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Operations of the Air Defense Division,
SHAFF, 1944-45, by Col W. H. Brucker, CAC.
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School of Combined Arms
Regular Course
1946-1947

Operations of the Air Defense Division, Supreme Headquarters, Allied Expeditionary Force, 1944-1945

(Personal experience of the Chief of a staff section)

Type of Operation Described: Coordination of Defense against air attack

Colonel Wallace H. Brucker, CAC

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2. SHAEF Operation Memorandum No. 7: "Antiaircraft Artillery, Barrage Balloons, and Antiaircraft Smoke in Continental Operations", 8 March 1944, with amendments.
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4. AFHQ Antiaircraft Operation Instruction No. 3: "Organization of Antiaircraft Defenses", 27 September 1943.

INTRODUCTION

From the date of its publication in Field Manual 100-20, "Command and Employment of Air Power", the concept that anti-aircraft defense is only one aspect of the all-inclusive problem of air defense, whose effectiveness is assured only by integrating all defense elements under an Air Force commander, has been widely opposed. This opposition, which was almost universal among Anti-aircraft Artillery officers serving in the Mediterranean and European Theaters of Operations, was based initially upon combat experience in North Africa under a defense system which can best be described as "coordinated anti-aircraft-air defense", where the relationship between the Anti-aircraft Artillery and the Air Forces was substantially the same as that which later developed in the joint air-ground operations conducted by Armies and Tactical Air Forces. Further experience in the European Theater of Operations not only convinced its proponents that coordinated defense is fundamentally sound, but it demonstrated to them that an integrated defense system definitely impairs the flexibility of Anti-aircraft Artillery. The validity of the arguments for coordinated defense was soon recognized by the senior Ground Force officers in the European Theater, and culminated in the conclusion of the Theater General Board that the placing of Anti-aircraft Artillery under Air Force command was not justified by experience. This conclusion was supported by General of Flakartillery Walther von Axthelm, who commanded the German Anti-aircraft Artillery in an integrated system under the Luftwaffe, when he stated during an interrogation after the German surrender that it is much better for the AA Artillery to be a separate branch, instead of under Air Force command.

During the summer of 1946, recognizing the necessity for achieving the maximum degree of flexibility in the employment of the limited Artillery resources of the post-war Army, Headquarters Army Ground Forces made a study of the anti-aircraft defense problem and reached the conclusion that the tactical doctrine and defense concepts of the Anti-aircraft Artillery and the Air Forces were so different as to make the integration of AA weapons and fighter aviation under an Air Force commander impractical and illogical. As a result of this study, the Commanding General, Army Ground Forces requested reconsideration of the current War Department air defense policy.

The purpose of this monograph is to describe the evolution of the European Theater organization for defense against air attack during the past war, to discuss a few of the major problems encountered by the Air Defense Division, SHAEF, as the senior coordinating agency of the Theater defense organization, and to draw some conclusions in support of the Army Ground Forces contention that anti-aircraft defense presents a distinct problem which can best be solved by the employment of Anti-aircraft Artillery and fighter aviation, each under its own commanders, in a coordinated and complementary effort, in accordance with the directives of a higher authority, exercising command over both Air Forces and Ground Forces.

ANTIAIRCRAFT PLANNING FOR OPERATION "OVERLORD"

When the Air Defense Division was established on 1 June 1944 as a special staff division of Supreme Headquarters, Allied Expeditionary Force, the antiaircraft planning for Operation "OVERLORD" had been completed and the launching of the operations on the Normandy coast was imminent. In order to provide an understanding of the organization for defense against air attack which existed as the operations began, and to explain the reasons for the adoption of the defense system which was initially employed, it is necessary to review briefly the events of the six months which preceded the establishment of the Air Defense Division.

In November, 1943, an Antiaircraft Sub-Section was activated in the G-3 Division of what was then known as Headquarters COSSAC, in London, and directed to prepare an operation memorandum governing the employment of antiaircraft artillery during the forthcoming operations on the European continent. The AA Sub-Section, slightly augmented in personnel, remained a part of the G-3 Division after Headquarters COSSAC had been re-designated SHAEF and until the establishment of the Air Defense Division, when it was absorbed by the latter.

In accordance with its directive, the AA Sub-Section immediately began the preparation of an operation memorandum which would define the responsibilities for command and control of AA Artillery, the rules for antiaircraft engagement, and the restrictions to flying designed to prevent the damage or destruction of friendly aircraft by AA Artillery. The defense organization and procedures employed in the North African Theater having proven highly effective, it was decided that they should form the basis for the instructions governing the employment of AA Artillery in the European Theater, insofar as they were applicable. Accordingly, it was proposed that, initially, all AA Artillery employed on the continent would be under command of the Army Groups, and that when independent lines of communications areas or communications zones were established, the responsibility for antiaircraft defense and command over the AA Artillery employed therein would pass to the commanders of these rear areas. As in the North African Theater, Air Force Controllers were to be given "operational control" over AA Artillery, to the extent that they could impose temporary restrictions upon AA gunfire in all except the most vital areas, designated as "Inner Artillery Zones", whenever it was impossible to recognize or identify approaching aircraft. In spite of this control feature, which had proven effective as a means of minimizing losses to friendly aviation in North Africa, even though occasionally misused by Air Force Controllers, the Allied Expeditionary Air Force objected to the proposed command arrangements for an independent U.S. communications zone, insisting that the AA Artillery employed in the defense of such a rear area must be placed under Air Force command, in accordance with the newly adopted, and as yet untried, War Department air defense doctrine, which had appeared in Field Manual 100-20. It was therefore necessary for this contentious issue to be presented in the form of a staff study to the Chief of Staff for a decision, with the result that the Air Forces were overruled. The rules for antiaircraft engagement and restrictions to flying followed fairly closely the rules then in effect in the North African Theater, as set forth in Air Defense Instruction No. 1 of Allied Force Headquarters, with the exception of the special rules for beach restricted areas, where the experience of Fifth Army at Salerno was used as a guide. With one controversial feature in the rules for beaches and adjacent waters, over which the Allied Naval Commander, Expeditionary Force, and the Commander in Chief of the Allied Expeditionary Air Force differed, settled by a Chief of Staff's decision, the balance of the proposed operation memorandum was accepted by all major commands substantially as written in

a second draft, and was published on 8 March 1944 as SHAEF Operation Memorandum No. 7, entitled "Antiaircraft Artillery, Barrage Balloons, and Antiaircraft Smoke in Continental Operations".

