

THE GENERAL BOARD
UNITED STATES FORCES, EUROPEAN THEATER

REPORT
ON
STUDY OF THE FIELD ARTILLERY OBSERVATION BATTALION

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MISSION: Prepare Report and Recommendations on the Employment of the
Field Artillery Observation Battalion.

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.

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THE GENERAL BOARD
UNITED STATES FORCES, EUROPEAN THEATER
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STUDY OF THE FIELD ARTILLERY OBSERVATION BATTALION

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CHAPTER 1

FIELD ARTILLERY OBSERVATION BATTALIONS IN COMBAT

SECTION 1

INTRODUCTION

1. Purpose. The purpose of this study is to prepare a report covering:

a. The employment of the field artillery observation battalions in combat in the European Theater of Operations.

b. Recommendations for changes in organization and equipment based on combat experience.

2. Organization. The field artillery observation battalion is an outgrowth of the first attempts at locating artillery by sound and flash ranging during World War I. The battalion consists of a headquarters and headquarters battery and two observation batteries. The batteries of the battalion have the following special sections:

a. Headquarters Battery.

(1) One meteorological section.

(2) One topographical platoon consisting of a survey headquarters and four survey sections.

b. Observation Battery.

(1) One sound ranging platoon consisting of one operations section, sound ranging, and two survey sections.

(2) One flash ranging platoon consisting of one operations section, flash ranging, and two survey sections.

3. Missions. The missions of the field artillery observation battalions are:

a. Location of enemy artillery.

b. Registration and adjustment of field artillery.

c. Collection of information.

d. Coordination of survey.

e. Comparative calibration of field artillery.

f. Providing the field artillery meteorological message.

4. Assignment. One field artillery observation battalion is assigned to each corps. This battalion and the corps artillery headquarters and headquarters battery comprise the only organic parts of the corps artillery. In the European Theater of Operations there was one

additional battalion for each army.

SECTION 2

EMPLOYMENT

5. General. Field Artillery observation battalions were employed throughout the combat period in the European Theater of Operations. They were successful in accomplishing their various missions. The counterbattery fires, based to a great extent on the service furnished by these battalions, forced the German artillery to adopt a policy of frequent displacement. 1, 21, 23.

6. Availability. Field artillery observation battalions usually arrived in the European Theater of Operations at the same time as the Corps with which they were to operate. There was never a shortage among the organic corps battalions. The army battalions did not begin to arrive until September 1944. 1, 24.

7. Coverage. Corps fronts were frequently between 30,000 and 40,000 yards in width. Irregular front lines further complicated the problem of observation. The field artillery observation battalions were not able to give complete observation coverage on the long, irregular corps fronts. After the army battalions became available, observation batteries were attached to the corps which had the most difficult observation problems. This relieved the situation to some extent; however, there were only two observation batteries available in each army and there were usually three or more corps. 1, 18, 19, 20.

8. Types of Employment.

a. Assault of a Beach. In the assault on the Normandy Beach the coastal defense guns and the artillery of the static coastal defense divisions were quickly overrun. Artillery opposition to the advance was light until contact was made with the German divisions that were sent to contain the beachhead. The 13th and 17th Field Artillery Observation Battalions arrived on Utah and Omaha beachheads on 8 June 1944. The survey and meteorological sections were immediately employed in providing survey and meteorological data for the control and correction of interdiction fires. Sound and flash ranging sections were in action on 9 June 1944, but were of very little value as intelligence agencies until contact with the German containing force was established. 1.

b. Support of a Beachhead. The German artillery reaction to the Normandy Beachhead was violent. On the V Corps and XIX Corps fronts there was a period of stabilized warfare. On the VII Corps and VIII Corps fronts there was a period of slow advance and the reduction of a fortress. Under each of these conditions the field artillery observation battalions were successful in accomplishing their missions. Complete and accurate survey control was established throughout the area. Meteorological messages were delivered on schedule. Sound ranging was effective in locating the German artillery and in adjusting counterbattery fire. Flash ranging was only moderately successful as an intelligence agency. Terrestrial observation was hampered by the lack of commanding terrain, the natural cover afforded the enemy, and poor atmospheric conditions. 1.

c. Pursuit. In the European Theater of Operations the field artillery observation battalions were of little value during the pursuit of the German army across France and later across Germany. Attachment of the individual observation batteries to the infantry divisions during the pursuit kept them well forward in positions from which they could be readily deployed when contact with the main enemy

force was made. The survey assistance that they were able to furnish the divisional artillery was the main source of value during these periods. Meteorological sections functioned during the pursuit but the value of the data was doubtful because of the distances between the meteorological stations and the gun positions, 1, 18, 19, 20.

d. Stabilized Warfare. Stabilized warfare and limited gains in the attack characterized the operations against the Siegfried Line. The field artillery observation battalions furnished complete survey control of the combat area. Sound ranging operated efficiently in locating the German artillery and in adjusting counterbattery fire. Visibility for flash ranging was poor because of extensive periods of heavy fog, rain, and snow. The meteorological service functioned throughout the period and was particularly valuable since observation of fire was restricted by the poor visibility.

e. Retreat. There were only two examples of field artillery observation battalions operating in a retreat. In both cases alternate positions well in rear of the front line positions had previously been selected and surveyed. In one case the alternate position was not in rear of a natural barrier and the rapidity of the German advance caused it to be abandoned before it was occupied. In the second case the alternate base had been selected in rear of a river barrier and functioned efficiently in assisting to halt the German advance. 1, 9, 21.

