U.S. Air Force Historical Study No. 66

AAF AIR DEFENSE ACTIVITIES IN THE MEDITERRANEAN

1942-20 SEPT. 1944

Prepared by the USAF
Historical Division,
Air University
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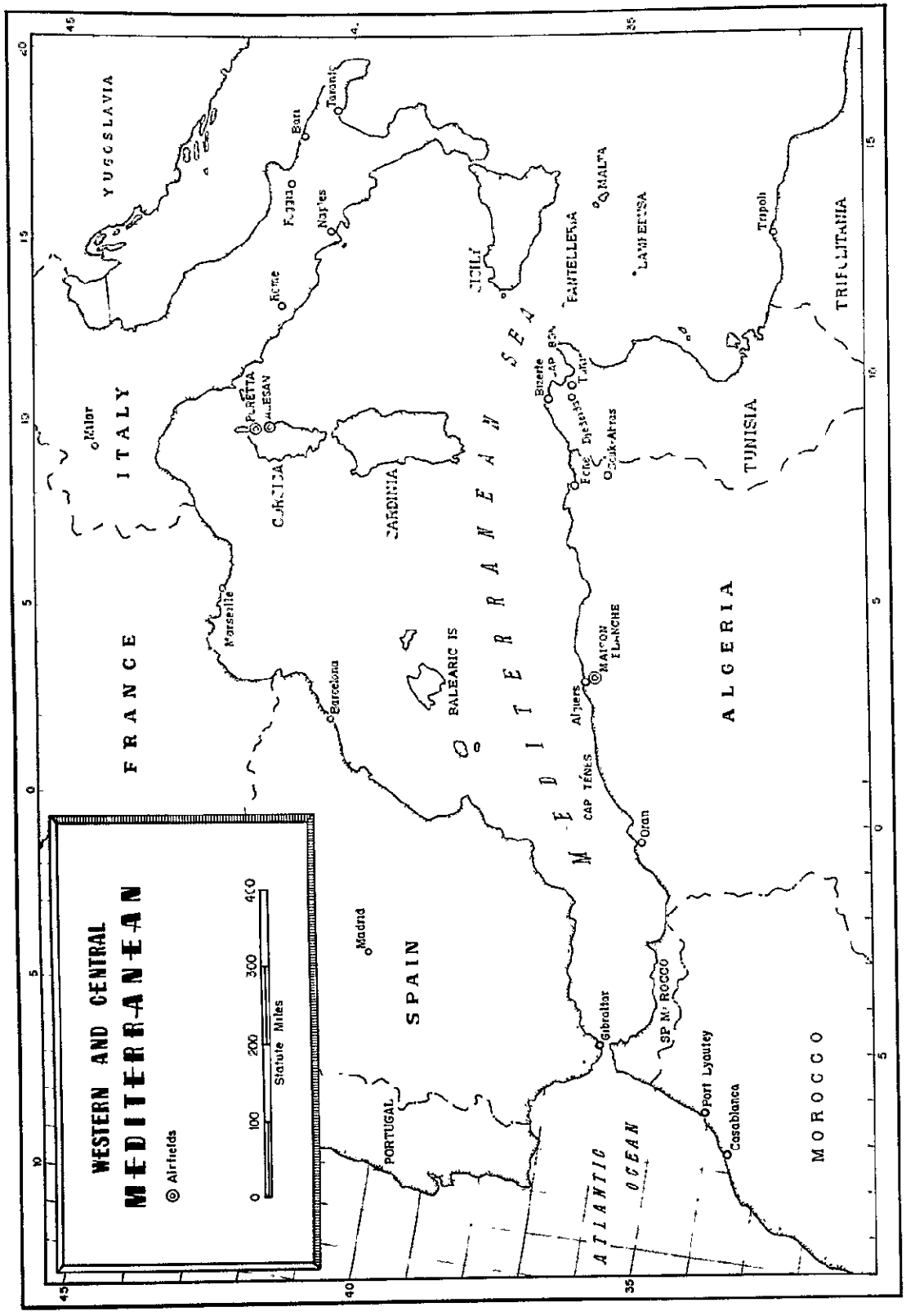

F O R E W O R D

The subject covered in this monograph is related to several other histories prepared by the Historical Division: AHS-105, Air Phase of the North African Invasion, November 1942; AHS-114, The Twelfth Air Force in the North African Winter Campaign, 11 November 1942 to the Reorganization of 10 February 1943; AHS-37, Participation of the Ninth and Twelfth Air Forces in the Sicilian Campaign; AHS-115, Air Phase of the Italian Campaign to 1 January 1944; AHS-92, Development of Night Air Operations. This study was written by Dr. C. L. Grant of the USAF Historical Division, Air University, Maxwell Air Force Base, Alabama

Like other Historical Division studies, this history is subject to revision, and additional information or suggested corrections will be welcomed.

C O N T E N T S

MAPS AND CHARTS

AAF AIR DEFENSE ACTIVITIES IN THE MEDITERRANEAN

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INTRODUCTION

The provision of a defense against enemy air attacks was one of the many problems which confronted American and British planners as the Allies prepared to assume the offensive against the Axis in North Africa in late 1942. Because American combat experience was extremely limited, many air defense requirements were unknown or misunderstood by many of the American planners. Fortunately, the British were not similarly handicapped; the Battle of Britain, the defense of Malta, and the desert warfare in northeast Africa had afforded them valuable experience in air defense. Consequently, Allied air defense in the Mediterranean area in the opening months of the North African campaign became largely a British responsibility. Later, however, as additional personnel and equipment arrived in the theater, American participation gradually increased until, by September 1944, approximately 40 per cent of the air defense burden in the Mediterranean area was entrusted to American forces. This is a study of that American participation from the point of view of the American Air Forces with primary attention given to air defense of areas behind the actual battle zones.

For several reasons, the Mediterranean area was selected as a World War II theater well suited to an air defense study. Allied cooperation in air defense reached a high level in the theater. For the first time in the war the Allies assumed the offensive on a large scale thereby presenting to the still formidable German Air Force choice targets such as masses of supplies, troops, concentrations of shipping, and overcrowded airfields. Finally, for the first time the American Air Forces

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were faced with the necessity of defending from continuous air attack compact and vital targets under actual battle conditions while simultaneously carrying on an offensive.

In order to stress the various activities of the AAF in the Mediterranean air defense system, the study follows a topical arrangement. The preparations made for air defense presented in the first chapter are to provide a framework in which to fit the account of the various functional aspects of the air defense system. Successive chapters are devoted to these aspects, e.g., early warning radars, interceptor forces, antiaircraft artillery, and passive air defense, and an account of operations is included to illustrate the air defense in action.

From its participation in the Allied air defense in the Mediterranean area, several significant requirements were recognized by the AAF. An effective passive air defense system was a necessity if military operations were to proceed unhindered by bomb damage. It was found that radar sets required correct siting and frequent calibration, that radar had to be mobile to be effective in an active theater, and that radar personnel had to be highly trained. The necessity for a ground observer system and for an interceptor force able to operate at night was realized. Lastly, the need for effective communications and for liaison among all elements concerned with air defense was emphasized.

Although this monograph is concerned primarily with the role of the AAF in the air defense of the Mediterranean area, it could not have been written without frequent reference to the activities of the Royal Air Force. In fact the dearth of AAF documents made it mandatory that the

records and histories of the various Allied headquarters, largely British in form and terminology, be relied upon to a considerable extent. Such AAF documents as were available consisted of the records of combat commands, particularly those of the Twelfth Air Force and XII Fighter Command.

Chapter I

PREPARATIONS FOR AIR DEFENSE

By mid-1943, the Axis forces which, as late as October 1942, had posed a threat to Egypt, had been driven from North Africa; by the end of the year almost complete control of the Mediterranean was in the hands of the Allies. This resounding setback to Axis plans for world domination could only have been achieved by maximum Allied cooperation in all phases of the military campaign. Perhaps no better illustration of this joint effort is to be found than in the preparations for air defense in the Mediterranean theater, an account of which is essential to an understanding of the operations and successes of Allied air defense efforts. Ultimate success of the air defense system, which slowly emerged as the campaign progressed, was necessary to the Allied triumph and was a tribute to the effective Anglo-American cooperation achieved in all theaters of war.

Before the entrance of American armed forces into the European conflict, the British had gained much valuable experience in the field of air defense. The Battle of Britain, the loss of which might have doomed the world to Axis domination, had been won by a resolute air defense manned by a united populace. German and Italian plans to reduce Malta by air power had been foiled only by the most strenuous counter-measures on the part of the intrepid British and Maltese defenders. Furthermore, as a result of the prolonged land warfare in eastern North Africa, the British military forces had made rapid strides toward the

establishment of an adequate air defense of battle areas. Because of this vast experience, it was logical for the British to assume leadership in the organization of an Allied air defense system for the Mediterranean area.