In April 1944, the Antiaircraft Sub-Section also produced SHAEF Operation Memorandum No. 31, entitled "Coast Defense", which was logically related to the antiaircraft defense problem by the fact that antiaircraft artillery, including searchlights, sited in a secondary coast defense role, was to provide the only shore-based artillery for the defense of ports, beaches, and anchorages on the continent. The coast defense capabilities of AA Artillery was one of the several compelling factors which influenced the decision to place all AA Artillery under the commanders having area responsibility, rather than under the Air Forces.

In May 1944, the Supreme Commander decided to centralize in one senior staff officer the responsibility for coordinating all active and passive air defense measures, as well as antiaircraft defense where it existed as such. Accordingly, on 1 June 1944, as planning for Operation "OVERLORD" came to a close, the Air Defense Division was established as a special staff division of SHAEF.

ORGANIZATION AND FUNCTIONS OF THE AIR DEFENSE DIVISION, SHAEF

In order to provide the Supreme Commander with an air defense adviser of suitable rank and experience, a British major general of AA Artillery was selected as Chief of the Air Defense Division. No provision was made initially for a Deputy Chief, largely because the complexity of the problems to be encountered were not at first completely visualized, and also because the size of the Division at first was not considered to justify the assignment to it of two general officers. However, in February 1945, a U.S. brigadier general of AA Artillery was appointed as Deputy Chief of the Division. In the meantime, the Chief of the Air Defense Division had selected as his assistant a British colonel, formerly Chief Instructor in Gunnery of AA Command, Air Defense of Great Britain.

As initially organized, the Air Defense Division consisted of three sections, as shown in Figure 1. These three sections, together with the personnel in them, were transferred from the G-3 Division on 1 June, and were subsequently augmented in strength by the addition of officers from the British AA Command. The Air Defense Division was a fully integrated staff division, with British and U.S. personnel in about equal proportions.

Broadly speaking, the three original sections of the Air Defense Division operated along distinctly parallel lines, with the operations of any one section only occasionally affecting those of the other two sections. The Operations Section was concerned generally with all operational aspects of active air defense and antiaircraft defense, with ramifications into such fields of activity as aircraft flight corridors, the Air Force movement liaison system, the use of I.F.F., and air intelligence. It also published the Air Defense Review on a monthly basis, the material for which came from all sections of the Division. The Technical Section dealt almost entirely with the radar and gunnery problems of the AA Artillery, but its activities also embraced the investigation of other uses for AA Artillery radar by the Ground Forces. The Passive Air Defense Section, as its name implies, confined its activities to the coordination of measures designed to mitigate the effects of bombing. Since the purpose of this monograph is to clarify the issues of air defense and antiaircraft defense, the operations of the Technical and the Passive Air Defense Sections will not be further discussed.

In October 1944, when it became fairly evident that the Germans soon would commence launching their V-1, flying bombs, and V-2, long range rockets, against vital installations of the Allied Expeditionary Force on the European continent, the Supreme Commander placed upon the Chief of the Air Defense Division the additional responsibility for coordinating all counter-measures, both active and passive, directed against V-1 and V-2. To assist him in the discharge of his new responsibilities, the Chief of the Air Defense Division established what was known as the Continental Crossbow Organization, whose composition was substantially as shown in Figure 1, in broken lines.

Within the Air Defense Division proper, two new sections were created as part of the Crossbow Organization: the Continental Crossbow Collating Section and the Air Advisory Staff. The first of these was essentially a statistical and analysis group which operated on a 24-hour daily basis, receiving reports of V-1 and V-2 incidents from numerous sources. These incidents were plotted on large scale maps and analyzed to determine centers of impact, mean deviations from apparent targets, variations in the intensity of attack, and indications of any shifting in the direction of attack or in targets being attacked. The Air Advisory Staff consisted of an RAF group captain and a USAAF lieutenant colonel, whose function was to advise the Chief of the Air Defense Division on suitable targets for attack and the scale of effort

which should be applied by Air Force units against V weapon launching sites or their related supply installations. Assistance was also given to the Chief, Air Defense Division, by the Intelligence Interpretation Section of the A-2 Division, SHAEF Air Staff, which attempted to establish the location of V weapon launching sites by means of information coming in via intelligence channels.

The field agencies of the Crossbow Organization, which were administratively under command of Headquarters 21 Army Group but under the direct operational command of the Chief, Air Defense Division, consisted of the Special Defense Headquarters, Royal Artillery, and the Continental Crossbow Forward Unit. The mission of the Special Defense Headquarters, RA, was to detect and track V-2 missiles in flight, and by extrapolation of such portions of their trajectories as could be plotted to determine the location of the launching sites. The Forward Unit examined V-2 craters and attempted to determine from the fragmentation pattern the direction of approach of the missiles.

From this brief description of the organization and functions of the Air Defense Division, it will be seen that the operations of the various sections were somewhat diverse in nature. However, considered collectively, these operations dovetailed together and covered completely all aspects of the problem of defense against air attack, with extremely little duplication of effort.