9. Tactical Control.

a. Centralized Control. The most common type of tactical control of the observation batteries was central control within the battalion. This had distinct advantages. Enemy battery and intelligence data for the entire corps zone were evaluated and plotted at one headquarters. Battery commanders were not concerned with evaluation and had greater freedom to supervise their widely separated installations. Confirmation of locations by photo intelligence, shelling reports, and air OP's was more accurate when handled between the field artillery observation battalion operations section and the corps artillery counterbattery section than when transmitted through other channels. In general centralized control was relaxed to allow sound and flash ranging officers to call the nearest divisional artillery battalion direct in order to attack targets of opportunity. Lateral lines were laid for this purpose. 4, 5, 17, 18, 19, 20.

b. Field Artillery Group Control. In those cases where the communications problem on extended corps fronts made centralized control impractical, either one or both of the observation batteries were attached to field artillery groups. Usually counterbattery intelligence personnel and field artillery observation battalion staff and survey personnel were attached to the field artillery group at the same time to provide a counterbattery intelligence and survey information center. The exact composition of the attached sections was not standardized and varied in each situation. Complete records were maintained at the field artillery group, and the advantages of centralized control were exploited to the extent permitted by the communications net. The greatest disadvantage of this method of control was that rapid cross checking of sound ranging locations with the corps artillery photo intelligence section was not always possible. 20.

c. Decentralized or Divisional Control. This method of control was employed to keep the field artillery observation batteries well forward during a rapid advance. It operated smoothly in the early stages of deployment. However, except in those cases in which it was augmented by a counterbattery section and a field artillery observation battalion liaison section, the division artillery did not have the per-

sonnel or facilities for keeping the records and cross-checking with other intelligence agencies. 18,19,20.

d. Divisional Detachments. An improvised divisional sound and flash ranging detachment was used during the training period to demonstrate the method of locating and adjusting artillery fire on enemy artillery involved in a delaying action. This detachment was not self-sustaining and was incapable of extended action. The divisional sound and flash ranging detachment as utilized during the training period was not used in the European Theater of Operations. A self-sustaining unit, though not always a complete battery, was invariably sent on any mission. 18,19,20.

10. Combat Failures. The failures of individual sections of the field artillery observation battalions in combat in the European Theater that are attributable to training deficiencies are discussed under the individual subject headings.

a. Sound Bases. Almost all of the field artillery observation battalions that saw extensive action in the European Theater installed sound ranging bases which did not obtain locations. This was expensive in wire and effort. Experience in combat taught the battalion commanders to make slower and more accurate estimates of the German artillery capabilities. 1,19.

b. Surveys. Survey control for the artillery was handled in a superior manner. However, there were isolated examples of field artillery observation battalions failing to make the best use of the existing trigonometric data and running unchecked surveys for too great a distance. 1,20.

c. Relations with other Units. The value of the missions accomplished by the field artillery observation battalions in combat was not understood by many artillery units and staffs. A true appreciation of the value of sound ranging locations, as an example, was necessary. Artillery staffs which accepted the locations without reference to the accuracy assigned by the observation battalion and fired counterbattery were frequently wasting ammunition. On the other extreme were the staffs which wasted opportunities by failing to appreciate the methods of decreasing the errors and obtaining effective counterbattery fire. Another example arose from the fact that a simple sound ranging film could be read and plotted in three minutes while complex films that showed the traces of many guns and shells could frequently not be untangled to locate a particular gun in less than two hours. Many individual officers failed to realize that a location two hours late was still valuable intelligence. 8,9,18.

SECTION 3

SOUND RANGING

11. Sound Ranging Locations. There is no accurate method for determining how many German batteries were actually located by sound ranging. The term "sound ranging location" was used with entirely different meaning in various units. Under static conditions sound ranging averaged 750 locations per battalion per month on the active fronts. A large percentage of these were recognized and reported as self-propelled guns whose locations were transient. From a study of the confirmations of sound ranging plots by photo intelligence, air OPs, flash ranging, shelling reports, and prisoner of war reports, it would appear that sound ranging actually located the majority of the German battery positions and that the actual accuracies of the locations were

much better than the assigned accuracies. Corps artillery normally did not fire on any targets that were not confirmed by other intelligence sources. Photo intelligence was able to plot positions accurately but was not able to identify them clearly as active or inactive; however, combined with sound ranging it formed the perfect team to pin point the active batteries. One hundred sound ranging locations were inspected, and the average error of the locations was determined to be 156 yards. If counterbattery had been fired on all these targets the fires could have been 51 percent effective. No consideration was given in this study to assigned accuracies. Assigned accuracies frequently were as high as 500 yards and during adverse weather seldom were below 200 yards. An interesting question that was not answered during combat in the European Theater is, "If corps artillery had accepted the assigned accuracies and fired on those which were 100 yards or less and used those that were greater for their information value only, would the counterbattery fire have been effective?" In those cases where the assigned accuracy of the locations indicated that counterbattery fire would probably not be effective, adjustment of fire by sound on sound (paragraph 13d(3)) was used by approximately half of the units when confirmations could not be obtained by either photo intelligence or air OP. 1,4,5,9,13,18,19,20,22.

