,000 to 1/25,000 and (2) daily coverage of enemy installations to the depth of his long range artillery with scales from 1/6,000 to 1/10,000. The former was needed down to include battalions and because of frequent shifts of units, a constant resupply was required. The latter were most valuable to the corps artillery for counter-battery intelligence but were required and used by lower echelons whenever photos could be secured.[1, 3, 6]

c. Obliques made by high performance planes were valuable for planning and orientation of observers of all kinds, but there is a conflict of opinion as to the value or necessity of gridded obliques for use as described in appendix VI, FM 6-40.[1, 3] Obliques made using artillery air observation posts are discussed in paragraph 17 of this report.

14. Adequacy of Supply. It was felt by most commanders that the supply of air photos as to number was

adequate but that the time lag from exposure of the film over the target area to delivery of prints was excessive.[12] There were several causes for this delay. One difficulty was that communications with the squadrons taking the photos were not adequate. Another difficulty was the slowness of distribution caused by passage through too many headquarters.

15. Interpretation. A photo interpretation team was employed at each corps artillery fire direction center or command post depending upon the method of coordinating intelligence from the interpreters and the observation battalion. The interpreters were essential to the corps artillery in order accurately and quickly to confirm sound and flash locations and targets reported through other sources. Where two corps fire direction centers were employed because of wide frontages, two interpreter teams were needed. At division level it was found satisfactory to make use of the facilities of the photo interpreter team at division headquarters.[3,5,6,9]

16. Photos as Firing Charts or Supplements. There is no evidence from this theater to support the pre-war artillery demands for vertical photos to be used as firing charts. As a supplement for correcting detail on maps and charts and for planning fires, photos proved valuable at all levels.[1, 6, 9, 12]

17. Photos Made by Artillery Air Observation Posts. Theater General Board Report "Organic Field Artillery Air Observation" treats this subject in detail. Field artillery and other liaison planes can and did take oblique photographs of areas immediately along the front line. Taking advantage of local breaks in the weather, they could at times get photos when high performance planes were grounded. Delivery could be made the night of the day on which photos were taken, and distribution to include infantry platoons was possible. Artillery commanders do not feel that those photos replace air force obliques which cover areas deep into the enemy territory. However, it is believed that obliques taken by artillery planes supplement the air force pictures and are of great value to both the artillery and infantry.[3, 6, 9]

CHAPTER 3

SHELLING REPORTS

18. Background. The study of shell craters and traces to determine both direction and range to the cannon which fired the projectile cannot be considered as new technique. Studies concerning this subject had been made and reported on by the Field Artillery Board and Field Artillery School; but, like other means of target location, lack of emphasis in training prior to this war relegated this subject to the status of forgotten technique. As a matter of interest the first practical use made of shelling reports by US artillery against the Germans in this war was initiated by Captain George Morgan, S-2, of the 32d Field Artillery Battalion of the 1st Infantry Division. In December 1942 when this battalion was supporting the 78 Infantry Division (British)

at Medgez-El-Bab, Tunisia, Captain Morgan became interested in shell craters and fragments and compiled a reference manual for his own use. Later he became assistant counterbattery officer of the II Corps and by combining the results of his research with data obtained from the 1 and 8 Armies (British), he was able to produce a reference manual part of which, in one form or another, was used by counterbattery intelligence personnel in this theater.

19. Development.

a. Prior to the invasion of France, lessons learned in combat in Africa, Sicily and Italy had received wide distribution among US forces scheduled for participation in the invasion. Artillerymen in all echelons were aware of the importance of shelling reports and training reflected this attitude.

b. In addition to the training received by field artillery personnel, an intensive educational campaign was initiated by the First Army Artillery Officer to acquaint other branches with the meaning and importance of the military term "shellrep". "Shellrep" forms and complete instructions were given a wide distribution and by D-Day the "forgotten technique" had been revived.

c. The operational procedure adopted by each corps for obtaining shellreps varied after experience in combat. In some corps shellrep teams, usually consisting of two men equipped with an azimuth measuring instrument and calipers for measuring shell fragments, were required of each battalion and group headquarters. In one corps three teams per battalion were required, while in another, special emphasis was placed on forward observers and liaison officers obtaining shellreps with no special teams required.[1, 3, 9]

20. Use Made of Shellreps: The following extract from "The XII Corps in Combat", dated 13 August 1944 - 8 May 1945, outlines in detail the typical use made of shellreps at corps fire direction centers.

* * * * *

E X T R A C T

* * * * *

"8. Shellreps. A shellrep is a report of hostile shelling which contains, as a minimum, information on impact area, and the time and direction from which the shelling came. If possible, it should also include angle of fall, time shelling began and time ceased, number of hostile guns, type of shell, and fuze, number of shells, number of duds, nature of fire, target and damage. The more items included and the higher the degree of accuracy, the more value is the shellrep.

"a. Shellreps are classed as 'general' and 'team'. A general shellrep is of approximate accuracy as to target area and direction of fire. It is the kind of

report which might be expected to come from infantry or engineers or other units not primarily concerned with artillery. On the other hand; a 'team' shellrep is of surveyed accuracy (See VIII, Annex A).

"b. Each artillery battalion maintained three two-man shellrep teams, each higher headquarters had one, and the observation battalions maintained four. (Incl 3, Annex A). These teams had to be selected and trained and made responsible for their work in the same manner as a soldier filling a T/O position was responsible for his work. Direct support battalions obtained reports of shelling in areas occupied by the infantry or armor, and other battalions and higher headquarters were responsible for areas within 1500 yards of their installations. In practice, there was no limit of responsibility for other battalions and higher headquarters; in one instance, a team from the FDC drove 12 miles to get a team shellrep. The significant difference between team and general shellreps is not in the number of men making the reports but in the degree of accuracy. Several men, with insufficient training, equipment or interest might turn in a report which was so general as to be without value, whereas one man, properly equipped with measuring instruments, training and courage, turned in reports which resulted in the elimination of fire on our own troops and destruction of enemy materiel.

"c. Location of artillery by shellreps. In theory, the intersection of two or more shellrep rays of the same caliber on the counterbattery chart would indicate the presence of a battery in the vicinity of the intersection. This could not be regarded as the positive location of a battery, however. There may be two batteries of the same caliber; one somewhere along the length of each ray. Judgment, as in all phases of counterbattery work, was more important than mechanical operation. The area indicated by the intersection should be examined through some other agency: Photos, air OP's and the sound base covering the locality should be alerted. If some other source corroborated the suspicion aroused by the shellreps, there may be a profitable place to shoot.

(1) In a stabilized situation, and over a period of time, a number of shellreps may intersect in an area, and this will be fairly conclusive as to a battery location. German artillery was in the practice of moving frequently, however, and shellrep rays more than three or four days old became misleading. For this reason, the counterbattery chart was cleared periodically.

"d. Action taken on shellreps. Unless a 'sleeper' policy was in effect, prior to a preparation, a team shellrep was followed up with a fire mission. In the case of a general shellrep, an effort was made to improve the data, and if this was impossible and our troops were being bothered, a mission was fired on a battery location.

(1) A shellrep plotted on the counterbattery chart, should be an arrow pointing to an offending hostile battery. A team shellrep was regarded as being accurate within 100 mils and all hostile batteries within 100 mils of the shellrep ray were tied in. In the event that the shellrep indicated several locations, the counterbattery officer had to use his judgment and experience in determining which one was firing. Caliber, slope of fall, 'flash-bang' interval, terrain and map study contributed to the making of an intelligent decision. If the counterbattery officer was undecided between two or three likely prospects, the practice was to recommend to the S-3 that all be fired.

(2) Shellreps enabled the S-2 to gauge the volume of enemy fire. Team shellreps were necessary to determine this accurately. General shellreps, from inexperienced troops or troops not familiar with artillery, were apt to be misleading. Green troops either classed heavy shelling as 'not so bad' or, more frequently, characterized light shelling, mortar fire, or nebelwerfer fire as heavy enemy artillery fire. To correct this, areas where enemy fire could be expected were determined, and trained shellrep teams posted there. The mission of these teams was to report accurately the density of the enemy fire and to obtain team shellreps which would aid the counterbattery section in silencing the fire. These shellrep teams were maintained at all bridge sites during and after the crossing of the Sauer River into the Siegfried line. The teams were effective. They were usually posted in pairs, one team on each bank of the river at each crossing site. Communication was by both radio and wire, although messengers were sometimes used.