ORGANIZATION OF THE AIR DEFENSE DIVISION, SHAEF

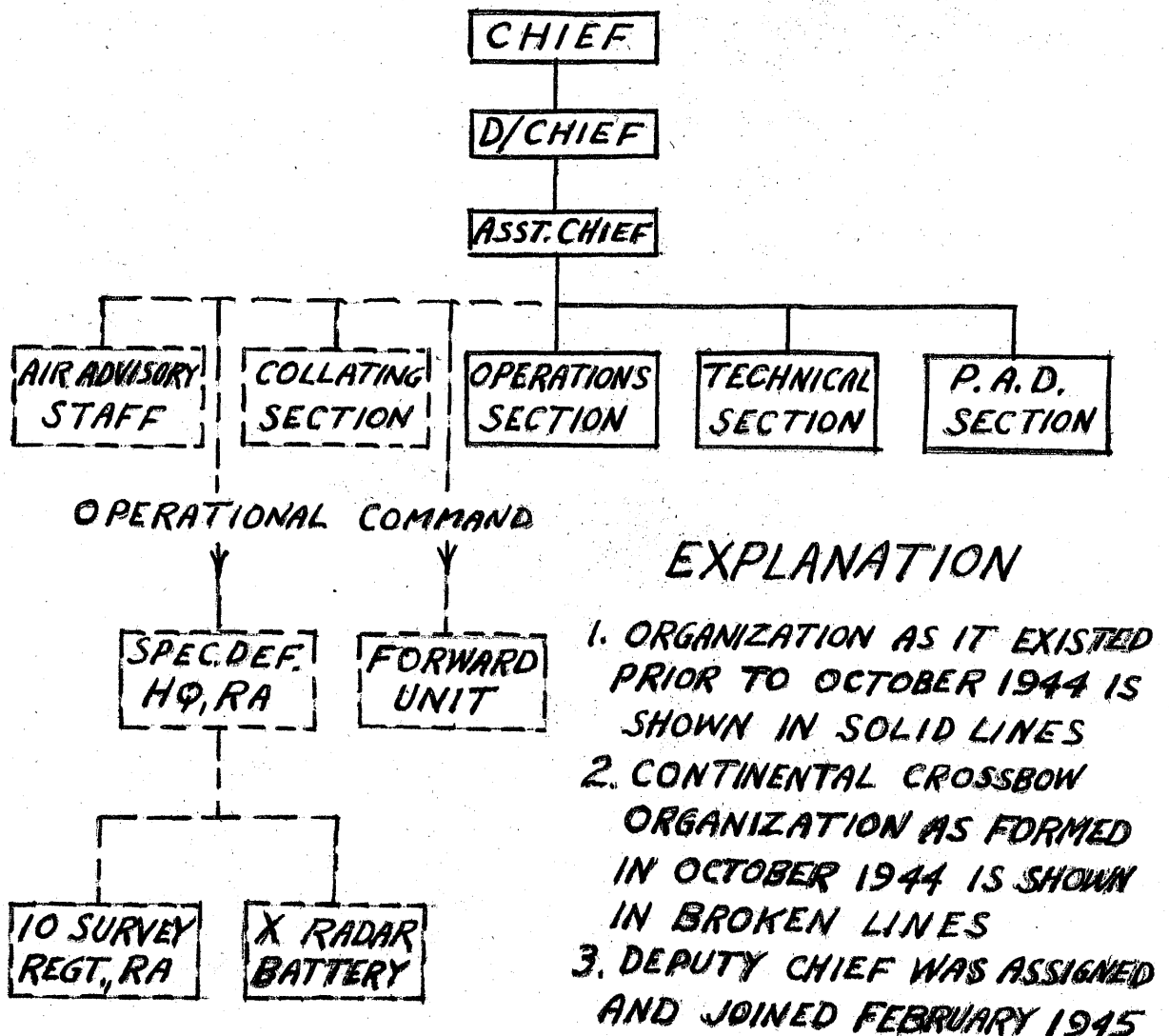


FIGURE 1

ORGANIZATION FOR DEFENSE AGAINST AIR ATTACK IN THE EUROPEAN THEATER

CHAINS OF COMMAND

AIR FORCES ———

GROUND FORCES ———

OPERATIONAL CONTROL - - -

← SHAEF

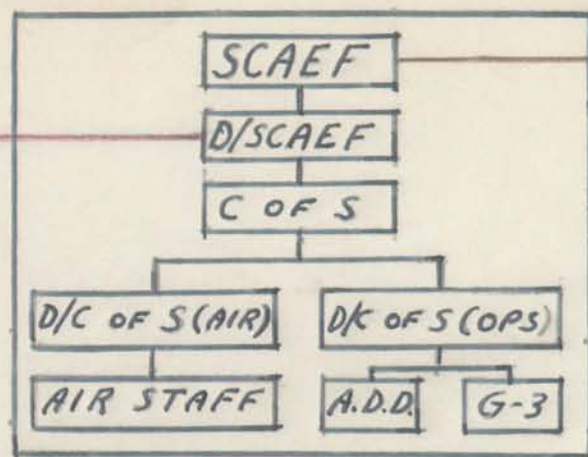
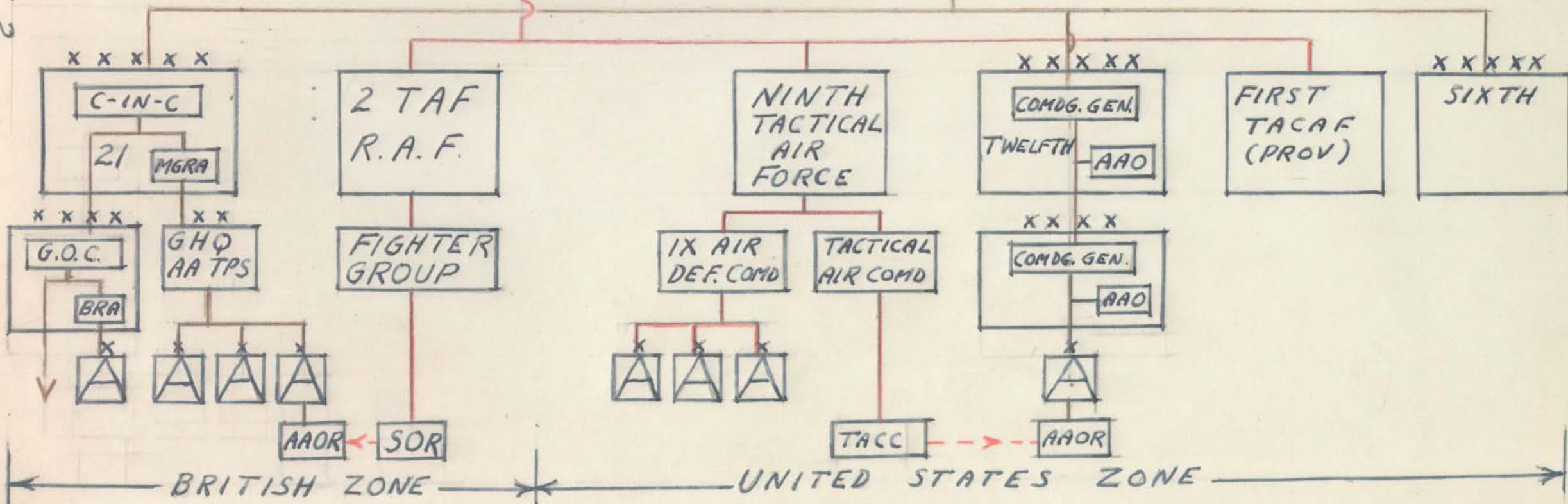


FIGURE 2



ORGANIZATION FOR ANTI-AIRCRAFT DEFENSE IN THE EUROPEAN THEATER

As previously stated, during the planning phase for Operation "OVERLORD", the decision had been made to place all AA Artillery employed on the European continent under the commanders having area responsibility. This decision had been made over the objections of the U.S. Army Air Forces, who argued that all AA Artillery which was not assigned to the Armies for the protection of ground troops should be placed under Air Force command, to participate in area air defense, in accordance with the War Department air defense doctrine.

In late July 1944, after the lodgement area in Normandy had been secured and preparations were being made for the break-out, Headquarters Communications Zone was established on the continent and assumed command of the AA Artillery deployed behind the newly established First Army rear boundary. Contrary to the expectation that he would retain centralized control over his AA Artillery, the Commanding General, Communications Zone, immediately began to sub-allot AA Artillery units to port and district commanders, thereby disrupting the brigade and group organization which was then in effect on the Cotentin Peninsula, including Cherbourg.

The Air Force reaction to this development was prompt and effective. The Deputy Commander, Allied Expeditionary Air Force, then Major General Hoyt Vandenberg, immediately conferred with the Assistant Chief of Staff, G-3, and the Chief, Air Defense Division, of SHAEF, and it was agreed that the AA Artillery employed in the Communications Zone should be placed under IX Air Defense Command of the Ninth Air Force. Before presenting this informal agreement to the Supreme Commander as a definite recommendation, the Chief of the Air Defense Division submitted the proposal to the major commands for their comments. Both Headquarters, European Theater of Operations, U.S. Army, representing the Commanding General, Communications Zone, and the Commanding General, Twelfth Army Group, in his capacity of coordinator of all U.S. operations on the continent at that time, objected to the proposal on the grounds that