12. Sound Ranging Registrations. All of the observation battalion commanders were definitely against making sound ranging registrations for the purpose of determining a velocity error for artillery except as a last resort. The inherent errors of sound ranging were too great to use it for this purpose. Registrations were frequently made for the purpose of establishing a base point from which shifts could be made to sound ranging locations. 49.

13. Methods and Technique.

a. Types of Bases. Standard straight, five or six microphone bases of four to five and one-half second sub-bases were almost invariably used. No curved bases were employed. Bases installed by inspection were used until survey was completed. There were a very few examples of irregular bases. Most units used one-half of the regular sub-base length as an initial installation where speed was essential. There were several examples of four, seven and eight microphone bases. 1,18, 19,20.

b. Identification Aids. The aids which were used to assist the film reader in identifying the initial gun breaks on the film were:

- (1) A microphone placed in front or rear of one of the regular microphones of the base. This allowed the film reader to determine quickly whether the sound source was in front or rear of the base for any set of initial breaks.
- (2) Additional microphones placed half way between the regular microphones of the base. This increased the number of points on the curve of initial breaks, making the curve easier to identify.
- (3) The approximate location of the gun was plotted to assist the film reader in determining the shape of the curve of initial breaks. This position was obtained from the estimated range and azimuth to the gun as furnished by the outpost. The outpost was equipped with an azimuth measuring instrument which

was pointed at the apparent source of the sound to obtain the estimated azimuth. 20.

c. Deployment of bases. Because of the wide corps fronts the observation battalions had to employ more than one base per battery for large portions of the time. Within the battery the most common installation was that of two bases crossed at approximately 30 degrees, operated on separate sound recording sets but using only one recording and plotting crew. A variation of this was the use of crossed four and five microphone bases employing a common microphone and one recording set. Hinged bases applying both the above principles were also common. Normally, three outposts were employed in the operation of the above bases. Battalions organized under the larger T/O 6-75, 1 April 1942, operated two independent bases per battery for periods as great as one month. Three independent bases per battalion were operated effectively by employing a detachment made up from the battalion as a whole. These special types of deployment were only possible where the tactical situation was stable. 1,18,19.

d. Counterbattery Technique. The confidence that the corps artillery counterbattery section placed in sound ranging influenced the method of attacking sound ranging locations. While the degree to which each corps employed each method varied, the methods themselves were quite standard.

- (1) Map Data Corrected. In those cases where a sound ranging location was considered as accurate or where it was confirmed by a photo intelligence location, counterbattery was fired on corrected map data. Surveillance by sound ranging of the effect of the fire was frequently obtained.
- (2) Sound Ranging Registration. In those cases where sound ranging locations were not sufficiently accurate for the firing of map data corrected, a sound ranging registration was usually conducted at some distance from the location. The sound ranging errors of location of the registration and the target were considered to be the same and a direct shift was made between the two locations. This method permitted the rassing of artillery fire on the target without warning.
- (3) Sound on Sound Adjustment. This method of attacking targets was the most accurate but lacks the element of surprise. Artillery shells were fired one or two at a time as near the target as the data permitted. The position of each set of bursts was plotted by sound ranging and the deflection and range corrected before the next firing. This was continued until the pattern of initial breaks of the shells and the target were identical. This method was slow and lacked the element of surprise but had the advantage of greater accuracy.
- (4) Coordination with Air Ops. In all the above methods artillery air ops executed surveillance of the firing whenever visibility permitted. If they identified the target they frequently took over the mission on orders of the corps artillery counterbattery officer. 1,4,5,17,18,20,22.

e. Positions of Sound Ranging Bases. Where conditions were

favorable, the observation battalion commanders kept their bases well forward. Sound outposts frequently lived with the forward elements of the infantry and did not appear to be less efficient because of the small arms fire. Several bases were put in and operated where individual microphones were between the friendly front line and the enemy and could only be serviced at night. In general, however, bases averaged from 1500 to 2500 yards behind the front with outposts at least 1000 yards in front of the base. 18,19,20.