Allied Plans and Organization

In cooperation with the British, AAF personnel first became concerned with air defense in the Mediterranean area in planning for the successful invasion of North Africa (code-named TORCH), which took place on 8 November 1942. Allied planners realized that, following a successful invasion, each advance of the land forces would intensify the task of maintaining an effective defense against Axis air attack. As the enemy retreated the space occupied by the Allies would increase and the quantity of Allied personnel and materiel would expand; thus the Axis air forces would be presented with an increasing number of choice targets. With this in mind, an Antiaircraft Section was formed in London in September 1942 to plan the coordination of all means of active defense against enemy air operations. Headed by Col. Aaron Bradshaw (CAC), the small Allied section (four American and two British) was also to advise the commander in chief on antiaircraft (AA) matters and to determine the requirements and missions for AA.[1] Although events were to prove that the gradually weakened enemy would be unable to take full advantage of the potential vulnerability to air attack presented by the dispersed Allies, the existence of the threat necessitated such a coordinating agency and the organization and implementation of an adequate Allied air

defense.*

In providing for an air defense of the invasion area, TORCH plans called for the two major air commands, which had been activated for the invasion, to provide fighter defense until the Allied landings were made secure. Eastern Air Command (RAF) under Air Marshal Sir William L. Welsh was delegated the responsibility for fighter defense of the land area and for convoy routes east of Cap Tenes (100 miles west of Algiers); Twelfth Air Force commanded by Brig. Gen. James H. Doolittle was to provide fighter defense west of that point to Gibraltar. To aid in the performance of their mission, which included both the provision for a cover over the assault areas and for the protection of bases and communications from air attack, both major commands were assigned fighter squadrons and, until airfields had been secured for these squadrons, carrier-based aviation was to support the Allied assaults.[2] Task Force commanders were responsible for air defense other than fighter defense of their areas[3]--Colonel Bradshaw acted in an advisory capacity--and TORCH plans provided for aircraft warning battalions to be landed with the assault troops and for a temporary communications network to be in operation soon after the landings had been secured.[4] Antiaircraft defense was to be supplied by AA battalions assigned to the various assault divisions.[5] Bradshaw's AA Section had no command authority and no provision was made in the invasion plans for a central air defense command to function during or immediately after the assaults. Despite a number of mishaps which marred the effectiveness of these defensive measures,/ because of meager opposition, little

* According to AAF doctrine, "Air Defense includes all measures necessary to prevent, to interfere with or to reduce the effectiveness of hostile air action after hostile aircraft have left their own airdromes or carriers" (AAF FM 1-25, 24 Dec. 1942).

/ See Chap. II.

damage resulted from air attack on the initial Allied landing forces.

In the weeks following the successful assaults the need for an effective central agency for the coordination of Allied air defense efforts was recognized. To meet this need an Antiaircraft and Coast Defense (AA&CD) Committee was formed at Allied Force Headquarters (AFHQ). The committee was headed by G-3 AFHQ and was composed of representatives of the naval and air staffs, AA Section, signal section, and other interested groups. Its chief functions were to study and recommend action for the allocation of: fighter aircraft to ports and to escort duty; detection and warning devices; and defenses to ports, airfields and coastal regions.[6] Beginning on 13 December 1942, 77 meetings of this committee were held at regular intervals, the last on 5 April 1944.[7] As this committee was given only recommendatory power, however, a central air defense command was still lacking.

This shortcoming was partially corrected in February 1943 with reorganizations of the Antiaircraft Section and of the entire Allied air forces in the Mediterranean area. The AA Section was expanded into the Antiaircraft and Coast Defense (AA&CD) Section and, at the request of General Eisenhower, a British officer, Maj. Gen. R. B. Pargiter, was selected to head the section, with Colonel Bradshaw as his deputy.* General Pargiter arrived in the theater 16 February to assume his post which carried the official title, Major General Antiaircraft and Coast Defense (MG AA&CD). All AA defense in the theater outside of the battle

* Bradshaw was also Chief of AA&CD Section, Northwest African Theater of Operations, U.S. Army (NATOUSA).

areas was placed under his operational control and supervision* and his section was enlarged to 4 American and 2 British officers, 17 American and 16 British enlisted men.[9] On 7 March Pargiter's responsibilities were increased when he was named chief adviser to Commander in Chief Eisenhower on AA matters and the coordinating authority for the Allies on AA&CD policy. Coordinating the AA and coast defence efforts of the naval, air, and ground forces of all of the Allies became his responsibility under the latter directive.[10] Later changes during 1943 increased Pargiter's area of responsibility and continued his operational supervision of AA defense but transferred the coordinating authority for AA&CD policy to the AA&CD Committee.[11]

The reorganization of the Allied air forces, which also took place in February 1943, resulted in a parallel organization for the control of the other important air defense weapons: fighter aircraft and radar. On 17 February, 1943, Mediterranean Air Command, commanded by Air Chief Marshal Sir Arthur Tedder, was formed to replace the temporary Allied Air Force which had been functioning since 5 January under the command of Lt. Gen. Carl Spaatz.[12] Under Mediterranean Air Command (which was primarily a policy making and planning staff) was placed Middle East Air Command (later MAF, Middle East), AF Malta Air Command (later AFC, Malta), and Northwest African Air Forces (NAAF).† The most important of these new commands, NAAF, under General Spaatz, was composed

* See p. 68.

† For full details on the reorganization see: The Army Air Forces in World War II, II, 161 ff.

principally of Twelfth Air Force and EAC units, thus uniting the most important Allied air forces in North Africa. Northwest African Air Forces, in turn, was divided into five subcommands: Strategic (NASAF), Tactical (NATAF), and Coastal (NACAF) air forces, a training command (NATC), and an air service command (NAASC). Also, the Northwest African Photographic Wing (NAPW) was provided for by the reorganization.[13] Each of these organizations was allied, with the commands divided about equally between USAAF and RAF, an arrangement which, with the exception of Coastal Air Force, was to continue throughout the remainder of the war.

Northwest African Coastal Air Force was designated as the principal Allied agency for air defense--other than AA defense--behind a line approximately 50 miles from the bomb line (forward of that line NATAF was responsible). Under the command of Air Vice Marshal Sir Hugh Pugh Lloyd it was to exercise the following functions: 1) plan the air defense and control all units assigned for that purpose; 2) direct air-to-air and air-to-ground recognition; 3) control air-sea reconnaissance; 4) control antisubmarine air operations; 5) in cooperation with naval authorities, control air operations for the protection of shipping; and 6) control shipping strikes of its own or of other commands operating in its sphere.[14]

Although these reorganizations promised to improve the air defense situation materially, a central authority for all air defense still did not exist. The Air Officer Commanding, Coastal Air Force was responsible for planning air defense but controlled only the weapons assigned to his command for air defense purposes.* These assigned weapons did not include

* Initially AAF units assigned to NACAF were 350th Fighter Group and 1st and 2d Air Defense Wings.

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AA which was assigned to Allied Force Headquarters and controlled by General Pargiter. As a result, the responsibility for carrying out a single mission--air defense--was divided between a ground force and an air force commander, both of whom had other responsibilities besides air defense.*

AAF Air Defense Arrangements

While these improvements were being made in the Allied command structure, the air defense arrangements within AAF in North Africa were undergoing several significant changes beginning shortly after TORCH D-day. On D plus 6, Headquarters, Twelfth Air Force announced an air defense plan for the areas allocated to the American Western and Central Task Forces (RAF was organizing air defense to the east). Air defense of these areas was made the responsibility of XII Fighter Command.† According to this plan, an economical and efficient air defense should consist of "an adequate Aircraft Warning Service centering into an Information Center from which all Air, Anti-Aircraft, Naval and civil measures for active and passive air defense are directed."[15] This was the ideal, and organization of such a service, utilizing the existing French facilities as much as possible, was assigned to XII Fighter Command which was instructed to design the service so that it could be integrated later into the complete Allied air defense system.[16]

Implementation of this plan was begun and it sufficed temporarily,

* For the effects of this arrangement on the operations of AA see Chap. IV.

† XII Fighter Command was activated 24 August 1942 at Drew Field and was assigned to Twelfth Air Force prior to the invasion (Hist. XII Ftr. Comd., 24 Aug. 1942-Sept. 1944, p. 1).

but in a post-invasion report to CG AAF, Lt. Gen. Henry H. Arnold, General Doolittle pointed out the necessity for a reorganization. Doolittle believed that Twelfth Air Force, in addition to performing offensive operations, should be ready to resist a possible enemy invasion through Spain as well as to be prepared to combat air raids and to protect the convoy routes through the Straits of Gibraltar. For the more efficient performance of these functions until final victory was attained in Africa, he suggested the division of the area of American responsibility into districts.[17] Based on Doolittle's suggestion, three composite wings were planned which, together with XII Bomber Command and XII Fighter Command, would each control a district, and in addition to performing tactical and administrative functions, would be responsible for air defense. The Moroccan Composite Wing was to assume command of all Twelfth Air Force units in Morocco and XII Fighter Command was to control all units east of the Algerian-Tunisian border. Algeria was to be divided into three approximately equal districts commanded from west to east by Western Algerian Composite Wing, Central Algerian Composite Wing, and XII Bomber Command.[18] This arrangement was predicated, of course, on the early expulsion of Axis forces from Tunisia; if the struggle was prolonged, changes in the plan would be necessary. Nevertheless, on 11 December, XII Bomber Command, Western Algerian and Moroccan composite wings assumed their responsibilities but Central Composite Wing never became operational. XII Fighter Command's area was still the battle front.