each commander having area responsibilities should exercise command over the AA Artillery employed in the defense of installations in his area. Headquarters 21 Army Group, although not directly involved in the problem, supported the view of the Commanding General, Twelfth Army Group. The Allied Naval Commander, Expeditionary Force, who also was not directly involved in the problem, concurred in the proposal, as did the Allied Expeditionary Air Force. The recommended change was then submitted to the Supreme Commander, who approved it on 1 August and directed that the change in command be effected immediately.

With the change described above, the Theater organization for defense against air attack assumed the form shown schematically in Figure 2, in which it remained essentially unaltered until the close of the war in Europe. For simplicity of illustration, Sixth Army Group has been omitted from Figure 2, since its command organization differed only slightly from that of Twelfth Army Group. An examination of Figure 2 will reveal the striking similarity which existed in all Army areas, regardless of nationality, in that each Army had an AA Artillery brigade under its command for the protection of installations in the Army rear areas, with decentralization of command over AA Artillery required for the protection of Corps and Divisions. The organization within the Armies differed to the extent that the Brigadier, Royal Artillery, as an artillery commander, exercised command over the Army AA Artillery, in addition to functioning as an advisor to his Army commander, whereas the AA Officer in the U.S. Army functioned only as a staff officer.

A major difference in defense organization between the British and U.S. Army Groups was that for defense of the British zone behind the Army rear boundaries, where GHQ AA Troops operated as a form of British Theater AA Command, under the supervision of the Major General, Royal Artillery, 21 Army Group. In late 1944, the British rear area defense organization approached more closely that of the U.S. Communications Zone, when the Air Officer Commanding 2 Tactical Air Force assumed responsibility for the AA defense of his airfields, employing the Royal Air Force Regiment for this purpose. This decision turned out to be a costly one, for the airfield defenses in the British zone were caught largely by surprise during the all-out attack by the German Luftwaffe on 1 January 1945, and suffered heavy losses in aircraft caught on airfields.