(3) Action taken on a shellrep was always reported to the unit submitting the shellrep. One of the officers in the S-2 section was required to telephone an officer in the unit making the report, giving a short account of what had been done, i.e., 'your shellrep number 1021 tied in with one of the sound locations, battery CD, and we are putting four battalions on it; your battalion will be one of those to fire'; or, 'your shellrep indicates

activity from an area where we had no previous information on German artillery; we have the cub planes looking that area over and have requested pinpoints'. In the latter case, if a battery subsequently was located which tied in with the shellrep, no matter how much later, the unit was given this information."

* * * * *

21. Mortar Reports.

a. Although this subject was treated by artillerymen in the same category as shellreps, it was of more special interest to the infantry. The high casualty rate caused by mortar fire and the extreme difficulty encountered in locating these weapons by ground or air observation resulted in exhaustive research for mechanical methods of location.

b. Training Circular No. 7, War Department, 21 February 1945, has as its subject counter mortar technique. The appendix to this circular explains methods of establishing approximate direction and range by examination of mortar shell craters. In combat, the "mortrep" (mortar report) described in Training Circular No. 7 proved of little value because of their inaccuracy and the time lag between the shelling and the report reaching the artillery.

22. Value of Shellrep. In summarizing, it can be stated that shellreps were not used as a primary means of locating enemy artillery but were of great value in confirming locations made by sound, photos, and other agencies. Additional personnel for shellrep teams were not required as the personnel so employed could be spared from other duties. The counter mortar organization and operation prescribed by Training Circular No. 7, War Department, 21 February 1945 was valuable for the emphasis it placed on the counter mortar problem but it did not present a solution.[1, 3, 5, 6, 9]

CHAPTER 4

MISCELLANEOUS SOURCES OF INTELLIGENCE

23. General. The focal point for all miscellaneous artillery intelligence was the corps artillery S-2 section. Battalions, groups and division artillery gathered and used all available intelligence concerning their local problems, but it was at corps that the intelligence for the "big picture" was coordinated to produce targets. Here reports from prisoner of war interrogation teams, spies, friendly civilians and other sources were studied and compared with photo, sound, radar, shellrep and other locations to give the corps artillery commander accurate target locations on which to base his fire plan.

24. Prisoner of War Reports.

a. Direct interrogation of prisoners of war by artillery personnel was seldom attempted. Reports from prisoner of war interrogation teams were normally secured through liaison with division and corps G-2 sections, however, items of intelligence of unusual interest were sometimes secured from forward observers and liaison officers who were given the information by interrogators with the infantry regiments.[2, 3, 6].

b. Prisoner of war reports were not accepted as an accurate means of locating targets but they were valuable in indicating target areas and in confirming other sources of intelligence.

25. Espionage, Captured Maps and Documents, Friendly Civilians. These three sources of intelligence are grouped together because of their common source insofar as the field artillery was concerned. These types of intelligence were always secured through G-2 channels and, like prisoner of war reports, were most valuable in confirming or indicating locations.

26. Comparison of Methods of Target Location. The chart below is a compilation of enemy battery locations made in one corps over a period of nine months when this corps was actively engaged. This record is included as a part of this report because it is the most complete data of this kind that could be found. It is believed, from a study of other records, that these data are representative of the theater. Fixed as used below means located with sufficient accuracy to warrant the placing of fire on the target.

FIXED

Date	Sound	Flash	Air OP	Photo Interpreters	Prisoners of War	Forward Observers	Other Sources	Total
Jun 44	57	5	7	7		3	19	92
Jul 44	57	10	15	51		1	1	135
Sep 44	46	5	18	6			6	81
Oct 44	14		6	11				31
Nov 44	107	5	65	137	2	3	1	320
Dec 44	191	13	36	144			1	385
Jan 45	179	16	3	91			3	292
Feb 45	81	6	16	70			5	178
Mar 45	37		3	32		1		73
Total	769	60	169	549	2	8	30	1,587

UNCONFIRMED

Jun 44	89	27	1	17	5		41	180
Jul 44	238	31	20	34			34	357
Sep 44	169	9	29	10	6		44	267

UNCONFIRMED (Contd)

Date	Sound	Flash	Air OP	Photo Inter-preters	Prisoners of War	Forward Observers	Other Sources	Total
Oct 44	103		12	36	12		25	188
Nov 44	496	54	175	142	72	3	41	983
Dec 44	461	78	206	185	43	7	36	1,016
Jan 45	433	77	47	166	27	20	11	781
Feb 45	271	35	57	184	36	1	30	614
Mar 45	204	28	26	72	7	7	15	359
Total	2,464	339	573	846	208	38	277	4,745

Bibliography

Part One

1. Artillery Conferences and Discussions on Gunnery, file 337, Artillery Section, The Theater General Board.

2. Seventh Army Artillery Officer's Conference, file 337, Artillery Section, The Theater General Board.

3. Third Army Artillery Conference, file 337, Artillery Section, The Theater General Board.

4. After Action Reports, 76th, 186th, 187th, 190th, 193d and 200th Field Artillery Battalions.

5. First US Army Artillery Information Service.

6. After Action Report, Third Army.

7. VIII Corps Report on the Brest Operation.

8. Theater General Board Study No. 66, "Organic Field Artillery Air Observation".

9. XII Corps Artillery in Combat, September 1945, file 370.2, Artillery Section, The Theater General Board.

10. Anti-aircraft Artillery Notes No. 24, Hq ETO, 4 April 1945.

11. Report on "Organization for the Control and Operation of Tac/R and P/R Facilities, dated 1 March 1945, prepared by Headquarters (Advance) XIX Tactical Air Command.

12. Answers to Questionnaire For Key Commanders on "Effects of Strategic and Tactical Air Power on Military Operations ETO", G-3 file, The Theater General Board.

THE GENERAL BOARD
UNITED STATES FORCES, EUROPEAN THEATER
APO 408

PART TWO

FIRE DIRECTION

CHAPTER 1

DEVELOPMENT OF FIRE DIRECTION

SECTION 1

GENERAL

27. Definition. Fire direction is the tactical command of one or more artillery units, for the purpose of bringing their fire to bear upon the proper target at the proper time. (FM 6-20)

28. Field Artillery in Combat. The ability of the field artillery to deliver effective massed fires with speed and accuracy over a zone of great width and depth was apparent from the first action in which field artillery participated in this war. This success was possible through the progressive development of gunnery technique between World War I and World War II, combined with a standard type training for all field artillery units.

SECTION 2

BACKGROUND

29. General. The mission of field artillery in World War I and II was the same - that of rendering fire support to the other arms.[1] Field artillery was and is considered as a supporting arm, and every effort in the improvement of field artillery technique has been toward increasing the speed and intensity of the fires delivered in support of other arms. The developments in fire direction since the last war have been one of the major improvements in field artillery technique.

30. Fire Direction in World War I. Fire direction in World War I was not so highly centralized as in the second world war. Artillery fire was flexible but because of poorer communications, slower transportation, and more cumbersome technique the maneuvering of fire could not be accomplished so rapidly. The massing of artillery fire was accomplished by massing guns rather than by maneuvering the fire of fewer guns to accomplish the same end.

31. Development in Methods of Delivering Fire.

a. In the period between the two wars the technique of fire direction was improved constantly with the greatest improvements being made in the five years just prior to the second world war.

b. In the early employment of fire direction the actual calculation of data for the guns was accomplished at the battery level. The higher artillery headquarters, from battalion to brigade, designated how, when, and where the fire would be placed. This procedure worked very well, but the decentralization of the computation of data to batteries and the use of tabular firing tables instead of graphical firing tables slowed the deliver of fire.

c. The first steps away from the decentralization of computation of firing data came with the battalion operating the firing chart and sending range, deflection, and altitude to the batteries to be converted into firing data for the guns. This procedure speeded up the delivery of fire.

d. The final steps in the improvement of delivery of fire came when computation of firing data was centralized at battalion level. This procedure speeded the deliver of massed fire. Further, with the advent of graphical firing tables and better communications, the delivery of artillery fire was possible in a matter of minutes. The intensity of the fire depended upon the number of battalions centralized under the control of one commander.