While this temporary plan was being implemented, Headquarters AAF was planning a more permanent air defense organization along the line of

the AAF doctrine that active air defense* of an area was the responsibility of a fighter command within an air force. This air defense area was to be divided territorially into regions and the air defense of each region was to be assigned to an air defense wing.† Each air defense wing commander was to be given control of all air defense facilities (including antiaircraft artillery) assigned to the region.†† Based on this conception,††† American participation in the air defense organization of North Africa was contemplated at least as early as 20 November 1942 when the activation of four air defense wings (one each for Casablanca, Oran, Algiers, and Tunis) to operate under XII Fighter Command was considered. It was planned that these wings would cover the entire North African coast from Casablanca to Tunis.[19] Actually, only three wings were activated; 1st, 2d, and 3d Air Defense Wings came into being at Mitchel Field on 12 December 1942.[20] When these wings reached the theater it was planned that they would replace the temporary composite wings; 2d ADW to replace Moroccan Composite Wing, 1st ADW to relieve Western Algerian Composite Wing, and 3d ADW to take the place of Central Algerian Composite Wing. XII Bomber Command was to retain its responsibilities in the eastern third of Algeria and XII Fighter Command would take command of the three air defense wings. Until the new wings arrived in North Africa, the composite wings (Western Algerian performing the functions of Central

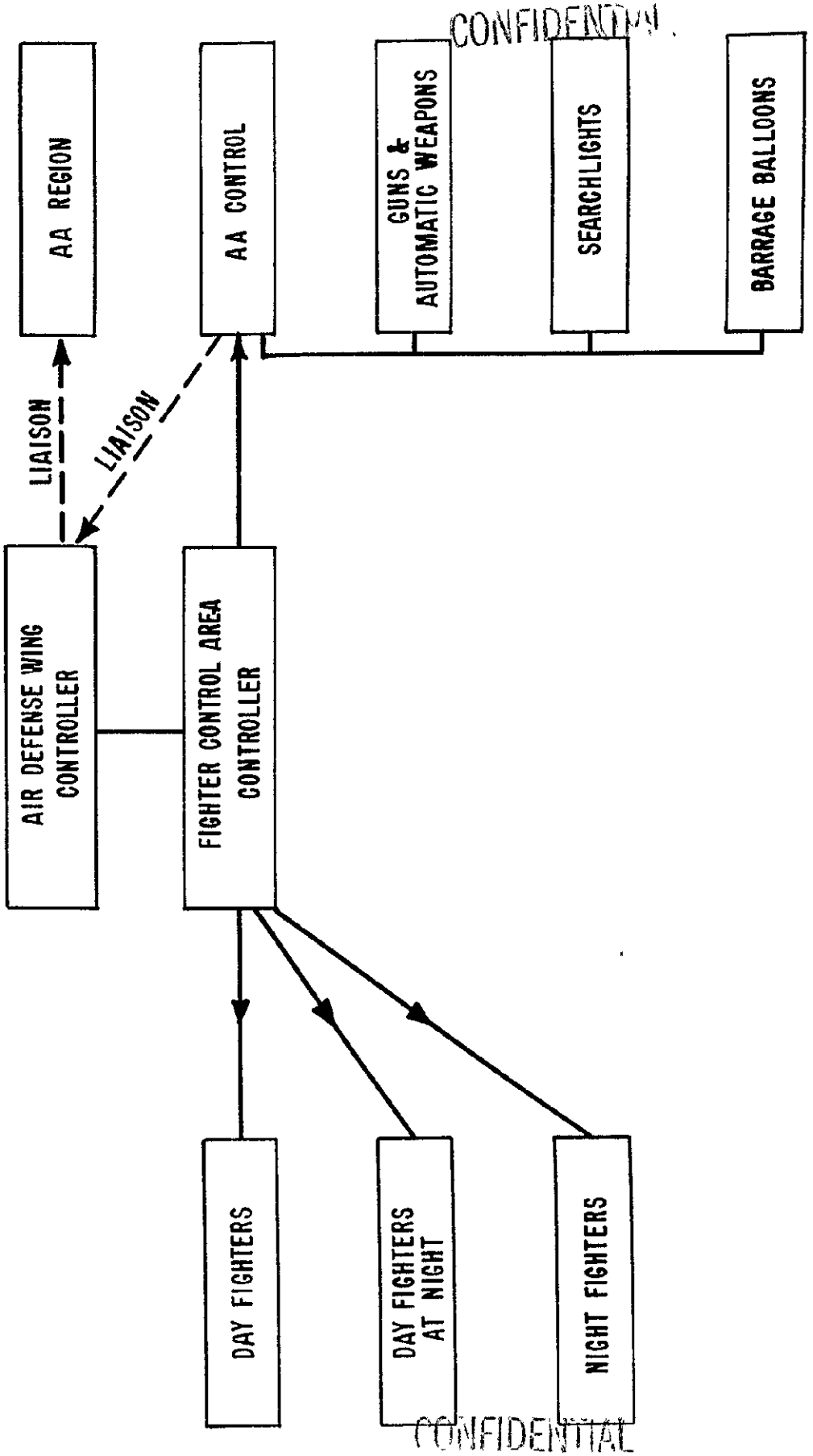
* Active air defense includes "all measures aimed to destroy or threaten destruction of hostile aircraft and their crews in the air." Passive measures are designed to minimize the effects of enemy air action (AAF FM 1-25, 15 June 1943).

† This plan of organization was later published in AAF FM 1-25, 24 December 1942.

†† If no fighter aircraft were assigned to the region it was to be called an air defense region.

††† See chart following p. 12.

OPERATIONAL CONTROL CHART



Algerian as well as its own) would continue to function.[21]

1st and 2d Air Defense Wings arrived in the theater 27 January and 3 February respectively and immediately took over their duties; 3d ADW arrived in the theater 21 February and was assigned to XII Air Support Command (ASC) 9 March. Apparently it never functioned in its assigned sector.[22] With the arrival of the air defense wings--1st and 2d were assigned to Northwest African Coastal Air Force upon its activation--AAF doctrine (except for the assignment and control of certain weapons) was placed in operation and the resulting basic organization was continued throughout the Mediterranean campaign (RAF groups* performed in a similar manner in British areas of responsibility).

The air defense wings (which operated under XII Fighter Command) were composed basically of a headquarters and headquarters squadron, two fighter control squadrons, and a signal aircraft warning (SAW) battalion. This was the minimum organization and an increase was often necessary when the size or nature of the wing area of responsibility demanded.[23] Fighter aircraft were assigned to the wing and its commanding officer was responsible for all activities which were necessary to provide his area with an adequate air defense. As the wing's geographical area was usually large, it was divided into two (or more if necessary) Fighter Control Areas (sectors). Each sector was provided with a fighter control squadron and elements of the SAW battalion assigned to the wing. For each sector a Sector Air Defense Commander (SADC), an air force officer, was

* An RAF group was roughly comparable to an AAF wing.

appointed (by NACAF after its formation) whose many responsibilities (some of which might be assumed by the wing commander) included: operational control of AA; origination of air raid warnings from his Sector Operations Room; operational control of barrage balloons; and (after 17 January 1944) allotment of AA within his sector. It was the duty of the sector air defense commander to satisfy himself that all measures for air defense in his sector were properly coordinated and used to the best advantage.[24] within the sectors, defended areas were usually designated, each with an Antiaircraft Defense Commander (AADC) who was responsible for all phases of air defense within his area.[25] The AADC was appointed by the AA Brigade Commander and operated from a Gun Operations Room. Thus within the sector a chain of command was established from the SADC to the AADC's. Above the sector, however, command authority passed from Marshal Lloyd (AOC, NACAF) through XII Fighter Command and the air defense wing commander to the sector commander in all air defense matters except AA defense. In AA defense, the line of control was from General Pargiter to the sector commander.

Despite the division in command of air defense means, the implementation of this air defense organization promised to alleviate an air situation which was not encouraging. The invasion ground forces were progressing satisfactorily in spite of a rapid build-up by the enemy. On the other hand, the air forces were experiencing difficulties because the enemy air forces had the advantage of good airfields in Tunisia and could be easily reinforced from Sicily and Sardinia whereas mud rendered unserviceable many of the newly-captured Allied fields. As the Allies were forced to make use of every available airstrip, accumulated aircraft offered

tempting targets to enemy night bombers. Consequently, the Axis air forces were able to inflict considerable damage on Allied positions as the Allied forces moved eastward from the assault beaches. In the face of this opposition, Allied Force Headquarters reported that everything was being done to protect Allied installations. Day fighter squadrons were available but other air defense operations were handicapped by a scarcity of night fighters* and by a shortage of vital materiel such as radar and mobile AA guns.[26] Nor did the arrival of the AAF air defense wings in January and February improve the situation immediately. The wings were a new type of organization and much testing of methods and equipment was necessary. Nevertheless, although months of operational experience would be required before the wings could become proficient, a gradual improvement in their operations could be expected.[27]

Coastal Air Force Expansion

In the midst of this organization and adaptation, the area of Northwest African Coastal Air Force responsibility grew as the ground forces advanced and, with few exceptions, successive advances of NACAF and its units followed a definite pattern. RAF groups were normally entrusted with the air defense of the forward sectors of Coastal responsibility while the AAF wings, lacking in experience and using less mobile equipment, operated in the more quiet regions. Thus in April 1943, NACAF territory in North Africa was divided into five areas. RAF 323 and 242 Groups/ operated in the two exposed sectors with headquarters at

*See chap. III.

/In order to distinguish between AAF and RAF units, the policy has been followed of dropping the "th," "st," and "d" when designating RAF units.