It is pertinent to this discussion to describe the close coordination which existed between AA Artillery and Tactical Air Force operations in the U.S. Army areas, particularly in the areas of the First, Third, and Ninth Armies. In order to insure the closest possible coordination at the actual operating level, the Army AA Operations Room and the Tactical Air Control Center were located together whenever possible, and frequently in the same room. The close teamwork which characterized the joint air-ground offensive operations was even more pronounced in the joint defensive operations conducted from these combined centers. Here, aircraft movements reported by the Signal Aircraft Warning Battalions and by the Antiaircraft Artillery Intelligence Service were filtered, and the AA Liaison Officer either alerted the AA defenses affected or placed temporary restrictions upon AA gunfire, depending upon the identification of the aircraft reported. Although the principle of operational control was in effect, it was seldom invoked, since the AA Liaison Officer, the Movement Liaison Officer, and the Controller, working closely together, were usually in agreement as to the action to be taken.

Having gained command over all U.S. AA Artillery which was not assigned to the Armies, and having established an air defense area in accordance with Field Manual 100-20, it might be concluded that the Air Forces had attained all of their objectives and consequently, that no controversial features remained in the Theater defense organization. However, a new controversial phase was about to begin, presenting one of the most difficult problems confronted by the Air Defense Division of SHAEF during its year of operations. This controversy, in which the Twelfth Army Group and the Ninth Air Force engaged, will be discussed in the next section.

CONTROVERSY OVER ANTI-AIRCRAFT DEFENSE IN ARMY AREAS

The controversy between Ninth Air Force and Twelfth Army Group over AA defense in Army areas began shortly after a review of the Theater AA Artillery troop basis, conducted in September 1944 at the request of the War Department, resulted in a scaling down of AA Artillery units earmarked for the European Theater from the original total of approximately 200 battalions to 150 battalions, exclusive of Sixth Army Group's battalions which were provided by the Mediterranean Theater. The reduction, which was based upon revised estimates of minimum requirements by IX Air Defense Command and Twelfth Army Group, was taken in units not yet shipped from the Zone of the Interior, and its effect was soon felt in the reduced flow of AA Artillery units into the Theater. Although provision had been made in the reduced scales of defense for battalions to be attached to each Corps and Division as they became operational, these large units began to arrive in the Theater at a more rapid rate than did the AA Artillery units which were earmarked for them, with the result that by November Twelfth Army Group was faced by a temporary shortage of AA Artillery battalions, and appealed to SHAEF for reinforcements. The Army Group contended that, inasmuch as virtually all of the enemy air activity was concentrated on the forward areas, AA Artillery deployed in the Communications Zone should be regarded as a Theater reserve for the reinforcement of the Armies. This view is supported by the record, which shows that between 6 June 1944 and 8 May 1945, out of a total of 2,138 enemy aircraft confirmed as destroyed by U.S. AA Artillery, 2,116 were destroyed by units assigned or attached to the Armies. The totals on aircraft probably destroyed are about half as large, and are in the same proportion.

Unfortunately, the requirements of Twelfth Army Group for temporary reinforcements conflicted with those of Ninth Air Force, which was attempting to strengthen the defenses of its airfields in the Communications Zone, and this tight situation was made more critical by the fact that it had been necessary to transfer 15 battalions from IX Air Defense Command to GHQ AA Troops of 21 Army Group for the flying bomb defense of Antwerp. As a consequence, each request by Twelfth Army Group for reinforcements at the expense of IX Air Defense Command was vigorously opposed by Ninth Air Force, supported by the SHAEF Air Staff. It was necessary for the Air Defense Division in each case to prepare a staff study, reviewing the Theater AA Artillery position, and to submit recommendations to the Chief of Staff for decision, frequently with the non-concurrence of the Air Staff. In some instances, the arguments of Ninth Air Force for retaining its AAA units were more logical than those presented by Twelfth Army Group as a basis for requesting them. This situation was particularly true when the Army Group requested a searchlight battalion for each of its Armies, in order to provide artificial moonlight. The Ninth Air Force argument against giving up the battalions was that, at the time the Theater AA Artillery troop basis had been revised, Twelfth Army Group had indicated no requirement for AA searchlights, and IX Air Defense Command had reduced its requirements for this type unit to a bare minimum, in order to provide sufficient searchlights for homing beacons on airfields. In the staff study which followed, the relative needs of the two major commands were weighed, and the recommendation that only one searchlight battalion be transferred to Twelfth Army Group, sufficient to provide each Army with one battery, was approved by the Chief of Staff.

This situation reached a climax early in January 1945, as the result of a Theater administrative instruction which stated in effect that the Communications Zone would not be extended into Germany. The AA Artillery implications of this instruction were that under the existing division of responsibilities, IX Air Defense Command could not enter Germany, and that as the Army areas extended in depth there would be a continual demand for AA Artillery reinforcements, which could be met only at the expense of IX Air Defense Command. Again, as in July 1944, the Air Force reaction was prompt and effective. The Commanding General, Ninth Air Force, Lieutenant General Hoyt Vandenberg, submitted a letter, asserting that his airfields in Army areas were not being adequately defended and stating that it was a fundamental principle that every commander is responsible for the security of his troops and installations, and should have under his own command the means for insuring their security, regardless of where they might be situated. In effect, he requested that Ninth Air Force assume responsibility for the antiaircraft defense of its airfields in Army areas, employing AA Artillery units assigned to IX Air Defense Command for this purpose. At the same time, General Carl Spaatz, commanding U.S. Strategic Air Forces in Europe, addressed a letter to the Supreme Commander stating that now was the time to put into effect in the European Theater an integrated air defense system, such as had proven so successful in other theaters of operations.