32. Improvement of Transportation. The other factor vital to fire direction was the necessity for commanders to be able to maneuver artillery units. The ability of commanders to move artillery units rapidly where and when required by the situation improved in direct proportion to the improvements in speed and durability of artillery transportation. Since the improvement in transportation between the two wars followed the transition from horse-drawn to powerful motor vehicles, the strategical and tactical mobility of field artillery in this war was far superior to that in World War I.

SECTION 3

LEVELS OF FIRE DIRECTION

33. General. Fire direction, or the maneuver of artillery fire, is possible throughout all echelons of artillery from battery to army. The methods of accomplishing fire direction at the various levels of artillery command are dependent on numerous factors. In order that fire direction in all echelons of field artillery may be better understood, the means of accomplishing it in each command are discussed below.

34. Battalion Fire Direction. The battalion commander is the commander most intimately concerned with the details of fire direction. His fire direction functions result in the translation of the general fire missions of higher commanders and the requests for fire by observers into firing data for the batteries. (FM 6-101)

35. Division Artillery Fire Direction. The division artillery commander directs the fire of the division artillery by organizing the artillery for combat; by assigning position areas; by assigning zones of fire; by designating

specific important targets or areas to be covered by fire; by procuring and allocating ammunition; and by coordinating fires and displacements. (FM 6-100)

36. Group Fire Direction. The fire direction responsibilities of the group commander are the same as those for the division artillery commander except that some of the group commander's functions may be prescribed by the corps artillery or other artillery commander under whom he is operating.

37. Brigade Fire Direction. The fire direction responsibilities of the field artillery brigade commander are the same as those of the group commander. However, the brigade commander will be concerned with groups of artillery in addition to battalions.

38. Corps Fire Direction. The corps artillery commander controls the fire power of corps artillery by organizing the artillery for combat; by assigning position areas; by assigning and coordinating zones of fire to insure the massing of fire in support of the corps action; and by coordinating fires, registrations, survey, communication, observation, and displacements. The degree to which fire direction is exercised depends primarily upon the degree to which operations are centralized. (FM 6-100)

39. Army Fire Direction. The army artillery officer is not an artillery commander. However, he exercises fire direction in that he recommends to the army commander the allocation of artillery and artillery ammunition to subordinate units.

SECTION 4

FIRE DIRECTION TECHNIQUE

40. Training Literature.[2, 3, 4, 5, 6] The policies and procedures of fire direction technique prescribed in War Department field manuals are basically sound and were followed generally by all field artillery units in this theater. However, a discussion of certain phases of this technique which were employed more than others will aid in training and in preparing training publications in the future. Further, some units contrived certain modifications of standard procedure which have merit and will be discussed in order that they may be further tested for their training and combat value.

41. Fire Direction Centers. The functions and duties outlined in training literature for fire direction centers were used throughout the European campaign. The chief difficulty encountered by fire direction centers was a deficiency in numbers of personnel to perform 24 hour operation.[7] Also, when a corps was operating on an extended front, some corps artillery commanders found it necessary to operate two corps artillery fire direction centers in order to maintain centralized control.

SECTION 5

MASSING OF FIRES

42. Forms of Fires.

a. Both concentrations and barrages were fired continually throughout the war. The use of concentrations was predominant, while the use of all types of barrages was limited.

b. Two types of standing barrage, normal and emergency, were prepared each time friendly troops were not moving. The use of the rolling barrage was limited because of excellent means of target location and the shortage of ammunition. A box barrage was used in a few instances to extract friendly troops from a precarious situation.

43. Prearrangement of Fires.

a. The high degree of centralized control reached in several phases of the war permitted the maximum use of prearranged fires. This was particularly true in all defensive and most large scale offensive actions. The planning of prearranged fires was carried on simultaneously at three levels of command: the infantry regiment (or other unit) with the direct support artillery battalion, division with division artillery, and corps with corps artillery.[8] The coordination of these plans was accomplished by manipulating reinforcing missions, ammunition allotments or extending the time that fire units are available to a planning headquarters. This process eliminated the time consuming process of passing fire plans up and down through the various higher artillery headquarters.

b. The assignment of prearranged fires to units was usually prepared in a tabular form similar to those shown in FM's 6-40, 6-100, 6-101, and 6-105. However, the assignment of fires by overlay alone was not considered sufficiently accurate because of variations in assembly of maps and the stretching or shrinking of overlay paper.

c. Few corps artilleries made any attempt to assign blocks of numbers for concentrations to division artilleries or corps groups. Concentrations were usually assigned by eight digit coordinates and the lower unit assigned the number. However, division artilleries and groups did use the block of numbers system in the numbering of concentrations.

d. Planned fires were effective in relation to the number and accuracy of located targets and the accuracy of the gunnery, but another factor was the ability of artillery staff officers to select concentrations most appropriate for preparations, counter-preparations, barrages, and other planned fires. It was felt that artillery staff officers should receive more training in this subject so that they could exhibit better judgment and speed in the selection of concentrations, calibers, and ammunition most appropriate to the mission at hand.[9]

44. Attack of Targets.

a. In the attack of targets, the method of attack, the number of battalions to fire, and the amount of ammunition to be expended were dependent on three major considerations:

(1) Size and nature of target.

(2) Accuracy of chart location of target.

(3) Ammunition supply.

Units had varying experiences in the attack of targets, and only certain general lessons are presented.

b. Amount of ammunition to be expended:

(1) In the attack of targets such as towns, enemy batteries, troops near shelter, etc., with medium and heavy artillery, two volleys initially are about all that will produce casualties.[8] A repeat of this fire by single volleys at irregular intervals will possibly produce more casualties. This procedure will be more conservative of ammunition consumption and produce as many casualties as firing an initial five or six volleys.

(2) The above procedure does not apply to fire on troops in the open nor fire for destruction, where fire is continued until complete neutralization or destruction has been accomplished.

c. Choice of fuze to be used:

(1) The choice of fuze to be used in the attack of targets presents many possible variations. When fired on towns, a mixture of fuze quick and fuze delay was very effective. The quick fuze produced casualties on troops in the open, and the delay fuze penetrated buildings.

(2) A preponderance of the quick fuze was used in the attack of enemy batteries since destruction could rarely be accomplished unless the fire was observed.

(3) The Pozit fuze and time fire were used on troops in the open and to deny the enemy the use of bridges, roads, and various critical points in their lines of communication.

d. White phosphorous was used extensively in towns and cities where resistance was heavy to start fires and blind the enemy. Base ejection smoke was used for screening in open ground but was not too satisfactory for

screening in heavily wooded areas.

e. Light artillery was of little value in destruction missions on towns or even light fortifications. Medium and heavy artillery using the T-105 fuze was very effective in accomplishing destruction missions.[10, 11]

45. Serenades.

a. Higher commanders found it necessary to develop a quick method of massing all available artillery fire in extreme emergencies when lack of time precluded prearrangement of fires. There were several names and procedures for these types of fire, but the most common name and procedure used was called SERENADE. This type mission was controlled entirely by radio.

b. The firing of this type mission could be authorized only by the corps, division, or group artillery commander. The commander making the authorization had to insure that the target warranted the expenditure of the ammunition and that the map location of the target was sufficiently accurate to produce the desired results. The mission was fired either "When Ready" or by designating a time for all battalions engaged to have fire on the target simultaneously.

c. Several outlines of the procedure used are enclosed in this report as Appendix 1.

46. Time on Target.

a. Another method to get quick massing of fire on critical targets was called TIME ON TARGET (TOT). This procedure was very similar to the SERENADE, but the fire mission was usually controlled by telephone and the rounds for all units were to land on the target simultaneously.

b. This method of fire required frequent syncronization of time and the determination of time of flight of projectiles for all units.

47. Miscellaneous.

a. Safety precautions with the Pozit fuze:

(1) Beginning with the use of the Variable Time (Pozit) fuze in December 1944, it became necessary to prescribe certain safety precautions. These precautions were necessary because of the proximity functioning of the fuze which required certain clearances from friendly troops and aircraft.

(2) Lack of a thorough understanding of the functioning of the fuze caused some commanders to be overly cautious with its use while others ignored its dangers completely. No single standing operating procedure was used for the theater as a

whole. Examples of standing operating procedures for the use of the fuze are included as Appendix 2.

b. In order to prevent firing on friendly troops and to prevent the slowing down of the delivery of fire because of excessive checking between units, divisions were required to establish No Fire Lines. This line was established from 500 to 1,000 yards in front of all friendly troops and was changed with the situation. Corps and adjacent division artillery were permitted to fire beyond the line without prior clearance from the division concerned. On the other hand, corps and adjacent division artillery could fire inside the line only upon clearance or request from the division concerned. This procedure did not substitute for good knowledge of the situation but served as an expedient for the safe and rapid delivery of artillery fire.