Algiers and Souk Ahras in eastern Algeria, respectively. 1st Air Defense Wing (Casablanca) and 2d Air Defense Wing (Oran) remained in the original invasion area while 3d Air Defense Wing,* operating under XII Air Support Command, was with the II Corps (U.S.) in central Tunisia.[28] As the front lines advanced, 1st and 2d Wing units gradually replaced RAF units as the latter moved forward; continuity of operations was thereby maintained.[29]

By the middle of May 1943, the ending of all organized Axis resistance in North Africa resulted in a further extension of Coastal Air Force responsibility. The eastern limit of its territory now became the Tunisian-Tripolitanian border. As the expulsion of the enemy from Africa opened the Mediterranean to Allied shipping, the area in which NACAF was to protect convoys also was increased. In order to cover this expanded territory, 242 Group moved up to Bizerte to work with the Royal Navy on static defenses, reconnaissance, and air-sea rescue and 323 Group assumed the responsibility for the air defense of Bizerte and Tunis. 1st ADW moved into the Sousse-Sfax area while 2d ADW took over the Algiers sector.[30] Two provisional organizations, 2688th and 2689th Air Defense Regions were formed to replace the 2d and 1st Wings, respectively.[31]

Coastal Air Force responsibility further increased during the preparatory phase for the invasion of Sicily (code-named HUSKY), which followed the victory in North Africa. Heavily laden Allied shipping, filling the harbors of North Africa and moving through the Mediterranean, had to be protected and this protection, according to HUSKY plans, was

* Efforts by 3d ADW commanding officer, Col. Robert S. Israel, to have the wing reassigned to NACAF in order to perform its intended mission were to no avail. (Ltr., Hq. 3d ADW to CG NAAF (thru CG XII ASC), sub.: Reassignment of the 3d Air Defense Wing, 4 June 1943, in USAF HD microfilm roll no. 96.)

assigned to Coastal in addition to the air defense of North Africa. Also, up to a north-south line extending seaward from the eastern border of Tunisia, it was to provide all air-sea rescue and air-sea reconnaissance connected with the invasion.[32] Despite many enemy air raids on the shipping, NACAF efforts were successful for no Allied ship was sunk and only one was damaged during the pre-invasion weeks.[33]

With the successful completion of HUSKY--during which NACAF afforded air protection to the assault fleet--landings on the Italian mainland and the capture of Corsica and Sardinia quickly followed and Coastal Air Force successfully performed the same role as it had in the Sicilian invasion. This enlargement of Allied-controlled territory again extended the commitments of NACAF, making another readjustment necessary. As the threat to North Africa was now considerably reduced, it was decided that 63d Fighter Wing (formerly 2d ADW)* should remain in North Africa with headquarters in Algeria and assume the responsibility for the entire North African mainland between Casablanca and the Tunisian-Tripolitanian border. Sardinia and Corsica were combined into one sector which was allotted to 62 Fighter Wing (formerly 1st ADW). The Naples-Foggia-Taranto area (242 Group) and Sicily and the toe of Italy (211 Group) were to be British responsibilities.[34] In the case of Sardinia and Corsica, an American air defense organization for the first time took over the defense of an area not formerly protected by a British unit.

In October and November 1943 the units of Northwest Coastal Air Force

* In August 1943 the names of the air defense wings were changed to fighter wings; 1st ADW became 62d Fighter Wing, 2d ADW became 63d Fighter Wing, and 3d ADW was renamed 64th Fighter Wing.

advanced once more. As the front line moved up the Italian peninsula, the British groups became responsible for the east coast and 64th Fighter Wing for the west coast, north of Naples.[35] The 62d Fighter Wing replaced 242 Group in the Naples area and AHQ Malta took over the defense of Sicily and the toe of Italy from 242 Group. The 63d Fighter Wing then replaced 62d Fighter Wing in Sardinia and Corsica* while the North African mainland was made the responsibility of 210 Group with actual operations, except for convoy protection, largely in the hands of the French.[36] Although minor changes were made from time to time, NACAF units retained these areas of responsibility until late in 1944.

Command Reorganization and Centralization of Control

In the midst of this rapid expansion of Coastal Air Force commitments, the entire structure of the Allied air forces in the Mediterranean theater was again reorganized. Because of the far-flung commitments of the air forces, it was believed that one supreme air command was desirable. Therefore, Mediterranean Air Command and Northwest African Air Forces were disbanded and replaced by a new organization, Mediterranean Allied Air Forces (MAAF), which was activated 10 December 1943 under the command of Marshal Tedder. All USAAF units in the North African theater, all RAF units including AHQ Malta and Headquarters RAF Middle East, and all other

* The commanding officer of 63d Fighter Wing, Col. Davis D. Craves, was named Air Defense Commander of Corsica and Sardinia. His assignment orders from NACAF read: "In this capacity you will be responsible to this Headquarters for the employment, disposition and operation of all active Air Defence means assigned to or stationed in Corsica or Sardinia, whether assigned to air or ground forces, Allied Forces or co-belligerent." Apparently, in contrast to other air defense wing commanders, he had operational control of AA (Directive Hq. NACAF to Col. D. D. Graves, CO 63d FW, 26 Oct. 1943, in USAF H D microfilm roll 264).

Allied and cobelligerent air force units in the theater were combined in the new organization.[37] USAAF units in MAAF were assigned for administration and supply to AAF North African Theater of Operations (AAF/NATO)--changed on 1 January 1944 to AAF Mediterranean Theater of Operations (AAF/MTO)--commanded by General Spaatz.[38] Command changes were made soon after the reorganization when Spaatz left the theater to head U.S. Strategic Air Forces in Europe and Tedder departed to become General Eisenhower's deputy in command of OVERLORD. Maj. Gen. Ira C. Eaker was designated to replace General Spaatz and to fill the dual role of commanding general AAF/MTO and air commander in chief, Mediterranean Allied Air Forces, with Air Marshal Sir John C. Slessor as his deputy.* Coastal Air Forces, renamed Mediterranean Allied Coastal Air Force (MACAF) and unchanged except for its title, remained under the command of Marshal Lloyd.[39]

Of more importance to the functioning of air defense--and a further centralization of command authority--was another change made early in 1944. Operational control of all air defense means was finally given to an air officer. In November 1943 Coastal Air Force had proposed that the Antiaircraft and Coast Defense Committee be redesignated as the Mediterranean Antiaircraft Artillery Command and that this command be assigned to Marshal Lloyd.[40] Headquarters MAAF concurred in the proposal and, at General Eaker's request, Marshal Slessor investigated the possibility. In principle, Slessor's report agreed with the MACAF proposal[41] and presented an outline for a new system of control of AA defense.[42] Based

* For details of the creation of MAAF see: The Army Air Forces in World War II, II, 744 ff.

on Slessor's report,* a reorganization was announced 5 April 1944 which gave the control and direction of all Allied active air defense matters to General Eaker, the theater air commander in chief. Eaker in turn delegated this control and direction--including allocation and control of AA in the MACAF area--to Marshal Lloyd. The Mediterranean Antiaircraft Advisory Committee was established to advise the Supreme Allied Commander and the air commander in chief on policy and allocation of resources.† Antiaircraft and Coast Defense Section was to continue to be responsible for operational efficiency, operational supervision, and training of all AA materiel and personnel.[43] As a result of this change, control and direction of all active air defense was placed under one command--Mediterranean Allied Air Forces. However, the full effect of this change could not be determined since it came at a time when the weakness of the enemy air forces was enabling the Allies to reduce drastically their air defenses.

The End of AAF Air Defense Activities

Despite the lessening of the air threat, during the first eight months of 1944 Mediterranean Allied Coastal Air Force continued to perform the varied functions formerly assigned to Northwest African Coastal Air Force and now assigned to it: air defense, convoy protection, air-sea rescue, and reconnaissance. Although Coastal Air Force's defensive responsibilities were decreasing, they would not end as long as enemy air forces remained in the theater.[44] Gradually as the offensive power

* See chap. IV.

† AA&CD Committee was replaced by AFHQ-MACAF Antiaircraft Committee which held its first meeting 15 April 1944 (USAF HD microfilm roll 10).

of the enemy diminished, some Coastal fighter units were assigned offensive duties such as shipping strikes and intruder missions while other excess units were transferred to Strategic or Tactical air forces. Surplus AA units were transferred or disbanded and AA personnel was retrained for other ground tasks.* With the successful invasion of Southern France (code-named DRAGOON) in August 1944, the danger of Axis air attack on North African ports virtually disappeared and the French--utilizing American or British equipment and operating under British supervision--were given almost complete control over the North African air defenses.[45] Likewise the threat to Corsica and Sardinia and to Allied convoys in the Central Mediterranean was considerably reduced by the landing in France.

As a result of these changes in the air defense situation, another major reorganization became necessary and, at a meeting held at Allied Force Headquarters 1 September 1944, it was decided to withdraw all American units from Coastal Air Force.[46] All air defense commitments in the Central and Western Mediterranean would thereafter be fulfilled by a Coastal Air Force composed of RAF and French units; this change took place 14 September.[47] The 62d Fighter Wing was relieved of its responsibilities in western Italy and was assigned to a new American unit, XXII Tactical Air Command,[48] while 63d Fighter Wing turned over the air defense of Corsica and Sardinia to RAF and moved to the DRAGOON (code name for the invasion of Southern France) area.[49] During the transition period, USAAF units continued to perform some functions with Coastal Air Force

* See chap. IV.

with RAF organizations replacing them as soon as possible. By November Mediterranean Allied Coastal Air Force, without American units, was performing all air defense functions in the Mediterranean theater as well as defending Southern France from air attack to a line 40 miles from the coast. Air defense north of this line was delegated 16 November to a new American organization, IX Air Defense Command.[50]

With this realignment, air defense in the Mediterranean area ceased to be a responsibility of any USAAF organization with the exception of those tactical units--primarily 62d Fighter Wing under XXII TAC--which continued to operate in Italy. For two years American units had been operating in close cooperation with the RAF with extremely favorable results. Although it is impossible to determine the exact extent of American efforts because of the intermingling of Allied units within Coastal Air Force, the combined operational records are impressive. For example, during the period from 17 February 1943 to September 1944, Coastal fighters flew 103,719 sorties in protecting Allied convoys; of a total of 12,801 ships protected, only 22 were sunk and 16 damaged. Total ship losses to enemy aircraft in convoy and in port were only 40 ships sunk and 52 damaged. In the matter of combat with enemy planes, USAAF pilots claimed 125 aircraft destroyed, 31 probably destroyed, and 144 damaged.[51] American AA also had impressive claims: 1,127 enemy aircraft destroyed and more than 253 probably destroyed.[52]

In addition to these victories over the enemy, much had been accomplished by 1 September 1944 in the building of a satisfactory air defense organization. Following three months of operations without a

centralized control of air defense, Northwest African Coastal Air Force was formed in February 1943, given control of all air defense weapons assigned to it, and assigned the air defense mission up to a line approximately 50 miles from the bomb line. For the operational control of AA--the principal air defense weapon not controlled by NACAF--the Anti-aircraft and Coast Defense Section was set up. As the area of Coastal responsibility increased greatly, the available AA was used to the best advantage, and the number of squadrons of aircraft assigned to Coastal Air Force increased to a peak of 56 (16 of which were American) by January 1944. Thereafter, its strength gradually diminished as, with the decrease in the Axis air threat, the Allies were able to concentrate more of their resources in offensive efforts. Throughout the period February 1943 to September 1944, NACAF remained an Allied organization under the direct control of Northwest African Air Forces and its successor, Mediterranean Allied Air Forces.