14. Mortar Ranging. The ability of sound ranging to locate German mortars was tested at ISIGNY, France, during August 1944 and found to be successful on German mortars larger than the 60mm in caliber. Using straight five microphone bases with one or two second sub-bases, sound ranging was able to locate effectively and cause the neutralization of mortars in all cases where it was attempted. Counter mortar detachments operated directly with a divisional artillery 105mm battalion. Several reference points were normally shot in from which rapid shifts could be made to any mortar locations. In order to be effective the counter mortar sound ranging base had to be employed about 600 yards from the front lines with the outpost staying with the infantry outposts. Effective fire was delivered on both mortars and self-propelled guns within three minutes by the use of these bases. Though the method was successful in the cases where it was used, it was not the solution to the mortar problem for these reasons:

- a. Defilade for the entire base had to be available 600 yards from the front.
- b. The terrain along the base and an approach to it had to be such that vehicles could be used.
- c. The microphone wire lines were too vulnerable to the German mortar fire. One base was unable to go into operation for two days for this reason.
- d. The bases covered such a small proportion of the front that their effect was purely local. 1,2,3,12,18,20,23.

15. Radio Link. Radio link is a term used to describe the transmission of sound over a system involving wire transmission followed by radio transmission which is in turn followed by wire transmission. The equipment used in the radio link for sound ranging consists of Modulator Assembly, AN/GRA-1(), and radios SCR-610. The purpose of the sound ranging radio link is to replace wire in the transmission of the sound impulse from the microphone to the sound recording set. This equipment was not available to most of the field artillery observation battalions in the European Theater of Operations. The battalions that were equipped with radio link did not consider it reliable. All battalion commanders stated that there was a definite need for equipment of this type and requested that development be continued. 18,21.

16. Training. The state of training of the sound ranging film readers was not satisfactory when the field artillery observation battalions entered combat in the European Theater of Operations. The primary cause of this condition was the training practice of sound ranging on explosives such as TNT and shell bursts. All training in film reading after the basic instruction should be against distant guns. 1.

17. Major Equipment Deficiencies. All observation battalion commanders were extremely pleased at the manner in which the sound ranging equipment functioned in combat in the European Theater. Because

of the specialized nature of the equipment all had difficulty in getting some expendable supplies and minor replacement parts, but this condition improved as combat progressed. They expressed the opinion that a lighter, eight channel, dry recorder and a lighter plotting board, based on the present Sound Ranging Plotting Board, M1, could and should be developed. A definite need existed for a light durable plotting surface for use with irregular bases. 14,18,19,20,21.

SECTION 4

FLASH RANGING

18. Flash Ranging Locations. Flash ranging was only about one tenth as successful as sound ranging in locating German artillery. Throughout the campaigns in the European Theater flash ranging observers operated under adverse terrain and weather conditions. Of an average of 70 artillery locations per battalion per month of static combat almost all were believed to be self-propelled guns. Operating against rockets of the nebelwerfer type, flash ranging was extremely successful, and fair results were obtained against targets of opportunity. The value of the vast amount of intelligence data, including individual single flash rays and negative information, cannot be estimated. Registration of artillery was of great value but could have been performed by the firing battalions. 1,5,7,18,19,20.

19. Registration and Calibration. Registration and calibration of artillery was a secondary mission of the field artillery observation battalions. Early in combat in the European Theater it was found that the flash ranging sections were devoting too large a portion of their time to registration and that the general intelligence mission was being slighted. The general policy was established that artillery groups must plan and staff their own lateral OPs for registrations but that they could still call on the observation battalions in an emergency. In order to assist the artillery groups joint occupation of observation battalion OPs and restricted use of the wire net was authorized. Even with these restrictions the number of special requests for registrations of division, corps and army artillery was enormous. 1,18,19,20.

20. Methods and Technique.

a. Type Flash Ranging Bases Employed. The long flash ranging base using four or five observation posts separated by at least 2000 yards was the standard type of deployment. This type base was highly favored because of the better angles of intersection obtained when plotting the flashes from German artillery or a high burst registration. Where terrain corridors limited the observation of a particular area to two observation posts, short base flash ranging plotting methods were used in relation to these two posts. 7,18,19,20.

b. Orientation. Survey control was always carried to the observation posts. However, in order to obtain rapidity in occupation of position it was necessary for the flash ranging observation personnel to map spot their position and establish their own azimuth. The ability to observe and compute a sun azimuth was of great value in obtaining orientation. 7,18,20.

c. Adjustment of Fire. The flash ranging observation posts were frequently called on to adjust fire on targets of opportunity. Where more than one observation post could observe the target, bilateral adjustment was favored. Forward observer methods were used in the cases where the target was visible to only one observer. 7,18,20.

d. Registrations. Registrations for the artillery were invariably bilateral observation using as many observation posts as possible. Either high burst or impact fire was used. 7,18,20.

e. Flash-bang. The terrain on the battlefields of the European Theater was such that visibility of a flash by more than one observation post was frequently impossible. The instrument azimuth and the range determined by the time between flash and gun sound were used extensively in determining locations. These data were not considered as accurate locations since they were unchecked by other observers. When combined on a plotting board of casual flash rays and on the shelling report plotting board at corps artillery, these data frequently were the key to excellent locations. 18,19,20.