CHAPTER 2

CONDUCT OF FIRE

SECTION 1

GENERAL

48. General.

a. The percentage of missions and ammunition fired on targets by observed and unobserved methods varied with each battalion, division, and corps. Further, a comparison of percentages between divisional and non-divisional artillery will show an even greater variation. This variation is due primarily to the differences in missions and intelligence agencies of the units.

b. Any attempt to compile an accurate figure on the number and percentage of missions fired by the two methods would be erroneous in that the two methods overlap each other and a fine dividing line cannot be established. An example of t is is that, whenever possible, surveillance is given on all prearranged fires which are normally considered to be unobserved fires.

49. Example of Missions Fired. In order to give a rough approximation of missions fired by type and percentage, the following summary of missions fired by the XV Corps Artillery in three type operations is quoted:[11]

a. Luneville - Strasbourg, 26 October to 22 December: (Stabilized situation followed by assault of strongly prepared position, pursuit to Strasbourg ending 1 December followed by advance to, and attack of, fortifications at Bitche).

Fire Missions		Percentage Observed	Percentage Unobserved
Registration	518		
Neutralization	3523		

Fire Missions		Percentage Observed	Percentage Unobserved
Destruction	330		
Harassing	3,160		
Interdiction	1,152		
Total	8,683	17.75	82.25

b. Defensive situation 22 December to 13 March:

Fire Missions		Percentage Observed	Percentage Unobserved
Registration	887		
Neutralization	4,651		
Destruction	233		
Harassing	6,044		
Interdiction	624		
Total	12,439	24.72	75.28

c. Spring offensive 13 March to 22 March:

Registration	183		
Neutralization	1,246		
Destruction	44		
Harassing	1,231		
Interdiction	469		
Total	3,173	12.19	87.81

SECTION 2

OBSERVED FIRES

50. General.

a. In order to give an insight into the percentages of observed fire missions by type of adjustment, a further breakdown of the XV Corps Artillery observed fire missions listed in paragraph 49 above are quoted:

(1) 26 October to 22 December:

Observed Missions		Percentages
Ground OP	700	45.4
Air OP	705	45.7
Radar	99	6.4
Flash	38	2.5
Total	1,542	

(2) 22 December to 13 March:

Ground OP	1,368	44.6
Air OP	889	29.0
Radar	786	25.7

Flash	22	.7
Total	3,065	

(3) 13 March to 22 March:

Ground OP	114	23.4
Air OP	268	55.0
Radar	105	21.6
Flash	0	0.0
Total	487	

b. It is apparent from the figures quoted above that the percentage of targets fired upon by observed fire methods will vary with the type of action in which the unit is participating. Note also that those missions fired by ground observation include both forward observation posts and static observation posts.

11

51. Static Observation.

a. The percentage of missions conducted from static observation posts is very small. And further, the number of missions conducted by methods other than forward observation methods is even small because conventional methods were seldom used except for registrations and precision fires.

b. The infrequent use by observers of axial, small-T or large-T methods of adjusting fire is attributable to several factors.

(1) Many observers had had only three months course in artillery with very little practical application of conduct of fire to entry into combat.

(2) Observers who had very little experience in the conduct of observed fires were inclined to fall back on a method which required no calculation of factors on their part.

(3) Observers were exposed to the elements as well as enemy fire and were prone to use the forward observation methods, This was brought about by the fact that the battery or battalion computers were in a relatively safe and comfortable location to perform the calculations for the observer.

(4) Experienced observers insisted that adjustments could be made as rapidly using forward observer methods as by conventional methods.

(5) The availability of excellent maps made it easy for observers to designate their targets by coordinates and not have to

bother with the calculation of data necessary to adjust fire by other than forward observation methods.

52. Forward Observers.

a. The preponderance of fire adjusted from ground observation posts was by forward observation methods. This was brought about by the conditions referred to in paragraph 51 b above.

b. It was found that the best adjustments by forward observation methods were conducted by those experienced observers who were well versed in the conventional methods of adjustment by axial and lateral procedures. Those observers who were not familiar with axial and lateral procedures were slow in obtaining adjustments and thus wasted valuable ammunition and time in placing fire on the targets.

c. The methods used for target designation and adjustment of fire were the same as those quoted in FM 6-40. The great preponderance of target designation was by map coordinates. Forward observers, in some cases, supplemented maps with marked or gridded vertical and oblique photographs which could be used in designating targets if the fire direction center possessed the same marked or gridded photograph.

53. Artillery Air Observation Posts.

a. The value of the field artillery air observation posts as a means of adjustment of fire cannot be overestimated. The percentage of observed fires conducted from air observation posts given in paragraph 50 above gives only a rough estimate of their value since there were only one-fourth or one-fifth as many air observation posts available as there were ground observers.

b. Designation of targets and conduct of fire from artillery air observation posts was generally as prescribed in FM 6-40. Designation of targets was usually by map coordinates. Air observers used both the 1/50,000 and 1/100,000 maps for obtaining target location. The 1/25,000 map required too many sheets for use in a plane. Shifts from a base or check point or a previously fired concentration were also used in target designation.

c. Most units used assigned observers to conduct fire from air observation posts. Trained observers were necessary in order to expedite the adjustment of fire and also to conserve ammunition. Again, those observers who were well trained in conducting fire by axial and lateral methods were the best observers.

d. For a more detailed report on the air observation posts see Theater General Board Study No. 66, "Organic Field Artillery Air Observation".

54. Radar Adjustments.

a. A new method of adjusting fire in this war was the use of radar. This method was tested by the XV Corps

Artillery using antiaircraft artillery equipment and personnel. (See paragraph 10). The number of missions fired by this procedure, see paragraph 50 above, shows that the method is in need of thorough investigation and development.

b. It must be appreciated that missions fired by radar are observed fire missions because of the line of sight characteristics of radar.

c. The SCR 584 set was used in the tests and missions fired. In these tests the radar did not actually adjust the artillery fire but located the target and gave the artillery the location by coordinates. Further, only moving targets were located. (See paragraph 10).

d. For a more detailed report on this subject see "Antiaircraft Artillery Notes #24", Headquarters European Theater of Operations, dated 4 April 1945.

55. Sound and Flash Adjustment of Fire. For a complete report on adjustment of fire by sound and flash methods see Theater General Board Study No. 62, "Study of Field Artillery Observation Battalions".

56. Special Observed Fires. The adjustment of artillery fire by other arms and the adjustment of naval gunfire by field artillery has brought about two techniques entirely different from normal field artillery procedures. These two techniques are: (1) adjustment of artillery fire by high performance aircraft, and (2) adjustment of naval gunfire.

a. Artillery fire was adjusted by high performance aircraft with the general procedure outlined in FM 6-40. The results obtained from this method of adjustment varied with the preponderance of the missions failing to obtain the desired results. Excluding interference by enemy aircraft and antiaircraft, the reasons for failing to complete missions may be summarized as follows:[11, 12, 13, 14]

(1) Communications difficulties.

(2) Observer failure to locate target or rounds fired.

(3) Observer's lack of knowledge of field artillery gunnery procedures. This was due primarily to constant rotation of air force personnel.

On the other hand, those missions which were completed, such as the registration of long range artillery, proved very valuable and could have been accomplished only by high performance aircraft.

b. The adjustment of naval gunfire by ground observers was employed in amphibious operations in this theater. The adjustment was carried out by specially trained Naval Shore Fire Control Parties. The method of adjustment is the same as given in FM 6-40. However it

must be noted the naval method of adjusting fire on ground targets is not the same as the field artillery method in that the navy uses commands rather than sensings. This variation in procedure requires some special training of observers for the adjustment of naval gunfire.[15]

SECTION 3

UNOBSERVED FIRES

57. Preparation of Data.[8,11]

a. Owing to the availability of excellent maps in this theater, the most effective method of determining data for unobserved fires was map data corrected. Target location was always determined by the most accurate means available, which included survey, previous firing, restitution from air photographs, sound and flash, map inspection, and radar.

b. These data were prepared by the standard methods outlined in training literature. For more details on the firing charts used see paragraphs 65-67 below.