American contributions to the success of the air defense efforts of Coastal were considerable. In addition to sharing command responsibilities with RAF and profiting greatly from British experience, AAF bore up to approximately 40 per cent of the air defense burden. Also, American personnel gained valuable battle testing, equipment was tested and improved, and techniques were perfected, all of which added to a successful air defense. How these improvements in American and Allied air defense activities were brought about will be explained in the following chapters.

Chapter II

THE RADAR SYSTEM

Early Warning in TORCH

The methods used during World War II to provide early warning of approaching aircraft were based upon the most important development of the early war years, "radio detection and ranging," or RADAR. By use of radar, the British had been able to develop (with American aid) a relatively efficient static early warning system by 1942 which met the needs for a defense of Great Britain. Planning for the invasion of North Africa in the summer of 1942, however, revealed to the Army Air Forces the necessity for a different type of equipment. Mobility would be required if radar was to be of value in an amphibious operation.[1] On 8 July the project of devising a mobile radar system for the American forces was assigned to the Fighter Command School by the U.S. Air Defense Board, and, despite the lack of adequate time to perfect either system or equipment, "the first operational sets in the light-weight, highly transportable field" were available by TORCH D-day.* Although many defects were uncovered when the equipment was tested under actual battle conditions, the basic system proved sound.[2]

The unit of this new system which was primarily concerned with the detection of aircraft was the Signal Aircraft Warning (SAW) Battalion. The mission of each SAW battalion was to maintain and operate the radar

*The RAF had been working on mobile radar prior to this time and had employed some mobile early warning equipment in the Middle East and in Europe prior to the fall of France.

assigned to it and to work in conjunction with the fighter control squadrons by furnishing air raid warning information. To each battalion was assigned the necessary administrative and housekeeping personnel. For the initial landings in North Africa, three battalions were formed: 561st SAW Battalion was assigned to Twelfth Air Force, and 560th and 562d SAW Battalions were allotted to XII Air Support Command. It was planned that detachments of these battalions would accompany the assault forces in order to provide land-based early warning as soon as possible.[3] Until these units were operational, shipborne radar would furnish the necessary warning information.

The most important pieces of equipment allotted to the SAW battalions were the radar sets for early warning. Each battalion had four SCR (Signal Corps Radio)-270's, early warning radars which gave both range and azimuth at a maximum range of 150 miles. Three SCR-516's, with a range of 70 miles, supplemented the SCR-270's by providing "good" altitude information. For the initial phase of the landings and for highly mobile use, 4 SCR-602's, with a 60 to 70 mile range and "good" altitude determination, were also provided. Additional equipment consisted of SCR-566's (direction finders), SCR-567's (relay stations), and radio sets for communication purposes such as SCR-299's.[4] All of these radars were mobile and were supplied with testing and maintenance personnel and equipment.

Despite these operational plans and the new mobile aircraft warning system, TORCH did not produce an actual battle test of the equipment. Misfortune attended the efforts of the SAW battalions and only the absence of hostile aircraft saved the landing forces from possible severe damage. Much delay in getting its equipment ashore was experienced by the 560th

SAW Battalion; its first detachment reached Port Lyautey Air Field 10 November but, being without equipment, personnel were pressed into service on an unloading detail. As a result, the first SCR-602 was not in operation until 15 November.[5] Meanwhile, a detachment of 561st SAW Battalion landed at Oran on D-day with only one light warning radar set. Although this radar was set up immediately, lack of operational control rendered its efforts of little use and, as no other battalion equipment arrived until 20 November, battalion personnel aided other units in such things as radio operating.[6] The remaining battalion, 562d SAW, suffered similar mishaps. Part of the battalion landed at Casablanca on D-day with its equipment and began limited operations; complete operations were impossible as a ship carrying the remainder of the equipment was sunk.[7] Because of these unforeseen mishaps, the task force air warning system failed to function as planned during the TORCH landings.

A post-invasion report by the 560th SAW Battalion revealed several defects in organization and equipment which also contributed to the failure of the assault plans. Personnel of the battalion quickly discovered that much misunderstanding of the proper mission of the SAW battalions existed among the Air Force officers; as a result the assembly of the various radar sets was delayed and radar personnel were employed at unrelated tasks. The battalion also reported that equipment was landed too slowly, was not mobile enough, lacked proper testing and maintenance tools, and that transportation for the equipment was inadequate.[8] Thus TORCH illustrated that many improvements would be necessary to assure adequate radar protection in future amphibious operations as well as in a static situation.

Extension of Radar Coverage

These defects notwithstanding, after the successful completion of the North African invasion, attention in radar matters was turned to the protection of fixed installations from air attack; as Allied land forces progressed, the need for air warning at ports, cities, and other fixed installations increased. Although Eastern Air Command was responsible for the radar protection of the North African coast eastward from the Spanish Moroccan border, American units moved forward as rapidly as their supply of radar equipment permitted. The Moroccan coast from 80 miles south of Casablanca to the Spanish Moroccan border was made the responsibility of 562d SAW Battalion (under 1st ADW) while 560th SAW Battalion (under 2d ADW) was to replace EAC units as equipment arrived. Early warning for inland forces and installations became the responsibility of 561st SAW Battalion (under 3d ADW). British radar stations were to remain at Casablanca and Oran.[9]

With the organization of Coastal Air Force in February 1943, it was possible to centralize control and to declare a command policy for radar. Control of radar was to follow the lines of responsibility for air defense; Coastal Air Force would control all Allied radar up to a line 50 miles from the bombline. Forward of that line, Tactical Air Force would assume responsibility for radar. It was not feasible, however, to lay down a policy concerning the necessity of British radar being controlled by RAF or American radar by USAAF for, although most American radar was set up west of Algiers, equipment was intermixed to a great extent.* Future deployment of radar, regardless of national origin, would be made accordi

*The principal radars used were: SCR-270's and 271's and their RAF counterpart MRU (Mobile Radio Unit) for long-range detection; SCR-51[illegible]'s and RAF COL (Chain Overseas, Low) for low flying detection; SCR-582 and RAF CD (Coastal Defense) number 1 for fire control and surface warning; SCR-588 (RAF GCI) for ground controlled interception; and SCR-521 and SCR-602 (RAF LW) for early warning.

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to availability and suitability of equipment.[10] By April 1943 a coastal chain of Allied radar had been installed from the Spanish Moroccan border to east of Bone; RAF GCI/GCI's (radar which performed low altitude coverage and GCI) sites on the coast were being replaced with SCR-588's, a static radar which provided early warning and Ground Controlled Interception (GCI) at a range of 80 to 100 miles. Therefore, as the Tunisian campaign drew to a close, the coastal defenses in North Africa consisted of a combination of British and American radar equipment manned to an increasing extent by American personnel.*[11] From a total of 22 RAF and 15 American operational stations which existed at the time of the formation of NACAF, the number had increased by July 1943 to a peak of 77 RAF and 46 American stations.[12]

As seen above,† in order more efficiently to control air defense operations--including the many radars and their operating personnel--all Allied territory which required air defense was divided into air defense wing (or RAF group) areas of responsibility. Each of these areas was subdivided into sectors, each with a Sector Air Defence Commander who was responsible to the appropriate wing commander.[13] Although the territory allotted to each wing was usually divided into two sectors, more than two were often required where the effectiveness of radar was reduced by terrain (low flying cover was difficult to provide in mountainous country). Each sector included elements of RAF