The Air Defense Division then began a study of this new development. As to the complaint about the inadequacy of airfield defenses in Army areas, General Bradley, commanding Twelfth Army Group, stated that General Vandenberg had never brought this fact to his attention, and furthermore, the record showed that during the mass attack on airfields which occurred on 1 January, Allied AA Artillery had destroyed 363 enemy aircraft out of an attacking force of approximately 900, with Twelfth Army Group AAA units accounting for more than half of this total. No other attacks of any consequence had occurred on airfields. General Vandenberg's assertion of the principle that every commander must be responsible for the security of his own installations was considered rather surprising, in view of his insistence the previous summer that the Air Force must assume command of all AA Artillery in the Communications Zone for the defense of Communications Zone installations. In discussions held with the Air Staff, it was brought out that the Air Force Group commanders found it convenient to charge the AA Artillery defending their airfields with the additional responsibility of protecting the airfields against all forms of attack, and that it was desirable for the same AA Artillery units to accompany the Air Force groups wherever they went.

As a result of its study, the Air Defense Division concluded that it was both tactically and administratively unsound to have two sets of identical units, performing essentially the same defense missions under completely independent commanders, intermingled in the same area, and it further concluded that it was a waste of highly trained AA Artillery units to use them for local ground defense missions, if they were required elsewhere on higher priority antiaircraft defense missions. However, it was foreseen that the struggle to reinforce the Armies at the expense of the Air Defense Command would be indefinitely prolonged, unless a change in territorial responsibilities could be effected. Accordingly, a compromise solution was offered by the Air Defense Division which was in effect a victory for the Air Forces. This solution, which was approved by the Supreme Commander, though opposed by General Bradley, provided that the Armies of Twelfth Army Group should receive no further reinforcements in AA Artillery, but that instead they would jointly agree with IX Air Defense Command to the

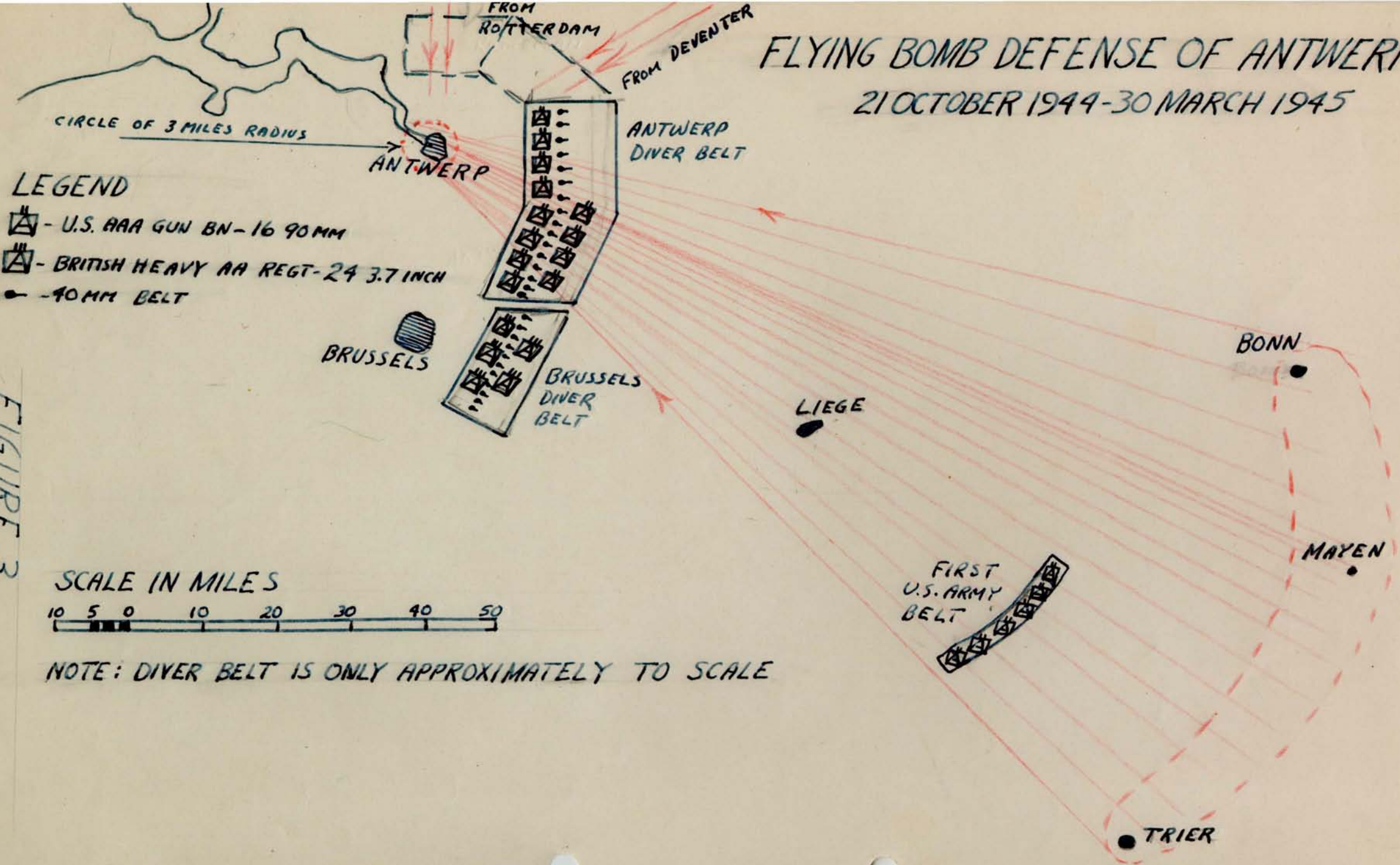
establishment of a "rear air boundary", in front of which Army AA Artillery would protect all installations, including airfields, and in rear of which Air Defense Command AA Artillery would protect all installations. Before the end of the war, by verbal agreement, the Air Defense Command was allowed to protect all airfields in the Twelfth Army Group area.