58. Registrations.

a. There were few times in this theater when registrations were restricted because of the tactical situation. Prior to large scale attacks, for which large amounts of artillery were massed, registrations were sometimes controlled for intelligence reasons. The following statement from "XII Corps Artillery In Combat" is considered as the typical experience of most corps artilleries:[8, 11]

* * * * *

E X T R A C T

* * * * *

"(5) At no time during the nine months of operation was registration ever definitely prohibited by higher headquarters. Consequently, battalions registered immediately after occupation of a new position, visibility permitting. Daily check registrations were conducted as long as the battalion occupied the same position. The majority of registrations were conducted by an air observer. If the battalion occupied position too late in the day for ground or air observation, registration was conducted by a flash base of the observation battalion."

* * * * *

b. Sound registrations conducted by observation battalions were not considered sufficiently accurate for the delivery of unobserved fires.[16]

c. Corps and division artillery frequently checked battalion registrations and survey by having the battalions fire on selected terrain features within transfer limits of their registrations. This procedure increased the accuracy of massed fires.

59. Corrections.

a. Registrations were the chief source of corrections. Those units that had wide frontages to cover usually had check point registrations in each part of their sector.

b. The SCR 658 directional radio for determining meteorological data was not available in this theater until after the close of combat. Thus, corps observation battalions and division artillery continued to use the pilot balloon method. However, meteorological data determined by Air Corps Mobile Weather Detachments and antiaircraft artillery units was converted to field artillery metro messages by the corps observation battalions. The old type (seven figure) metro message was used in most instances. Metro corrections were computed for determining VE's (Velocity Error) to be used when registration was impossible. Map data corrected by metro data alone was not fired except in emergencies.

c. Several units constructed slide rules similar to the Graphical Firing Table for the mechanical computation of corrections from metro messages. These and many other devices were devised to make the calculation of data mechanical rather than manual.

8, 11, 14.

60. Accuracy.

a. All field artillery fire was delivered with the most accurate data available. The inaccuracies that enter into field artillery fire may be divided into two classes:

(1) Errors. These represent sources of inaccuracy inherent in the weapons, instruments, ammunition and external conditions.

(2) Mistakes. These represent inaccuracies due to wrong target designation, poor gun drill, faulty sight settings, wrong reading of data from firing charts, etc. Mistakes are also referred to as "human errors".

b. Too many forms and types of errors that concern the accurate delivery of field artillery fire are technical subjects involving design and will not be discussed. However, one of these factors which was vital to field artillery in this war and is capable of being rectified is the issue of mixed lots of ammunition to units in combat. The attempt at segregation of lot numbers was a major problem for all field artillery battalions. Field artillery ammunition supply in this theater is discussed in detail in Theater General Board Study "Report on

Ammunition Supply for Field Artillery".

c. The mistakes which occurred in combat may be attributed primarily to design of equipment and training.

(1) The improvement of the design of sighting, laying, and computing equipment is under constant study by both the supply services and the field artillery. Recommendations for changes in or alterations of field artillery equipment or materiel are icluded in Theater General Board Study No.67, "Study of Field Artillery Materiel and Supply".

(2) In order to eliminate those mistakes which occurred because of improper or insufficient training a system of independent checks was necessary at all echelons responsible for the computation of data for and the deliver of artillery fire. This reduced the number of errors but did not eliminate them. Mechanical means of computing data were beneficial in the elimination of mistakes.

CHAPTER 3

SURVEY

61. General.[8, 12]

a. Survey control of France, Belgium, Holland and Germany had been completed by civilian and army agencies of the listed countries. The area and nets of this control had been adjusted and the positions placed in the proper grid zone. This information was available to allied forces in the form of trig lists which were assembled on a map series basis.

b. The trig lists mentioned above were made available to army groups and armies as SHAEF trig points. These points were of an accuracy of plus or minus ten meters which did not affect the accuracy required for field artillery use.

62. Army and Corps Engineers.

a. The army and corps engineer survey responsibilities were tied together with field artillery survey. The Third Army plan for the recovery and extension of survey control as applies to the army and corps engineers is quoted as a method of their use:

* * * * *

E X T R A C T

* * * * *

"2. Organizations:

"a. Topographic Section (Engineer Section).

"b. Army Survey Center (Survey Platoon, Engineer Topographic Battalion).

"c. Survey Information Center (Corps Survey Platoon and Observation Battalion Groups).

"3. Responsibilities:

"a. The topographic Section will assemble, evaluate and distribute the trig lists for the Army operational areas.

(1) It will supervise and direct the activities of the Army Survey Center.

(2) It will file copies of all new, revised and captured trig data as obtained or produced by army units within this plan, sending the original of these lists to Director of Survey, SHAEF, for examination, check and conversion, if considered necessary, into trig lists (SHAEF).

"b. The Army Survey Center will be responsible for the recovery and extension of points comprising the major net.

(1) It will furnish Corps with points with which to start lower order nets.

(2) It will establish azimuth and furnish to Corps the angles of declination between true azimuth and grid azimuth for each area of change.

(3) It will act as a reserve to help Corps SIC when necessary.

(4) It will tie in Corps nets where differences exist.

(5) It will supply control to artillery units retained under Army control. This may or may not be accomplished together with an FA observation battalion.

"c. Survey Information Center (SIC).

(1) Will extend lower order survey, from the major net furnished by Army Survey Center, to Corps, Division and Battalion areas.

(2) The SIC will be in charge of the CO of the Field Artillery Observation Battalion. The Engineer Survey Platoon (Corps) will be attached to the SIC as needed. It will be the responsibility

of the Army Engineer to see that its functions are performed in accordance with the general scheme of the plan. It will be the responsibility of the CO, Field Artillery Observation Battalion, that the talent of the Survey Platoon be utilized in the mission as set forth in paragraph 3 c (1) above and not used as a check on work done by artillery personnel."

* * * * *

b. The methods used by engineer survey personnel were those to conform with standard practice for 1/5,000 accuracy or better. Azimuths were based on or checked by star or sun observation.

63. Corps Artillery Survey. Corps artillery survey control was executed by survey parties of the observation battalion(s) assisted by the corps engineer topographic platoon. The details of the execution and dissemination of corps survey control are discussed in Theater General Board Study No. 62, "Study of the Field Artillery Observation Battalion".

64. Division Artillery Survey.

a. Corps trig lists were furnished the division artillery which in turn forwarded them to battalions. When additional control was required by division from corps artillery, the specific control desired was requested from corps artillery survey information center.

b. Division artillery survey usually consisted of lines of transit traverse using either star or sun azimuths. Triangulation was used in rough terrain and to carry control into the target area.

c. Battalion survey was usually directional transit lines to batteries with distances being determined by taping or stadia. Battalion survey computations were made by logs or slide rule. When battalion needed additional control, the request was made to the division artillery survey officer.

d. The lack of initial survey control in any artillery echelon did not slow the initiation of survey within that echelon. Each artillery echelon initiated its own survey which, if time permitted, was tied into a common control by the next higher headquarters.

CHAPTER 4

FIRING CHARTS AND PLOTTING EQUIPMENT

65. General. Firing charts for field artillery are used at all artillery levels from battery to corps. The size and type of chart maintained varies with each level. The firing charts at corps, division, brigade, and group artillery were not used for the actual computation of data for guns but were used to show the positions and fire

capabilities of the battalions and for the assignment of fire missions. The firing charts at battalions and batteries were used for the actual computation of firing data for the guns.

8, 11.

66. Maps.

a. Maps, when available, were used for firing charts at all fire direction centers. The maps most commonly used in this theater for firing charts were of 1/25,000, 1/50,000 and 1/100,000 scales. Maps of at least one and usually all these scales were available to units throughout this theater of operations.

b. Corps, division, brigade, and group artillery fire direction centers usually used the 1/50,000 map for a firing chart. This scale was found to be the most convenient in that it was small enough to cover wide corps and division fronts and also large enough to show the battalion fire capabilities distinctly. If the 1/50,000 map was not available, either the 1/25,000 or 1/100,000 scales were satisfactory.

c. Battalion and battery fire direction centers usually used the 1/25,000 grid sheet for the computation of horizontal control operator data, and the 1/25,000 map for vertical control operator data. When 1/25,000 scale maps were not available for vertical control, either the 1/50,000 or 1/100,000 scale maps were used. When the 1/100,000 map was used for vertical control, the map altitudes and grid sheet range were used for computing site.