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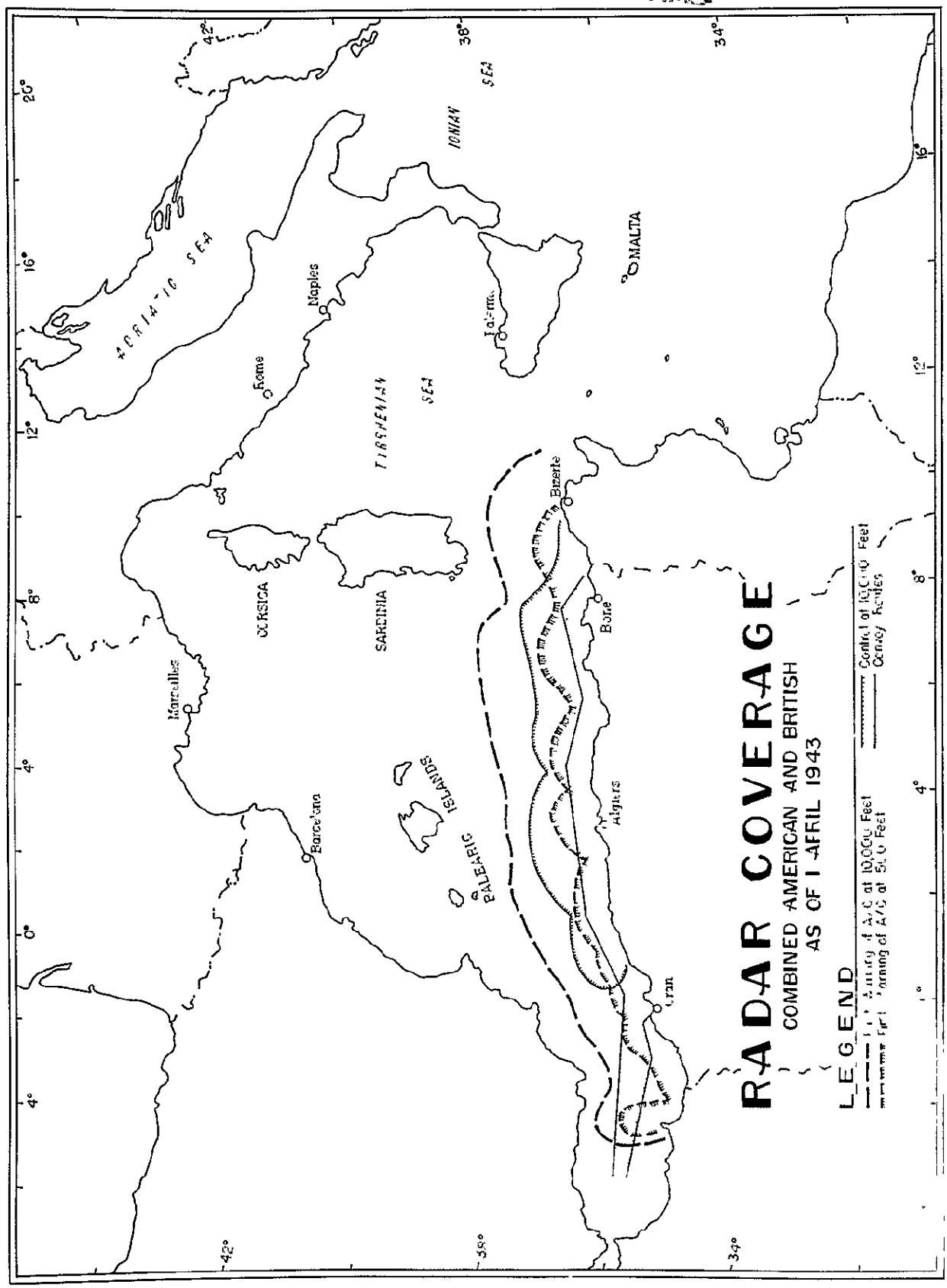
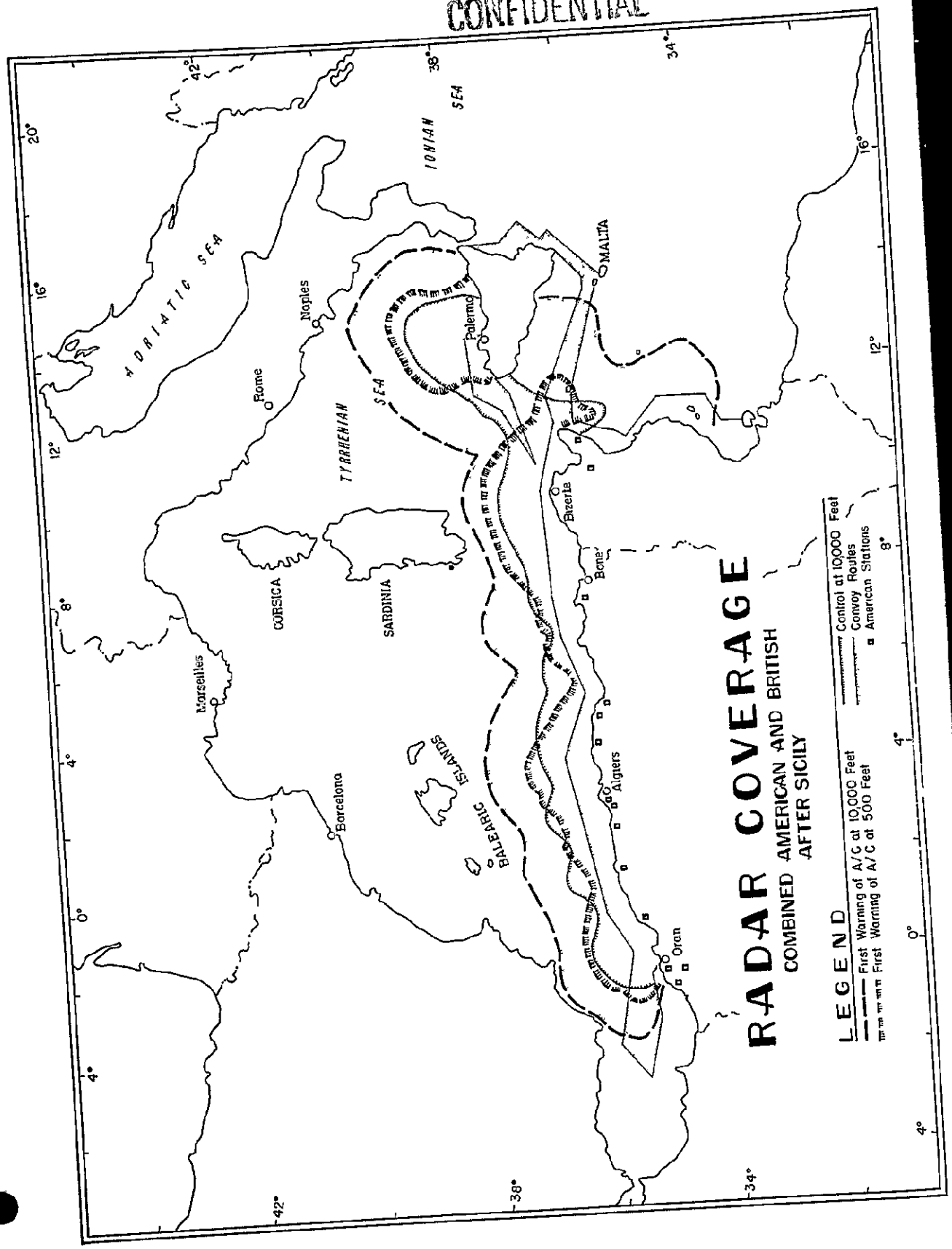
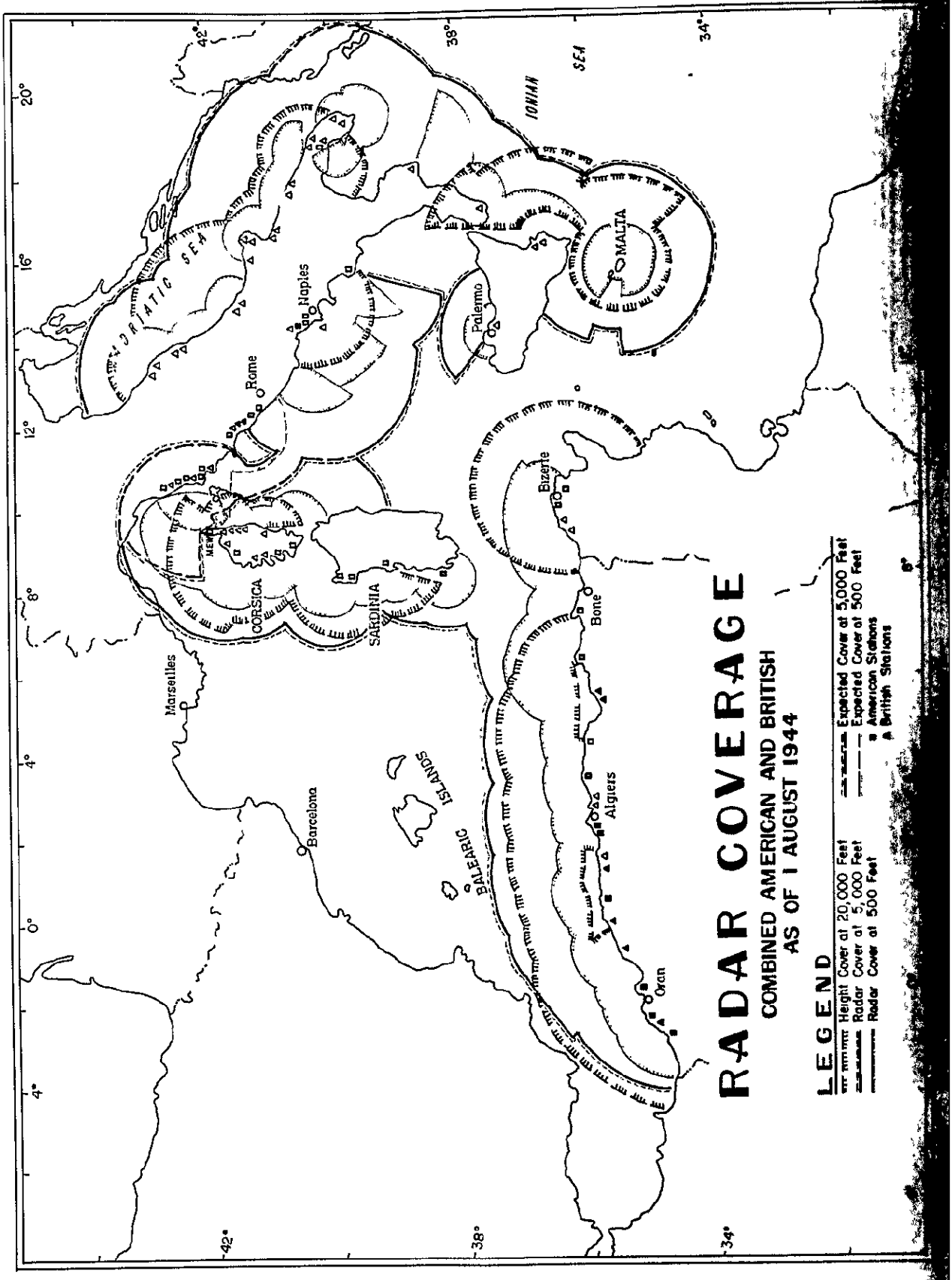
*See maps following p. 28.