21. Flashless Powder and Flares. The German artillery used an excellent flashless powder in all of its towed artillery. Because self-propelled guns did not use this powder, it was deduced that most flash ranging locations were on artillery of this type. The observation battalion commanders were convinced that the German flashless powder practically neutralized the value of flash ranging in obtaining artillery locations. Practically all commanders reported that the Germans were using flares as camouflage to their artillery. 1,21.

22. Training. The following training deficiencies were noted in the European Theater of Operations:

a. Map Reading. All men in the flash ranging section had to be familiar with standard maps and vertical and oblique photographs. Supplemental training had to be undertaken in combat to improve the state of training in these subjects. 20.

b. Orientation. All flash ranging observers were not familiar with the methods of orientation including azimuths of the sun. The policy of training a selected few in these calculations proved unsound when these men became combat casualties. 20.

c. Radio. All flash ranging observers were not familiar with the operation and maintenance of the SCR-610. This situation had to be corrected before full use was made of this means of communication. 18,19,20.

23. Major Equipment Deficiencies.

a. Azimuth Instrument. Neither the Azimuth Instrument, M1, nor the British Spotting Instrument, M2, was satisfactory in combat. A new flash ranging instrument with the following characteristics was desired.

- (1) Binocular vision.
- (2) Selective, eight or twenty power lens.
- (3) Light proof scale and reticle illumination.
- (4) Moisture proof.
- (5) Lighter weight and smaller bulk.
- (6) Horizontal and vertical scales that are easy to read.
- (7) Positive horizontal and vertical release mechanism.
- (8) Stable tripod. 14,18,19,20,21.

b. Flash Switchboard. The Flash Ranging Switchboard BD 70 was unsatisfactory in combat in the European Theater of Operations because it was not moisture proof. 14,18,19,20.

SECTION 5

SURVEY

24. Survey Mission and Accomplishments. The mission of the field artillery observation battalion survey in the European Theater of Operations was to provide map data and survey control to division, corps and army artillery and to survey their sound and flash ranging installations. The maps that were provided by the Corps of Engineers were probably the best that any army in the history of warfare has had at its disposal. Trigonometric stations were abundant and accurate. Observation battalions that fought throughout the campaigns averaged 1200 miles of accurate, connecting, traverse surveys. Survey parties established local control stations throughout the artillery area and forward almost to the front lines thus making the task of the regular artillery survey parties almost negligible. Azimuth checks by sun shots were used extensively. Very little night survey was attempted because of the reaction of our troops to the use of lights. Very little triangulation was attempted since the terrain was more adaptable to traverse and an excellent basic control already existed. All observation battalions operated survey sections under the direct supervision of the survey information center. This center was one of the most valuable innovations of this war. It was charged with obtaining the trigonometric data from the engineers and disseminating this with its own survey control to the artillery survey officers. Personnel were always available at this center who were qualified to give advice on survey, assist in the repair of equipment, or inaugurate new surveys to meet changing requirements. The accomplishments of the observation battalion survey parties and information centers were of the highest standards. 1,6,19,18,19,20,22.

25. Coast and Geodetic Survey Officers. Officers of the United States Coast and Geodetic Survey were attached to most of the field artillery observation battalions. During training they rendered invaluable service in supervising survey instruction and improving survey technique. In combat in the European Theater of Operations they supervised the survey information center and, under the battalion commander, planned and supervised the survey control of each combat area. 1,16.

26. Training. Survey training in the field artillery observation battalions was of the highest standard.

27. Major Equipment Deficiencies.

a. Transits. The 20 second Gurley Transit was unsatisfactory. It fell far below the standards of even the cheapest commercial transits. The development and procurement of two standard transits for the artillery is necessary: 6,9,14,18,20.

- (1) One second theodolite for astronomic observation and triangulation. One per observation battalion survey party and per division artillery.
- (2) Twenty second transit for traverse. One per observation battalion survey party and per division artillery, two per artillery battalion.

b. Chronometer. A good chronometer, to which the watches used

in taking astronomic observations could be compared, was a necessity throughout combat. 6,9,20.

c. Tapes. Steel tapes and repair equipment were not entirely satisfactory. Improvement of these items is desirable. 6,9,20.

d. Night Equipment. Night survey was impractical during combat because of the reaction of our troops to the necessary lights. The use of light waves outside the visual spectrum should be investigated and developed. 18,20.

e. New Survey Development. The survey equipment and methods that have been used in the past are slow and subject to personal errors. Electronic methods of survey should be developed. 18.

SECTION 6

METEOROLOGICAL SERVICE

28. Determination of Ballistic Winds. The division artillery and the field artillery observation battalions determined the wind azimuths and velocities up to the overcast by the pilot balloon method. Restricted visibility made this method ineffective except for extremely low angle firing. The antiaircraft artillery used its radar equipment to determine these elements and made the data available to the field artillery on a six hour schedule. Ballistic winds based on predicted data were used to a limited extent. 6,10,18,19,20,21,22.