67. Grid Sheets. Grid sheets of 1/25,000 scale were habitually used for determining horizontal control by battalion and battery fire direction centers. This procedure was found to be the most accurate because of shrinkage of maps and errors occurring in the assembly of maps.

68. Plotting Equipment. Standard issue plotting equipment was used throughout this theater. Some units used certain modifications of this equipment which are discussed in detail in Theater General Board Study No. 67, "Study of Field Artillery Materiel and Supply".

Bibliography

Part Two

1. FM 100-5.

2. FM 6-20.

3. FM 6-40.

4. FM 6-100.

5. FM 6-101.

6. FM 6-105

7. Theater General Board Study No. 59, "Organization and Equipment of Field Artillery Units".

8. XII Corps Artillery in Combat, September 1945, file 370.2, Artillery Section, The Theater General Board.

9. Seventh Army Artillery Officer's Conference, file 337, Artillery Section, The Theater General Board.

10. After Action Report, VIII Corps, BREST Operation.

11. Artillery Conferences and Discussions on Gunnery, file 337, Artillery Section, The Theater General Board.

12. After Action Report, Third Army.

13. First US Army, Artillery Information Service, 4 July 1944.

14. Third Army Artillery Conference, file 337, Artillery Section, The Theater General Board.

15. Naval Gunfire Support and Allied SOP, Naval Task Force 122.

16. Theater General Board Study No. 52, "The Field Artillery Observation Battalion".

PART THREE

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 1

CONCLUSIONS

69. Target Location. That prior to participation in combat target location did not receive sufficient emphasis in the training of field artillery personnel.

70. Forward Observers.

a. That the number of field artillery forward observers employed was based on the number of infantry and tank companies being supported.

b. That each infantry or tank company should be accompanied at all times by at least one artillery observer and party.

71. Field Artillery Air Observation Posts.

a. That liaison type aircraft organic to field artillery units proved to be invaluable for intelligence and adjustment of fire.

b. That artillery air observation posts were employed successfully in making oblique air photos to supplement air force photos.

72. Sound. That sound ranging proved a valuable source of intelligence but was not considered sufficiently accurate for the adjustment of fire.

73. Air Photos.

a. That air photos were furnished in sufficient types and quantity generally.

b. That the time from the exposure of the film to the delivery of air photos to ground units was excessive.

c. That photo interpretation teams were essential at corps artillery level.

74. Shell Reports. That shell reports were a valuable means for checking and confirming other intelligence agencies.

75. General Intelligence. That the practice of making the corps artillery fire direction center the focal point for all types of intelligence proved successful in combat and permitted the maximum use of such intelligence.

76. Variable Time Fuze (Pozit). That the use of the variable time (Pozit) fuze was handicapped by unnecessarily strict and cumbersome safety requirements and standing operating procedures which delayed or prohibited its being fired.

77. Adjustment of Observed Fires.

a. That conduct of fire by conventional methods (axial and lateral) was not used extensively.

b. That conduct of fire by forward observation methods was used successfully and extensively, but the efficiency was impaired by the lack of trained observers.

c. That observers trained in the conventional methods of conduct of fire were the most adept in adjusting fire by forward observation methods.

78. Radar. That first tests indicate that radar can be used as a means for locating moving ground targets and in the adjustment of field artillery fire.

79. Adjustment of Fire by High Performance Aircraft.

a. That adjustment of long range field artillery fire by high performance aircraft was completed in many cases, and that the adjustment in these cases could not have been performed by any other means available.

b. That the chief reasons for failure to complete adjustment of fire by high performance aircraft were due to: (1) Communications difficulties, and (2) observers lack of knowledge of field artillery gunnery procedures.

80. Adjustment of Naval Gunfire by Ground Observers. That adjustment of naval gunfire in support of ground action was successfully used, but the variations in technique of adjustment between the navy and ground forces required some special training for observers.

81. Accuracy of Fire. That inaccuracies in field artillery fire, other than those inherent technical inaccuracies of materiel and ammunition were attributable to:

a. Issue of mixed lots of ammunition to field artillery units.

b. "Human errors" in the computation of data for the guns and the setting of the data on the guns.

82. Planning of Fires. That fire plans were developed simultaneously at battalion, division and corps level and not as outlined in current field artillery training literature.

CHAPTER 2

RECOMMENDATIONS

83. Forward Observers. That the ratio of forward observers and parties be one per infantry rifle company or similar unit.

84. Air Photos.

a. That the procedure for obtaining air photos for ground units be revised to assure delivery of photos in time for them to be of value.

b. That division and corps artillery be furnished photographic equipment for taking and reproducing in limited quantities "close in" oblique photos.

85. Radar. That research and developments be continued on radar equipment for location of ground targets and the adjustment of field artillery fire.

86. Fire Direction.

a. That a combined board comprised of field artillery, army air force and navy personnel be appointed by the War and Navy Departments to standardize methods of adjusting terrestrial fire.

b. That experiments be initiated at the Field Artillery School to determine the feasibility of each of the following:

(1) Separation of observation and conduct of fire, i.e., observers make sensings which do not include estimation of distances and computers at fire direction center conduct the problems based on these sensings.

(2) Combining forward observer and conventional methods of conduct of fire to permit all type problems to be fired using sensings or commands in yards without disregarding the factors involved. For example, the student will be taught the significance of factors but will be required to bracket both target and line by giving the proper sensing or command in yards.

87. Variable Time Fuze (Pozit). That safety regulations covering the employment of the variable time (Pozit) fuze be published by the War Department.

88. Planning Fires. That field artillery training literature pertaining to planning fires be revised to include the principle that fire plans are developed simultaneously at battalion, division and corps level and the reasons for planning fires in this manner.

89. Ammunition.

a. That efforts be made in ammunition production to reduce to the minimum the differences in ballistic characteristics between ammunition lots.

b. That ammunition be issued by lots to field artillery units.

90. Mechanical Computation and Transmission of Data. That tests be initiated for the development of equipment for the mechanical computation and transmission of firing data.

ANNEX NO. 1

THIRD UNITED STATES ARMY

* * * * * 22 April 1944

E X T R A C T

* * * * *

OPERATIONS MEMORANDUM)
:
NUMBER 1)

SERENADE

"1. The purpose of the procedure outlined herein, which will be designated as SERENADE, is to expedite the massing of all available fires within a corps sector in extreme emergency when lack of time precludes prearrangement of fire. The following SERENADE procedure will be followed by all units of this command.

"a. Normally a request for SERENADE will originate with a forward observer who transmits to the battalion fire direction center the following:

		Example
(1)	The code word SERENADE, which indicates that three (3) volleys are to be fired.	SERENADE
(2)	Coordinates of the center of the area to be covered.	J301794
(3)	Nature of target.	40 tanks

"b. The battalion fire direction center will transmit the request by telephone to the division artillery fire direction center. If the division artillery commander (or corps artillery group commander) or his authorized representative decides that the target warrents calling for fires in addition to those of his divisional (or group) artillery, he transmits over the corps artillery radio net to the corps artillery fire direction center his request for SERENADE. He includes the desired time at which the concentration is to fall. Normally Corps and Division Artillery Commanders should realize that an allowance of ten to twelve minutes must be made to insure that all battalions will be ready, and more time will be required if checks are necessary. Time must be synchronized periodically and each battalion firing will make its own allowances for time of flight so that all projectiles arrive simultaneously in the target area. If surprise fire is not desired because of the exigencies of the situation, the words 'When ready' will be used and firing commenced as soon as possible. Example of division (or corps group) artillery request for SERENADE:

Appendix 1.

SERENADE

J301794

40 tanks

1435 (or 'When ready')

"c. If the target is deemed sufficiently profitable, the corps artillery fire direction center assigns the mission to all headquarters whose fire capabilities permit, and who are not engaged on a more important mission. (Note: All corps and division artillery units will have been alerted upon hearing the transmission for SERENADE over the corps artillery radio net.)

"d. Firing procedure:

(1) Each battalion, firing with its normal sheaf, and centered on the coordinates given, fires three (3) volleys at center range.