†See pp. 13-14.







battalions, fighter control squadrons, and the necessary supplementary personnel. The radar equipment allotted to a sector depended upon the potential danger from hostile raids but usually included a number of SCR-270's for early warning, SCR-588's for early warning and Ground Controlled Interception, and SCR-602's for mobile early warning, or their British equivalents. Any information picked up on early warning radar was immediately reported to a filter room where plotters attempted to identify the aircraft and passed the information to a Sector Operations Room. If the aircraft proved hostile, an alert was sent to the fighter control squadrons, AA positions, naval and Port authorities, and passive air defence (PAD) organizations in the area.* Constant communication within the sector and with other sectors was essential† so that continuous "tracking" or following of the aircraft on the radar scope could be made. Furthermore, it was necessary for the major commands, MAAF, NATAF, and MAAF, to exchange information for a more efficient air defense.††14 As a gap in the radar chain at any point could produce disaster, continuous surveillance on the part of all personnel was required.15

Despite the most strenuous efforts on the part of radar siting officers, gaps in the radar chain often existed; these gaps resulted, for the most part, from the presence of mountains which, by interfering

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*It was the responsibility of local PAD officers to establish communications with SOCs in order to receive warnings or other raid information (ltr. MAAF Section to all concerned, 17 Dec. 1943, in USAF HD microfilm roll 0B-6). For a discussion of PAD see chap. V.

†In May 1943 a uniform air warning code designed to facilitate the passing on information was set up for all units under command of Hq. MAAF, Hq. MAFME, and AM Malta. (Hq. MAAF Signals Instruction 13, 5 May 1943, in USAF HD microfilm roll 121).

††For maintenance purposes it was necessary to take radar sets off the air for an hour or two each day and for an eight hour period every four weeks. Such periods of inactivity normally were alternated so that at least one set was operative at all times. (Ltr. Hq. MAAF to all concerned, sub.: Maintenance and Supply of Ground R&W, 10 July 1943, in USAF HD microfilm roll 10).

with the emission of the radio waves, restricted the ability of the radar to see. No method for filling these gaps was discovered except the use of human observers and, as the American forces contained no ground observer formations, reliance was placed on British Ground Observer Units to which American personnel were attached for training.* In general, these ground observers were formed into a screen as close as possible to the front lines and were charged with reporting, by any available means, all hostile air activity which took place in their area of responsibility. Although great difficulty was often experienced by the observers in reaching suitable observation points and in identifying high-flying aircraft, or any aircraft when visibility was poor, no other means was available for assuring an unbroken chain in mountainous country.[16]

Difficulties Encountered by Radar Personnel

In addition to operational handicaps caused by terrain features, other difficulties were encountered in establishing radar facilities in North Africa. Communication facilities, perhaps the most vital part of the entire air defense system, were hampered from the beginning by the lack of dependable commercial telephone lines. Without commercial lines to employ as a foundation, signal companies were compelled to construct all lines and, after construction, the danger of sabotage and line failure was always present.[17] Difficulty was also experienced from time to time in that identification of aircraft was uncertain; this uncertainty

*By January 1944, American ground observer companies had arrived in Italy. (Hist. Rad., IV, Ground Radar history for the month of March 1944).

usually resulted from the failure of pilots to turn on IFF* or from the misuse of codes and frequencies. Transportation facilities were often inadequate; as late as the summer of 1943 air defense units in North Africa were limited to 30 per cent of the vehicles allowed by their T/E/A's.[18] Perhaps more serious, however, was the low quality of American radar personnel. A comparative study made in June 1943 revealed that American crews did not measure up to the standards set by the British. Whereas the RAF required, in general, that radar operators possess college educations and related civilian backgrounds, a typical American radar platoon showed no man with more than a high school education and few with civilian backgrounds which would aid in an understanding of radio or radar. It was felt that such a situation rendered American personnel less capable than the personnel of comparable British units./[19] As most of these weaknesses in the American radar system could be remedied by experience, the system showed gradual improvement throughout the remainder of the Mediterranean campaign.

Another problem which soon faced Allied radar personnel concerned the selection of radar sites. It was necessary to site North African coastal radar as high as possible for, after high and medium flying raids had proved too costly, the enemy began approaching the coast low and climbing when the target was reached. Radar sited on flat coastal land had difficulty picking up these low flying aircraft approaching from the

*See p. 36 ff.

/According to an RAF observer, who suggested that the matter be taken up with the War Department, the low caliber of American personnel resulted in indifferent operation caused by a lack of interest among the radar crews; however, in reply, Brig. Gen. Elwood R. Quesada, Deputy AOC NACAF, did not concur. (Ltr. W/C [illegible] Swinney (RAF) to AOC NACAF, sub.: American RDF Stations - SOM 588, 24 July 1943; Loose Minute Quesada to AOC NACAF, 29 July 1943, in DRB microfilm roll 169-D).

sea.[20] On the other hand, inland radar usually was most effective when sited on flat or slightly rising ground which afforded the widest horizontal sweep. Furthermore, personnel soon realized that all radar had to be calibrated; corrections in elevation and deflection had to be made by actual use of the radars in spotting and tracking friendly aircraft. A calibration flight was the only means--except for actual combat operations--of testing the siting and operational efficiency of radar stations.

In North Africa radar siting and re-siting were normally done by an air defense wing siting officer with the aid of maps and personal reconnaissance. When possible, sites were selected well in advance, so that radars could be quickly erected by radar personnel when the need for them arose; for the most complicated radars such as SCR-588's, special teams were provided for installation. According to the reports of two siting and installation officers who inspected the North African radar system in the spring of 1943 the siting of American radar, for the most part, was accomplished satisfactorily. Any radar which these officers found to be poorly placed was re-sited on their instructions so that, before the end of the Tunisian campaign, coastal radar coverage was complete for the territory in Allied hands.[21] Because of the success of radar siting in North Africa, a similar system was used during the remainder of the Mediterranean campaign.*

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* One exception to this was in the siting of radar in Antiaircraft Defended Areas; there the siting was made the responsibility of the Air Defense Commander (ltr., AFHQ to ACC MAC, sub.: Siting and Coordination of Radar in Antiaircraft Defended Areas, 16 Sept. 1943, in DRB microfilm roll 77-C).

Unlike the sitin problem, the problem of radar calibration was never completely solved during the Mediterranean campaign. Prior to the North African invasion, radar personnel in other theaters had been unable to obtain suitable aircraft for calibration flights.[22] This difficulty also confronted the Allies following the consolidation of the North African landings; in fact, no calibration had taken place in North Africa prior to the formation of Coastal Air Force. However, in March 1943, a calibration program was undertaken which, despite a shortage of aircraft and personnel, was completed for all coastal radar by May. Later programs, which were designed to calibrate all radar, were handicapped by the same shortage; such aircraft as were made available often became unserviceable before calibration could be completed. Finally on 1 August 1943, a calibration flight, initially equipped with three RAF Beaufighters, was established under a Calibration Section, MAAF. This flight, to which four Hisleys were later added, performed calibration service for radar in Sicily, Sardinia, Corsica, and southern Italy and was supplemented in January 1944 by the American 2d Calibration Detachment equipped with two B-25's.[23] At a meeting held at Coastal Air Force Headquarters 15 February 1944, it was decided that the 2d Calibration Detachment would be operationally attached to that headquarters and work in conjunction with its calibration flight but would be employed as far as possible on American radar. In the future calibration was to be performed on a monthly basis; this had previously been impossible with the equipment and personnel on hand.[24] As a result of this new policy and because of

the more adequate supply of aircraft, calibration of Coastal Air Force radar improved noticeably during the closing months of the Mediterranean campaign.*

In the meantime, the rapid advance of Allied forces in the Mediterranean caused many changes in the priority of the radar defended points. In order to establish a new priority policy for the theater, a radar conference, attended by representatives from all services, was held 10-12 March 1944 at Algiers. Because of the need for continued convoy protection, it was decided that the North African coastal radar chain would remain in operation; however, radar employed in port defenses could be thinned out if the radar equipment was needed elsewhere. As the danger to Malta and the Middle East had lessened considerably, radar cover in those areas could be reduced and excess equipment could be added to the planned cover for Italy, Corsica, and Sardinia. Any radar equipment for which operating personnel was not available would be placed in a reserve status.[25] The Allied advance in Italy beginning in May 1944 again altered the radar situation and permitted further reductions in rear areas; the Oran area became a training base while radar cover in southern Sardinia and Sicily was considerably reduced. In North Africa all operational radar was withdrawn except for eight SCR-588's, one SCR-270, and SCR-582's at Casablanca, Oran, Bizerte, and Algiers.[26] Despite the almost total disappearance of the enemy air threat, the installation of these radars, which aided in convoy protection, was considered to be on a permanent basis.

*As late as June 1944, NAAF reported that it had made no attempt at complete calibration of the radar under its control. (Ltr. Hq. NAAF to USAAF Liaison Section, AAF Board, sub.: Information for Army Air Forces Board, 30 Sept. 1944, in USAF HD microfilm roll 123.)

In addition to this radar redeployment, several changes were made in 1944 in the operations of American radar. Two new Signal Aircraft Warning battalions increased the amount of radar available to AAF Air Support Command: 582d SAW Battalion was formed 15 January from elements of several disbanded SAW units[27] and, on 10 March, 593 SAW Battalion arrived in Italy;[28] both were assigned to 64th Fighter Wing. Another SAW battalion, the 594th, arrived in the theater 1 February and was assigned to AAF Fighter Command for operations in North Africa.[29] In July 1944 all American radar in North Africa was placed under the operational control of RAF 210 Group[30] while in August it was decided that all American radar personnel would be withdrawn from North Africa; American equipment was to be left for the French to operate.*[31] Further changes were required with the success of DRAGOON and the transfer of American units from Mediterranean Allied Coastal Air Force to IX Air Defense Command; all RAF radar was withdrawn from southern France and was replaced by American equipment.[32] Thus, with the exception of radar assigned to AAF Tactical Air Command in Italy, all American radar personnel and much American equipment had been withdrawn from the Mediterranean area by the end of 1944.