The problem just discussed represents a conflict between the integrated air defense concept and the coordinated anti-aircraft-air defense concept, the relative merits of which were, and still are, a matter of opinion. In the controversy just discussed it is worthy of note that the highest ranking Air Force commanders in the Theater threw their weight behind the effort to gain command over the AA Artillery, and used arguments which close examination revealed were not entirely valid. It is also worthy of note that, within approximately one month after the decision had been made to place AA Artillery under IX Air Defense Command, all Air Force elements with the exception of one Signal Aircraft Warning battalion were transferred from the Air Defense Command to the Tactical Air Commands, leaving IX Air Defense Command for all practical purposes a Theater AA Command under Ninth Air Force control.

In the next section a problem will be discussed whose complexity was due to German inventiveness and mechanical genius, and the solution to this problem is a matter of far greater concern than any other arising from World War II, with the single exception of the atomic bomb. Since this problem has many ramifications, the discussion will be limited in scope to the defense of Antwerp against V-1 and V-2.

FLYING BOMB DEFENSE OF ANTWERP

21 OCTOBER 1944 - 30 MARCH 1945



LEGEND

- U.S. AAA GUN BN-16 90MM
- BRITISH HEAVY AA REGT-24 3.7 INCH
- 40MM BELT

FIGURE 3

SCALE IN MILES



NOTE: DIVER BELT IS ONLY APPROXIMATELY TO SCALE

DEFENSE OF ANTWERP AGAINST V-1 AND V-2

From the time of the initial landings in Normandy, it had been appreciated that German V weapons would probably be used against Allied installations on the European continent as soon as suitable targets presented themselves. The defense of Antwerp and Brussels against such attacks had been under consideration since 1 October, when Allied intelligence had determined that preparations were being made by the Germans to attack these cities with flying bombs. In view of the outstanding success of British and U.S. AA Artillery units deployed on the south coast of England in destroying over 75 percent of the flying bombs which came within their range, it had been decided that AA Artillery would provide the most effective defense for Antwerp and Brussels against this form of attack. British AA brigades were already committed to the defense of the Scheldt Estuary, the Antwerp docks, and the important leave and communications center of Brussels, and could not provide the flying bomb defense for both Antwerp and Brussels. Accordingly, it was agreed by SHAEF that U.S. AA Artillery units should defend Antwerp, which was to be used jointly by U.S. and British forces, while British AA Artillery would defend Brussels.

The decision was made that 12 AAA Gun battalions and 3 AAA Automatic Weapons battalions, with two brigade and three group headquarters to provide the necessary control of operations, would be provided from units of IX Akr Defense Command, and would be placed under command of GHQ AA Troops, 21 Army Group. The senior U.S. AAA brigade commander was to command the entire U.S. force, and he established what was known as Headquarters Antwerp "X". Deployment of 3 Gun battalions began on 15 October, and the defenses were complete by 13 November. The objections of the Air Forces to the establishment of a restricted area around the flying bomb defenses of Antwerp had been overruled by the Chief of Staff, who stated that Antwerp constituted the most important single area in Europe, and that the AA Artillery deployed for its defense should have unrestricted freedom of fire. In the case of the Brussels defenses, he ruled that the Air Forces could exercise operational control over the defenses for the purpose of passing aircraft through the area when no attacks were in progress. The flying bomb defenses were termed the DIVER defenses, DIVER being the code name applied to the flying bomb. The DIVER restricted area was established on 31 October, with the AA Artillery deployed in belts as shown in Figure 3.

It was appreciated that the VT fuze which had been used with such good effect in firing over the water on the south coast of England could not be used in Belgium, owing to the fact that, at low quadrant elevations used in engaging flying bombs, these fuzes presented a considerable hazard to the densely populated areas over which firing had to be conducted. Accordingly, a requirement was submitted to the War Department for a modified fuze with a reduced time to self-destruction, and the first shipments of the modified fuze were rushed to the Theater by air.

On the morning of 21 October, the flying bomb attacks began on a small scale, and during November the scale of attack averaged 25 a day. After a few days it became evident that Antwerp was the target for attack, and that the few flying bombs which entered the Brussels area were strays. In an effort to over-extend and to flank the Antwerp defenses, the Germans constantly shifted their main effort. Commencing with the main weight of their attack from the TRIER-BONN area, centered on MAYEN, by the end of December they had shifted 80 percent of their effort to the vicinity of DEVENTER, Holland, and on 28 January attacks began from the vicinity of ROTTERDAM. However, until all attacks ceased on 30 March 1945, the main effort was centered at DEVENTER.

The gradual shifting of the direction of attack required that the AAA DIVER belt be extended to the northeast and eventually to the north of Antwerp, in order to cover all approaches. This extension of the belt resulted in a serious thinning of the defenses, but was accomplished without impairing the effectiveness of the defenses. During the Battle of the Bulge, the Antwerp DIVER defenses were stripped to a bare minimum, in order to reinforce First Army, and for a time the defenses consisted of only 8 Gun battalions and 1 Automatic Weapons battalion. It should be mentioned in passing that, during the Battle of the Bulge, in addition to reinforcing ground defensive fires and providing anti-mechanized defenses, Twelfth Army Group AA Artillery destroyed, prior to 1 January, 396 enemy aircraft and probably destroyed an additional 279.

On 20 November, the Germans temporarily shifted their V-1 attack from Antwerp to Liege, using the same launching ramps in the TRIER-BONN area which had been employed against Antwerp. To counter this threat, First Army established its own DIVER belt, practically in the front lines, covering the approaches to Liege, with IX Air Defense Command AAA units joining in this defense. This belt remained in operation until it was overrun by the Germans during their ARDENNES counter-offensive, and was not subsequently re-established.

The success of the AA Artillery DIVER defense of Antwerp can best be judged by the fact that, out of a total of 5,307 flying bombs launched, only 289 fell within a circle of 3 miles radius about the Antwerp docks. AAA units in the Antwerp DIVER belt destroyed 2,356 flying bombs, their best performance being during the period 22-30 March, when 87 out of 91 flying bombs approaching Antwerp were destroyed. Obviously, many bombs never came within range of the gun belt, owing to mechanical failures, and those which passed within range but were obviously heading for open country were not engaged, since their destruction would contribute nothing to the safety of Antwerp.