(2) Targets of more than 400 yards in width or depth are covered by including an additional set of coordinates in the request for SERENADE. When more than one set of coordinates are given, the method of attack will be in the order announced.

"e. If the forward observer decides that it is necessary to continue the firing on the target, he reports 'REPEAT SERENADE'. The battalion fire direction center will relay the request by telephone to the division artillery (or corps artillery group) fire direction center. If the division artillery commander (or corps artillery group commander) or his authorized representative decides the request is warranted, he will transmit over the corps artillery radio net 'REPEAT SERENADE'. Each battalion previously assigned the mission will repeat the firing without delay or further confirmation unless directed otherwise by its higher artillery headquarters.

"f. Extreme care must be exercised to insure the accuracy of location on any request for SERENADE. This is the responsibility of commanders of all echelons handling such requests. They will be responsible that the coordinates given are accurate and that friendly troops are not endangered by the shoot. In addition, they are responsible that the requests are justifiable, and that the target warrents such an expenditure of ammunition. If there is any question as to the location of the target and adjustment of fire is necessary the mission then becomes one not of SERENADE but of adjustment and a request for additional fires and reinforcement."

By command of Lieutenant General PATTON:

/s/ R. W. Hartman
/t/ R. W. HARTMAN
Lt Col., A.G.D.,
Asst. Adj. Gen.

DISTRIBUTION:
"H"

* * * * *

XII CORPS

* * * * *

E X T R A C T

* * * * *

STANDING OPERATING PROCEDURE
ARTILLERY WITH THE XII CORPS

SCR 193 SERENADE NET

"1. The purpose of the SERENADE NET is:

"a. To expedite massing of fires of artillery with the Corps.

"b. To transmit flash antitank or antiaircraft warnings.

"2. The SERENADE NET is a special set. It does not eliminate either the command net or the fire direction net normally employed between each headquarters and the subordinate units of that headquarters.

"3. The SERENADE NET is used for 'Serenade' missions and for 'Hitler' missions.

"4. 'Serenade' missions are called for when the target is to be hit with all available fire. All available fire is considered to be that which can be delivered:

"a. At the time specified if the fire called for is TOT.

"b. Within 15 minutes of the time of broadcast, if the fire called for is not a TOT.

"5. 'Hitler' missions are same as for 'Serenade' missions except that the target is to be hit with light and medium artillery only.

"6. 'Serenade' missions are broadcast only by:

"a. Corps FDC.

"b. Division artillery and field artillery group headquarters for critical fires. See par. 12b (2), Annex No. 3 (arty) to XII Corps SOP.

"7. 'Hitler' missions are broadcast only by:

"a. Corps FDC.

"b. Division artillery and field artillery group headquarters for critical fires or nebelwerfer targets.

"c. Direct support battalions for nebelwerfer targets.

"6. Other than authorized above, stations do not transmit except as follows:

"a. All stations transmit when reporting into or leaving the net, or in answer to a specific call.

"b. Division artillery and group headquarters transmit receipt for time synchronization broadcasts.

"c. Any station may transmit flash antitank or antiaircraft warnings.

"d. Any station may transmit messages or fire missions other than 'Serenade' or 'Hitler' in emergencies and when other communications are not working. Specific calls are used.

"9. Requests for 'Serenade' or 'Hitler' missions are not transmitted on the SERENADE NET, except under the provisions of par. 8d above.

"10. It is essential that the SERENADE NET be kept in a high degree of efficient operation. Receipt of missions is not acknowledged in the SERENADE NET. To insure effective operation and to inform broadcasting headquarters of the fire delivered, the following procedures are prescribed:

"a. Each battalion, whose capabilities of fire include the target, reports action taken to the next higher headquarters, which in turn reports to initiating headquarters.

"b. Each headquarters above battalion level is responsible for the synchronization of time in its units as well as for their effective operation in the SERENADE NET. A check of receipt of time synchronization broadcast under the provision of par. 8b above, by other means of communication than the SERENADE NET, is an effective means of checking the SERENADE NET.

"11. Some Corps battalions are not in the SERENADE NET due to lack of equipment. Lists of such battalions are published periodically. The next higher headquarters of such battalions transmit the 'Serenade' or 'Hitler' mission to them using any available means of communication. In addition, such battalions may receive the missions through other means, such as from liaison officers, reinforced units, etc.

"12. If fire is desired by certain designated battalions only, the SERENADE NET is not used, unless there is no other adequate means of communication.

"13. If 'Serenade' or 'Hitler' missions are to be fired TOT, they are so designated. Time is synchronized for TOT's by the headquarters broadcasting the mission. If TOT is not prescribed, units fire when ready but no later than 15 minutes after the time of broadcast.

"14. 'Serenade' or 'Hitler' missions are responded to with one (1) volley unless otherwise directed by headquarters broadcasting the missions. Status of ammunition

ration must be considered carefully.

"15. Operation, voice - 24-hour.

"16. Call signs as issued in TUSA SOI item 32-H will be used by all stations.

"17. NCS station will transmit 6 times daily to all stations a time signal to synchronize time of artillery with the Corps.

"18. Procedure for transmitting a 'Serenade' ('Hitler') fire mission:

"a. 'Hello all stations ____' (net call sign).

"b. 'Serenade (Hitler)'.

"c. Pause for 30 seconds to allow radio operator to alert his FDC when equipped with remote control.

"d. 'Hello all stations ____' (net call sign).

"e. 'Serenade (Hitler)'.

"f. 'Coordinates _____'.

"g. '_____ Volleys' (Omitted if only one volley is desired).

"h. 'TOT (When ready)'.

"i. 'I say again ____' (Repeat d to h).

"j. If TOT, add: 'When I say time, it will be exactly _____ minutes until time on target, 30 seconds, 10 seconds, 5, 4, 3, 2, 1, time, it is exactly ____ minutes until time on target.'

"k. 'Out'.

"19. Procedure for using serenade net in an emergency (pars. 8a, d, and 12 above) to fire selected battalions.

"a. 'Hello all stations ____' (net call sign).

"b. 'Fire mission for ____, ____, ____', (Call signs of units that are to fire).

"c. Pause for 30 seconds.

"d. 'Hello all stations ____' (net call sign).

"e. 'Fire mission for ____, ____, ____'.

"f. 'Coordinates _____'.

"g. '_____ Volley(s)'.

"h. 'TOT (When ready)'.

"i. 'I say again' (repeat d to h).

"j. If TOT add: 'When I say time it will be exactly _____ minutes until time on target, 30 seconds, 10 seconds, 5, 4, 3, 2, 1, time, it is exactly _____ minutes until time on target.'

"k. 'Acknowledge, over'.

"l. Stations receipt in order of call."

FIRST UNITED STATES ARMY

ARTILLERY INFORMATION SERVICE

8 May 1945

* * * * *

E X T R A C T

* * * * *

Section II

OPERATIONAL PROCEDURE

* * * * *

"4. POZIT FIRES - SAFETY TO AIRCRAFT.

"General

"a. In general Pozit may be fired by field artillery units on suitable targets without undue concern on the part of unit commanders.

"b. This memorandum prescribes a uniform policy designed to permit the maximum employment of Pozit fire consistent with safety to friendly aircraft.

"c. Such a policy is deemed necessary in order that the Artillery with the Army may be interchanged among the several corps without a loss of efficiency attendant to widely divergent regulations in this matter.

"d. Procedures prescribed by lower echelons will conform to this memorandum.

"Safety to High Performance Aircraft

"a. Pozit fire will not be restricted because of fighter-bomber and Tac/R operations over the front, except that it will not be directed against targets under direct attack by fighter-bombers.

"b. Artillery commanders will coordinate with air cooperation parties to prevent Pozit fire trajectories intercepting the routes of heavy and medium bomber flights, day or night.

"Safety to Air OP's.

"a. The majority of suitable targets can be attacked without danger restriction to Air OP operations. This will include:

(1) Fires during darkness and inclement weather when Air OP's are not operating.

Appendix 2

(2) Fires in which the trajectory, by proper choice of charges, is made to pass over or under the area of Air OP operations.

(3) Fires in which the Pozit fuze has not armed prior to crossing the front.

"b. Pozit fire not falling in one of the above categories constitutes a hazard to Air OP's. In order to minimize this hazard:

(1) Each corps will prescribe a 'Pozit Safety Zone' in which Air OP's may feel free to operate unless otherwise restricted. A zone 2,000 meters deep behind the front lines, with maximum and minimum altitudes above the ground of 3,000 and 1,000, is recommended.