29. Determination of Ballistic Densities. The division artillery and the field artillery observation battalions determined the ballistic densities by the psychrometer and barometer method. Mobile weather detachments from the air corps weather squadrons were attached to each corps and army. Approximately 30 percent of these detachments were equipped with radiosonde for the determination of the densities of the atmosphere. These data were available to the field artillery on a six hour schedule. Predicted densities were used to a limited extent, the procedure being for the weather detachment to modify the density lapse rate of the lower atmosphere based on ground measurements. 6,10,12,19,20,21,22.

30. Combat Solution of Field Artillery Meteorological Problem. The weather detachments that were attached to corps worked either independently of or in conjunction with the observation battalion meteorological sections. In either case they were responsible for receiving the wind and density data from the weather detachment attached to army. In those cases where the weather detachments operated independently of the observation battalion meteorological sections, the ballistic messages from both sources were broadcast to the field artillery. Selection of the appropriate message was made by the firing battalion. When the two units worked in conjunction with each other, the following method of blending was employed: 6,10,20,21,22.

a. Wind Data. The weather detachment compared the radar wind data from the last army weather message to the observation battalion's local pilot balloon data and indicated how the two should be integrated or blended. 20,22.

b. Ballistic Density. The weather detachment corrected the radiosonde densities from the last army weather message to station elevation, modified the lapse rate in the lower atmosphere as indicated by local terrestrial measurements, and weighed and computed the ballistic density message. The completed ballistic density elements of the message were given to the observation battalion meteorological

section. 20,22.

c. Plotting and Assembling Message. The observation battalion meteorological section plotted and computed the final ballistic winds for the message and assembled these with the ballistic densities in the final message. A message was normally computed every two hours. 20,22.

d. Transmission. It had originally been planned for the observation battalions to transmit the meteorological message on the corps artillery SCR-284 radio net. When this radio net proved too weak, transmission over the SCR-193 net was authorized. When the SCR-193 did not have the power to give positive transmission, the SCR-399 at corps artillery was used. The observation battalion meteorological section was responsible for delivering the meteorological message to the radio set which was to make the broadcast and to the battalion message center where a file copy was maintained. 20,22.

e. Division Artillery Meteorological Section. The division artillery meteorological section made pilot balloon determinations of the winds and psychrometer measurements of density. When atmospheric conditions permitted observation, division artillery used its local data for low angle firing. 21.

f. Sound Ranging Meteorological Message. This message was computed by either the observation battalion or division artillery meteorological sections. Because of the wide fronts involved the division stations were frequently able to give better data on the lower atmosphere. A small meteorological section was definitely needed with each sound ranging platoon. 1,20.

g. Deficiencies of Methods. The methods used in observing and computing the meteorological data were unsatisfactory in several respects. The radar and radiosonde data were taken at too great a distance from the corps artillery area. The time lag of two hours to observe, compute, and deliver the data, plus the six hour delivery schedule, made the message eight hours old when the artillery finished employing it. This was definitely too out of date to be trustworthy. 20.

31. Use of Meteorological Data. The field artillery was thoroughly indoctrinated with the value of meteorological data. Some units, not realizing the time elements involved in the messages, applied them too blindly. Units should be informed of the observing and computing times. Registrations should be fired before the message to be applied is received and preferably during the observing period. 18.

32. Meteorological Set, SCR-658. This equipment was not received in the European Theater until after the close of the combat period. Its directional radio and radiosonde elements place in the observation battalion meteorological sections the equipment necessary for the determination of ballistic winds, densities, and temperatures in overcast weather. This equipment should permit the artillery to have good local data on a four hour schedule. The observing and computing period will be about 75 minutes for a corps artillery message. 21.

SECTION 7

COMMUNICATIONS

39. Wire Problem in Combat. All observation battalions reported that they laid and maintained twice the authorized allowance of wire.

There were sufficient wire crews in the observation batteries but headquarters batteries needed one more truck and crew. All wire crews were slightly small. Light transportation was borrowed from other sections and was essential for maintenance of wire. This was particularly true on narrow roads at night. The practice of cabling wire by higher headquarters hindered maintenance and recovery. Cabling of wire was extensively practiced in the European Theater to improve appearance. The following wires, used in combat, were commented upon: 6, 18, 20.

a. W-110B. Insulation of this wire was unsatisfactory in wet weather.

b. W-130. Satisfactory when used on short lines such as command post installations. 20.

c. W-143. Excellent electrical characteristics but poor tensile strength and fabric cover tore off when removing it from ice. 20.

d. Spiral Four. (Cable Assemblage CC358). This wire was too bulky to use in initial installations. It was invaluable, however, to improve the base during snow, ice or heavy rains. Tests by the 8th Field Artillery Observation Battalion showed that in wet weather the microphones functioned a great deal better using this wire than they did using W-110B. 20.

34. Radio Nets. Very little use was made during combat in the European Theater of the observation battalion SCR-608 net. Distances from battalion to batteries were frequently so great that this set would not function. Within the batteries the flash ranging SCR-610 and a special net between scout outposts and central employing the SCR-610 were used extensively. The battalion SCR-284 net was used by some battalions that did not exchange these radios for SCR-199. The latter was a more satisfactory radio for battalion communications. 7, 18, 19, 20.