The remarkable degree of success which attended the efforts against V-1 was conspicuously lacking in the campaign against V-2. Although the Crossbow Organization, which has already been described, was fairly successful in locating the general areas of V-2 launching sites and in recording the incidents in the target area, the results obtained by the counter-measures were practically negligible. In the first place, the launching sites, consisting of little more than a stretch of roadway concealed by surrounding trees, was virtually invulnerable to attack, and in the second place, the length of time during which each missile was on the launching site was comparatively short. It was eventually found that greater success could be obtained by attacking supply points, railway sidings and bridges along the routes to the launching sites than in actually attacking the launching sites themselves.

From 14 September, when the attacks began, until they ceased on 28 March, the Germans fired 1,658 V-2 missiles against continental targets, the great majority being against Antwerp. The scale of attack seldom exceeded 20 per day, but the missiles themselves were much more accurate than were the flying bombs, and once in the air no means existed for destroying them before they reached their target. It is interesting to note that on 17 March 11 rockets were fired against the REMAGEN bridgehead, the only recorded instance of their being used in this role.

Various types of British and U.S. AA Artillery gun-laying radar sets were employed by the "X" Radar Battery, under command of Special Defense Headquarters, RA, in attempts to detect and track V-2 targets, and theoretical studies were made to determine the success which could be expected from the use of AA Artillery barrages against V-2. It was concluded that increases

in the range and sensitivity of radar must be made before it can be fully effective, and that while an AA Artillery concentration might destroy some targets before they landed, the results obtained would not be commensurate with the effort involved. However, the fire control equipment and technique of the AA Artillery appeared to offer a promising line of departure for development of a defense against supersonic missiles.

CONCLUSIONS

From the foregoing description of the organization for defense against air attack in the European Theater and the discussion of two major problems which confronted the Air Defense Division, SHAEF, during its operations, the following conclusions are drawn:-

1. The Air Defense Division, SHAEF, adequately fulfilled its mission of coordinating all aspects of defense against air attack in the European Theater during World War II.
2. The soundness of the procedure instructions issued by SHAEF, governing AA Artillery engagement of aircraft and the restrictions to flying, was conclusively demonstrated by the success of the coordinated antiaircraft-air defense operations conducted in the entire British zone and in U.S. Army areas, where approximately 99 percent of all AA Artillery action in the entire U.S. zone occurred.
3. The establishment of an integrated air defense system in the Communications Zone, ETOUSA, was not based upon any demonstrated superiority of such a system over that of a coordinated defense, but instead was the direct result of the unremitting efforts of senior Air Force commanders to gain control over the AA Artillery, assisted by the failure of the Commanding General, Communications Zone, to maintain centralized command over AA Artillery, such as was employed in the 21 Army Group rear area.
4. GHQ AA Troops, 21 Army Group, provided an excellent example of a Theater AA Command, operating under the equivalent of a Theater Antiaircraft Officer, who is responsible to the Theater Commander for the AA defense of the area in rear of the Armies, and who coordinates AA defense with air defense as conducted by the Air Forces.
5. The assertion made in Field Manual 100-20 that "when AA Artillery, searchlights, and barrage balloons operate in the air defense of the same area with aviation, the efficient exploitation of the special capabilities of each and the avoidance of unnecessary losses to friendly aviation demand that all be placed under the command of the air commander responsible for the area", was proven in the European Theater of Operations to have no basis in fact.
6. While the placing of AA Artillery under Air Force command did not impair the ability of AAA units to perform effectively their primary mission, it did complicate their administrative and supply problems and unnecessarily restricted the flexibility of the Theater AA Artillery by making it difficult to shift units to meet the main weight of the air attack.
7. The great destructive power of AA Artillery when employed against high speed piloted and pilotless aircraft was clearly proven by the successful defense of Antwerp against flying bombs and by the impressive total of more than 2,000 enemy aircraft confirmed destroyed in the European Theater by U.S. AA Artillery alone.
8. At the close of World War II, no effective defense against supersonic missiles of the V-2 type had been found, although AA Artillery fire control equipment appeared to offer a promising line of departure for further development.

LESSONS LEARNED

Although the conclusions which have been drawn might in themselves be considered as lessons learned, the following statements are offered as lessons which might be learned and applied as a better solution to the problem of future defense against air attack than the air defense concept, currently stated as War Department doctrine:-

1. In any future Theater of Operations, it is necessary that a coordinating staff agency be established in the Theater or combined headquarters, which will prepare and issue procedure instructions governing the engagement of aircraft and long range missiles of all types by ground and naval weapons, as well as restrictions on the operations of aircraft and missiles over friendly land and sea areas. In the Zone of the Interior, this staff agency should be directly under the Joint Chiefs of Staff, or whatever headquarters they establish to command the land, sea, and air forces engaged in defense of the continental U.S. It is necessary that the above-mentioned staff agency be directly under a combined commander, in order that it may be free of the special interests and pressures within each service.

2. In future Theaters of Operations, all AA Artillery and ground-to-air guided missile units not assigned to the Armies should be directly under the Theater or combined headquarters, since these units are not only protecting installations of all three services, Army, Navy, and Air Force, but in addition, they are a Theater reserve, to be used wherever the threat is the greatest and in whatever role the situation may demand. Their deployment for defense against air attack should be in accordance with priorities submitted by the commanders of the three services. In the Zone of the Interior, these units should be assigned to the Armies which have area defense responsibilities, for only the Armies are capable of exploiting the full capabilities of the combined Artillery arm in meeting attacks coming by land, sea, or air, or any combination of these forms of attack.