(2) Unit commanders will be charged with notifying the corps fire direction center whenever armed Pozit fuzed projectiles are to be fired or, in emergency, are being fired through the Pozit Safety Zone. Whenever the tactical situation permits, notification will be given at least 15 minutes prior to the time of firing.

(3) Each corps will develop an effective warning system which will permit maximum warning to Air OP's. It is recommended that the Corps Artillery Commander's Radio Net be used for this purpose. When the corps fire direction center is notified that Pozit fire is to be used, or that it is being used, this information will immediately be disseminated to the artillery with the corps, and to adjacent and supporting artillery. The corps sector will be divided into areas to facilitate designation of danger areas.

(4) Once the warning has been given, it will be the responsibility of each unit that its Air OP's are warned of the danger area.

(5) Corps fire direction centers may forbid or otherwise restrict Pozit fires when important air missions are being flown.

(6) Personnel at battery positions will be alert to suspend firing should they observe friendly aircraft likely to be endangered by their fire."

XII CORPS

* * * * *

E X T R A C T

* * * * *

STANDING OPERATING PROCEDURE
ARTILLERY WITH THE XII CORPS

INSTRUCTIONS FOR USE OF POZIT FUZE

"1. The fuze provides higher bursts at small angles of impact than at large angles of impact. The 25-second time fuze should be used with low angles of elevation; the pozit fuze with high angles.

"2. The fuze provides extremely high bursts over water, very high bursts over snow and wet ground, satisfactory heights of burst over dry ground.

"3. Clearance.

"a. When absolute safety of personnel forward of gun positions is desired, the clearances suggested in pars. 13-14, Artillery Operational Instructions, Hq 12th Army Group, 20 November 1944, apply.

"b. When reasonable safety of dispersed personnel forward of gun positions is adequate, clearances are reduced to:

100 yards for light artillery.
150 yards for medium and heavy artillery.

"c. Reduced clearances are used in a division zone of action unless otherwise directed by the division artillery commander. If full clearances are to be used the division artillery commander notifies the Corps fire direction center one hour in advance of the time full clearances are to be employed.

"4. Plan A for use of Pozit Fuze:

"a. The pozit fuze is fired at any elevation, consistent with clearance (par. 3 above), during the hours of darkness. It is not fired at other times.

"b. The hours of darkness are from one hour after sunset to one hour before sunrise.

"5. Plan B for use of Pozit Fuze:

"Same as Plan A except that the pozit fuze may be fired in daylight at angles of elevation above 800 mils, provided the target is 1500 yards beyond the friendly front lines.

"6. Plan C for Pozit Fuze:

"Same as Plan B except that those units whose battery air safety observers (par. 14 below) can see

planes flying at least 1,000 feet above the front line, may fire pozit fuzes at any elevation, consistent with clearance (par. 3 above) and with safety to airplanes (par. 15 below), at any time.

"7. Plan D for use of Pozit Fuze:

"Same as Plan A except that the pozit fuze may be used in daylight with angles of elevation in excess of 400 mils provided the target is 1,500 yards beyond the friendly front lines.

"8. Plan E for use of Pozit Fuze:

"The pozit fuze is fired at any elevation, consistant with clearance (par. 3 above), at any time.

"9. Field Artillery airplanes and Plan A.

"Airplanes fly without restriction except that they do not fly during the hours of darkness.

"10. Field Artillery airplanes and Plan B.

"a. Pilots mark on their maps:

(1) Friendly front line of division.

(2) Division boundaries.

(3) Artillery position areas in division zone.

(4) A line joining forward battery positions in division zone and a line parallel to it and 1,500 yards in advance of it.

"b. Airplanes fly low over position areas so as to be seen surely from the battery positions.

"c. Altitude is gained to the 1,500 yard line in advance of the gun positions.

"d. Airplanes observe at altitudes up to 3,000 feet and at horizontal locations between the 1,500 yard line in advance of the gun positions and the front line.

"11. Field Artillery airplanes and Plan C.

"Same as Plan B except that planes do not fly below the line of visibility from battery positions prescribed in par. 14b below.

"12. Field Artillery airplanes and Plan D.

"Same as Plan B except that airplanes fly at altitudes under 1,000 feet.

"13. Field Artillery airplanes and Plan E.

"Airplanes do not fly forward of the battery positions.

"14. Battery air safety observer.

"a. Each firing battery maintains an air safety observer at the battery position, except during the hours of darkness.

"b. The battalion is notified when visibility and location of the battery air safety observer are such that airplanes flying at least 1,000 feet above the front line can be observed. In general, visibility beyond 5,000 yards cannot be depended upon.

"15. Duties of battery air safety observer.

"a. Observes airplanes in zone of action of battery.

"b. Keeps running estimate of angle of site to, range to, and altitude of visible airplanes in the battery front.

"c. When Plan B, Plan C, or Plan D is in effect, notifies executive when any airplane is flying at unauthorized altitudes.

"d. When battery receives fire commands, checks direction of fire and location and line of flight of nearby airplanes. When Plan C is in effect, notifies executive if airplane and plane of flight of projectiles are liable to coincide. See par. 18.

"e. When Plan E is in effect, notify executive if airplanes appear forward of battery position.

"16. Duties of the Executive:

"a. When notified under provisions of par. 15c and 15e above:

(1) Notifies battalion, who checks what airplanes are in the air and follows through to see that responsible commander is notified.

(2) If firing pozit fuzes, sees that airplanes flying at unauthorized height are not endangered.

"b. When notified under provisions of par. 15d above:

Substitutes instantaneous fuze for pozit fuze.

"17. Designation of Plans.

"a. Operation is by division zone of action.

"b. The code name 'SCRAM' is used to designate plans. For instance, 'SCRAM ABLE' etc.

"c. Unless specified by Corps, the division artillery commander designates the plan to be used in the

division zone of action.

"d. One hour's notice between division artillery and Corps fire direction center is required for change in plan.

"e. Notification of units and their air observation if plan in effect follows command channels.

"f. Air officers stand ready to advise commanders.

"g. Commanders weigh all factors in deciding upon plan. In general, the plans are designed to meet conditions in daylight as follows:

PLAN	VISIBILITY	AIR OBSERVATION	USE OF POINT
SCRAM A	Unlimited	Unrestricted	Prohibited
SCRAM B	Variable ceiling	At altitudes up to 3,000 feet	At very high (above 800 mils) elevations.
SCRAM C	Unlimited	At altitudes 1,000-3,000 feet	Unrestricted for certain units, depending upon visibility
SCRAM D	Low ceiling	At altitudes under 1,000 feet	At angles of elevation greater than 400 mils.
SCRAM E	Poor	Prohibited	Unrestricted

"18. OBSERVERS GUIDE

Cub planes flying across the front subtend:

AT RIGHT ANGLES TO OBSERVER:		TOWARD OR AWAY FROM OBSERVER:	
At 1,000 yds	- 7 mils	At 1,000 yds	- 12 mils
2,000 yds	- 4 mils	2,000 yds	- 6 mils
3,000 yds	- 2 mils	3,000 yds	- 4 mils
4,000 yds	- 2 mils	4,000 yds	- 3 mils
5,000 yds	- 1 mil	5,000 yds	- 2 mils
6,000 yds	- 1 mil	6,000 yds	- 2 mil
7,000 yds	- 1 mil	7,000 yds	- 1 mil
over 8,000 yds	less than 1 mil	8,000 yds	- 1 mil

Cub planes travel at the following rate perpendicular to the line of fire."

RANGE	MILS TRAVEL PER 10 SEC
1,000	293
2,000	146
3,000	97
4,000	73
5,000	59
6,000	49
7,000	42

(See table on page 54)

TABLE OF ALTITUDES (In feet)

Range to Plane (yds)	Angle of Site to Plane														
	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300
1000	60	120	180	240	300	360	420	480	540	600	660	720	780	840	900
2000	120	240	360	480	600	720	840	960	1080	1200	1320	1440	1560	1680	1800
3000	180	360	540	720	900	1080	1260	1440	1620	1800	1980	2160	2340	2520	2700
4000	240	480	720	960	1200	1440	1680	1920	2160	2400	2640	2880	3120	3360	3600
5000	300	600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600	3900	4200	4500