35. Special Meteorological Net. A special meteorological net was employed by the air corps weather detachments during combat in the European Theater of Operations. Provisions for a similar net for the exchange of meteorological data between adjacent corps and between corps and army will be necessary. The equipment and personnel for this net must be provided to the observation battalion and to a supervisory or coordinating group at army level. In order to avoid duplication of broadcasts the frequency of this net should be in a band where all artillery can listen in and receive their meteorological message. 20.

SECTION 8

RADAR

36. Radar Observation of Terrestrial Targets. The conception of the use of radar in a terrestrial role to replace or supplement visual methods of observation was in its infancy during the combat period in the European Theater. Proper equipment for this work had not been developed and the investigations which were conducted should be considered largely as pointing the way toward future development.

a. Fifteenth U. S. Army Radar School. The Fifteenth U. S. Army established two counter mortar radar schools during March and April 1945. The first of these schools was established to train crews for the SCR-584 in a counter mortar role and to acquaint observation

battalion representatives with the possibilities of this equipment. Well-trained crews using manual plotting were able to locate mortars up to a range of 7,000 yards with an accuracy of 100 yards. Observing and plotting time was three minutes. Employing automatic plotting attachments, the radar crew obtained an accuracy of 50 yards in one and one-half minutes. The front that one set was able to cover effectively was 2,500 yards. Because of the size and lack of mobility of the SCR-584 and the fact that combat in the European Theater ended within a few days after the counter mortar crews reported to their observation battalion assignments, this method of locating mortars was not effectively used in combat. The 8th and 16th Field Artillery Observation Battalions reported locations by radar but the situation was too fluid for its practical use. The second school was designed as a test of the AN/APS -3 radar set. This was a small Navy set weighing approximately 250 pounds. It was capable of being mounted in two quarter ton trailers and could be put in action from its traveling position in five minutes. This set was not satisfactory for counter mortar locations without extensive modifications, but did demonstrate that a light weight portable radar set for service in the infantry areas is possible from a technical point of view. 15,20,22.

b. Radar Observation of Terrestrial Targets and Registrations. The antiaircraft artillery made extensive tests of the SCR-584 radar set in a terrestrial role. This set was not designed for this purpose and was unsuitable from the point of view of mobility and size. It was successful in locating vehicular traffic at 28,500 yards. Movements of individuals and groups of men were plotted and the operators were able to make quite accurate estimates of the number of men in any group. Plotting of friendly artillery shell bursts to an estimated accuracy of ten yards was possible. Observation of air bursts was more satisfactory than impact bursts. The tests demonstrated that radar can be developed as a line of sight observing instrument, the use of which is not limited by darkness or poor visibility. 11,20,21.

37. Division and Corps Responsibility. Exploratory work in mortar detection by sound ranging demonstrated that, to be effective, counter fires had to be quickly delivered. Corps artillery could not obtain the necessary clearances in time to accomplish the mission. Locations of mortars and nebelwerfers were therefore reported direct to division artillery. The development of radar should therefore be along two lines; a short range, mobile set for the division artillery and a slightly larger set for the observation battalions to accomplish long range observation and registration. 18,20,21.

SECTION 9

SUITABILITY OF ORGANIZATION

38. Observation Battalions in Combat in European Theater. There were observation battalions organized under Table of Organization 6-75, 1 April 1942, and Table of Organization and Equipment 6-75, 9 March 1944, in the European Theater of Operations. Units of the first type were able to deploy two independent sound bases per battery for short periods. It was not clearly demonstrated that units of the second type could not have accomplished this since it was never attempted in combat. The unit commanders, however, were satisfied that it was not feasible with the reduced number of men and vehicles. No observation battalions were reorganized under Tables of Organization and Equipment 6-75, 1 Feb 1945, in time to say that it had been tested in combat. This table is essentially the same as that of 9 March 1944. 1,18.

39. The Army Observation Battalion. In addition to the organic corps observation battalions there was one assigned to each army. Battalions assigned to armies were seldom employed as units, the two observation batteries being divided and attached to the two corps of the army which had the greatest observation problems. The headquarters of these army observation battalions were seldom employed with their batteries. 1,18,19.

40. Corps Fronts and Observation Battalion Capabilities. The excessive width of the corps fronts in the European Theater of Operations was discussed in paragraph 7. The observation batteries were organized for operation on a 10,000 yard front. To cover the corps fronts that existed in the European Theater a minimum of three observation batteries per observation battalion was necessary. 18,19,20.

41. Major Changes in Organization. A conference of the observation battalion commanders whose units had operated in the European Theater was held at Paris, France, from 18 July 1945 to 24 July 1945. Based on their combat experience, they recommended the following major changes in organization of the observation battalions:

a. Battalion Organization. The observation battalion should be composed of a headquarters and headquarters battery and three observation batteries. This recommendation was qualified to the extent that they desired an additional battery for terrestrial radar observation if it proved impractical to operate radar either from the flash platoon or as a separate platoon in the present observation battery.

b. Headquarters Battery Organization. The overall organization of the observation battalion headquarters and headquarters battery should remain unchanged. Two additional wire trucks and crews and adjustment of the service platoon to correspond to the increased size of the battalion will be necessary if an additional observation battery is added to the battalion.

c. Observation Battery Organization. The overall organization of the observation batteries should remain unchanged until radar equipment is developed for observation of terrestrial targets. Terrestrial radar observation should operate as part of the flash ranging platoon or as a separate platoon in the observation battery. Additional wire and maintenance personnel and equipment will be necessary at that time.

CHAPTER 2

CONCLUSIONS AND RECOMMENDATIONS

SECTION 1

CONCLUSIONS

42. Employment.

a. That employment of the field artillery observation battalion under centralized control as a corps artillery intelligence agency was more effective than employment under decentralized control with the field artillery group or division artillery.

b. That the employment of the field artillery observation battalion had its greatest value under stabilized conditions of warfare and that the value decreased as the rapidity of movement increased.

43. Sound Ranging.

a. That sound ranging was effective in locating the German artillery and that the standard methods of sound ranging described in Field Manual 6-120, May 1945, were used with the following exceptions:

- (1) No curved bases were employed.
- (2) No ballistic plotting was employed.
- (3) Microphones were inserted between the regular microphones of the base to give more points on the curve of initial breaks.

b. That sound ranging locations were not sufficiently accurate to permit the indiscriminate employment of map data corrected methods of counterbattery fire.

c. That when sound ranging locations were compared with photo interpretation, excellent results were obtained.

d. That the following sound ranging equipment should be improved:

- (1) Sound Ranging Recording Set, GR3-C.
- (2) Sound Ranging Plotting Board, M1.
- (3) Modulator Assembly AN/GRA-1-(), Radio Link.

44. Flash Ranging.

a. That flash ranging was not effective in locating the German artillery but was able to accomplish its missions of registration and general intelligence.

b. That the standard methods of flash ranging described in Field Manual 6-120, May 1945, were employed.

c. That poor visibility interfered with visual methods of observation and that a more positive method of gaining intelligence was needed.

d. That the following flash ranging equipment should be improved:

- (1) Azimuth Instrument, M1, and/or British Spotting Instrument, M2.
- (2) Flash Ranging Switchboard, ED70.

45. Survey.

a. That the survey sections of the field artillery observation battalion, employing the methods described in Field Manual 6-120, May 1945, successfully established survey control throughout the artillery area.

b. That the 20 second Gurley transit was not satisfactory in combat.

c. That survey sections needed lighting devices outside the visual spectrum for night surveys.

46. Meteorological Service.

a. That the field artillery observation battalions did not have the proper meteorological equipment during combat in the European Theater of Operations to furnish a satisfactory meteorological message.

b. That the observation battalion, the air corps mobile weather detachments and the antiaircraft artillery cooperated to furnish a meteorological message that was satisfactory with the exception of its frequency.

c. That Meteorological Set, SCR-658, arrived after the end of combat in the European Theater of Operations and is satisfactory except in the time required for observing.

47. Communications. That a special meteorological radio net was necessary in combat in the European Theater of Operations.

48. Radar. That it was successfully demonstrated that radar could be used to obtain intelligence, locate mortar projectiles, and observe for registrations.

49. Suitability of Organization.

a. That three observation batteries per field artillery observation battalion were needed during combat in the European Theater of Operations.

b. That radar methods of observing are needed in the field artillery observation battalion to supplement visual methods.

SECTION 2

RECOMMENDATIONS

50. Mission. That the missions assigned to the field artillery observation battalions in Field Manual 6-120, May 1945, should not be modified.

51. Employment. That the principles of tactical employment of the field artillery observation battalion described in Field Manual 6-120, May 1945, should not be modified.

52. Organization.

a. That the field artillery observation battalions should be reorganized with three observation batteries per battalion.

b. That one field artillery observation battalion should be reorganized on an experimental basis with a radar platoon in each observation battery.

c. That additional communications, maintenance and service personnel and equipment should be added to compensate for the increases recommended in paragraphs 52a and 52b.

d. That personnel and equipment to establish a meteorological radio net between adjacent corps and between corps and army should be added to the headquarters battery of the field artillery observation battalion. That a weather officer with personnel and equipment for supervising this net be at army level.

53. Training. That the regular course of instruction at the Field

Artillery School, Fort Sill, Oklahoma, should stress the analysis of intelligence data in a counterbattery intelligence course for all field artillery officers.

54. Equipment.

a. That development of the equipment described in Inclosures 10D, 1S, 7T, and 19T to the report of the Army Ground Forces Equipment Review Board, 20 June 1945, and concurred in by the Theater Commander, European Theater of Operations, will meet the requirements of the field artillery observation battalions.

b. That the development of meteorological equipment should be continued with a view to decreasing the time consumed in observation, computation and delivery of the field artillery ballistic message to the using units.

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