Since 8 November 1942, great strides had been made by the Allies in the use of radar for the detection of aircraft. American personnel had gained valuable battle experience, cooperation with the British had been perfected, and equipment had been tested and improved. As a result of the experience gained, the Allies had been able to set up an effective

*From December 1943 through July 1944 some 630 French Air Force personnel were trained as radar operators and repairmen at an Allied school conducted in L'Arba, Algeria. (Hist. AAF Fighter Command, Radar Organization, Jan. 1943-Sept. 1944, p. 4.)

radar chain to protect personnel and installations despite the handicaps of terrain and frequent equipment shortages. Nevertheless, all of this effort would have been to no avail without means of identifying aircraft as friendly or hostile.

The Identification System*

As in all World War II theaters, the principal method used in the Mediterranean area for distinguishing between friendly and enemy aircraft was based upon a function of radar known as IFF (identification friend or foe).† Despite improvements in the radar sets and better operational techniques, the identification function remained one of the major weakness of the World War II air defense system.

During the early months of the Mediterranean campaign, Allied reliance was placed on IFF radars known as Marks I and II.†† These models consisted of airborne transponders which swept through several frequency bands thereby altering the echoes picked up by the ground radars. Difficulties arose, however, as the number of frequency bands in use increased. This necessitated the adoption of a universal IFF

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*For a discussion of identification and of the development of IFF radar see Appendix I.

†The identity of approaching aircraft may be determined by two methods: "recognition," which is by visual observation, or "identification," which is by any means other than visual. Three identification methods may be used in addition to IFF: coordination of information received from early warning devices with reports of visual observation; assumption that any aircraft other than known friendly flights are hostile; and radio contact with all friendly aircraft. To aid in controlling the movements of friendly aircraft, MAAF was directed in April 1943 to compile all rules and information concerning air traffic to and within the North-west African theater. (Hq. MAAF CO 38, 7 April 1943, in hist. MAAF.)

††The term "mark" refers to type or model.

frequency band and the introduction of IFF Mark III which became the standard identification system in the Mediterranean theater.*

Despite an inherent weakness in the system (IFF positively identifies only friendly aircraft--in the absence of a correct response an aircraft is assumed to be hostile), when properly used IFF was an indispensable part of the Mediterranean air defense system.† To ensure its proper use, Allied headquarters and headquarters Army Air Forces set up certain operating principles, some of which were applicable only to Mark III.†† As a general rule, it was established that aircraft were to keep IFF turned on at all times when in range of friendly radar. On the other hand, to eliminate the possibility of enemy use of the radar pulses as an identification aid, IFF was to be kept off when aircraft were over enemy territory or in range of enemy radar stations. When the aircraft were in range of both friendly and enemy radar, the aircrews would be forced to choose the course which appeared less dangerous; ordinarily, the use of IFF was more important on the homeward flight.[33] Normally

*IFF Mark III differed from its predecessors in several ways: 1) the initiation of the identification procedure in IFF Mark III was made by the ground radar rather than by the airborne device; 2) IFF Mark III designated the entire system rather than merely the airborne radar set; 3) IFF Mark III airborne equipment was limited to one instrument (SCR-595 for use in bombers and transports, SCR-695 for use in all aircraft but usually used in fighters); and 4) the radar sets in the system could be turned off when not in use.

†Despite IFF, personnel of course relied to a considerable extent on recognition. For recognition purposes, several factors were considered such as the marking of aircraft, the characteristics, e.g. silhouette, and behavior of aircraft, and at night, the lights or colors flashed by the aircrew. (Hq. [illegible] and IFF [illegible], Routing [sic] Recognition & Identification of Aircraft in the Mediterranean Theater of Air Operations, 5b/[illegible]/7, no date, in Hist. [illegible] VIII, Combat Opns. Data.)

††For details of regulations governing the use of IFF in the tactical area see: Hq. [illegible], Regulations for the use of Mark III Airborne Equipment in the Tactical Area, 18 May 1944, in [illegible] microfilm roll 179.

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each flight of two or more aircraft was to include two planes equipped with IFF transponders; this would allow a substitute in case of equipment failure or loss of one equipped aircraft. However, to avoid an excessive number of signals which might "swamp" ground radar, only one of the transponders was to be switched on at a time. Each aircraft flying alone, of course, was to carry a transponder.[34]

IFF equipment and the establishment of rules for its use notwithstanding, the IFF system in the Mediterranean area never functioned at peak efficiency. Maintenance problems continuously hampered operations while improper use of the equipment, particularly the failure of aircrews to turn on the transponders at the proper time,[35] reduced confidence in the system and confused ground defenders. Both of these weaknesses in the identification system were apparent soon after the North African landings* but, in spite of strenuous efforts to correct them, improvement was slow and irregular.

With the introduction of IFF Mark III in 1943 a vast refitting program was necessary and delays in carrying out this program also handicapped operation of the identification system. By July 1943 the refitting was far behind schedule in the Northwest African Air Force area and orders were issued to hasten the program by all possible action. Many factors were responsible for the delay: the program had been badly planned and was not coordinated properly, e.g. the Navy was ahead of the

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*After 13 January 1944 failure to turn on IFF over Allied territory, the Atlantic, or the Mediterranean, except when otherwise specified, could result in disciplinary action. However, positively identifying Allied aircraft who failed to turn on their sets was difficult (Ltr., ADV. Hq. NAAF to all concerned, sub.: Aircraft approaching Air or Allied Naval ips or Convoys, 13 Jan. 1944, in USAF HD microfilm roll 104).

air forces in refitting which made it difficult for aircraft with IFF Mark II to identify themselves to ships equipped with IFF Mark III; some equipment was of the wrong type and had arrived in the theater without fitting instructions; and, responsibility for the refitting had not been centralized so that much wasted effort had resulted.[36] Until these deficiencies were corrected and the use of IFF Mark III became complete in the theater--refitting was not completed until after November 1943[37]--air force operations would suffer from unsatisfactory identification facilities.

Deficiencies of IFF

From the standpoint of air defense operations, the unreliable identification system constituted a serious weakness. As early as January 1943 it was reported that faulty identification had caused confusion, wasted effort, and danger to friendly aircraft[38] and by December 1943 Coastal Air Force stated that about 50 per cent of its fighter effort was being wasted for that reason.[39] Later Coastal Air Force reported that, between 24 November 1943 and 29 March 1944, its fighters made 2,315 "scrambles" (take-offs to intercept approaching planes); of these, 928 (or 40 per cent) were against aircraft, many engaged in non-operational flights, which were later recognized as friendly. If all pilots had been identified, Coastal reported, this percentage probably would have been greater. In addition to wasted pilot hours and fuel and unnecessary use of aircraft, this needless activity caused such confusion in filter rooms as to interfer with normal operations.[40]

The disclosure of this situation,* in addition to the recognized operational deficiencies of IFF, resulted in an investigation conducted in the Algiers area between 27 February and 17 March 1944. This investigation showed that airborne radar was suffering a loss of 10 to 15 per cent in operational efficiency; the principal reasons for this loss were failure of aircrews to turn on IFF and unserviceable IFF equipment. An additional 10 per cent loss was attributed to various deficiencies in ground radar.[41] Thus, the operational efficiency of IFF at airfields serving both operational and non-operational flights appeared to be about 75 per cent; not an impressive figure when it is considered that only daylight flights were checked. Further losses from night and all-weather operations as experienced by Coastal Fighters would undoubtedly have lowered the efficiency rating to approximately the 60 per cent level indicated by the Coastal scramble figures.

Despite the many proposals for improvements and the further checking made as a result of this investigation, IFF performance continued to be substandard. In an article entitled "IFF: It's Not Doing Its Job," the official AAF publication Radar pointed out a number of general reasons for this situation, applicable to all theaters: even though IFF was the best method of identification available, use of other identification methods divided efforts; IFF was an "all or nothing" system—one squadron with faulty IFF could disrupt the entire program; because the system was entirely automatic (except for switching the transponders on or off) it

*Naval authorities also complained that identification of air force aircraft was causing difficulties. Theater flying restrictions stated that aircraft were to avoid naval anchorages, warships, and convoys by staying outside of AA range (considered to be five miles). Despite the provision for disciplinary action if these restrictions were not adhered to, reports indicated that they were frequently violated. (Ltr. Nav. [illegible] to all concerned, sub.: Aircraft approaching HM or Allied Warships or Convoys, 13 Jan. 1944, in AAF HD microfilm roll 104.)

appealed little to pilots; and, recitancy to fire on the part of AA gunners even though IFF was not showing--perhaps allowing a pilot to escape once--caused pilots to feel that IFF as unnecessary. As these reasons for ineffectiveness were cumulative--one often led to another--the most stringent remedies were necessary. According to Radar, these remedies were a more concentrated training program in the uses of IFF and an increased emphasis on the fact that IFF was a system, not just a box in an aircraft.[42] To be effective, these remedies would have to be instituted in aircrew training as a part of a long-range program.

In the Mediterranean theater, little improvement was seen. The Air Evaluation Board AAF reported that IFF Mark III was at best an "unreliable aid" to air operations. Furthermore, unreliability had been increased by the capture of the Mark III transponder by the enemy* and his use of it to confuse Allied defenses.[43] Such reports raised doubts at Headquarters AAF as to the operational value of IFF equipment and a request was made for comments as to the possible elimination of the equipment from combat aircraft as a means of reducing weight.[44] Although Twelfth Air Force requested that IFF be retained on all aircraft,[45] the lack of confidence in the system as far from the scene of combat as Headquarters AAF was indicated.

Despite the deficiencies of IFF and the resultant criticisms from ground radar operators, antiaircraft personnel, and aircrews, IFF Mark III remained the best system of identification available for use in the

*All transponders were equipped with detonators for use in destroying the sets when in danger of capture but circumstances occasionally prevented Allied pilots from using them (Hq. AAF AAF Signal Operations Instruction 51-1, 5 Feb. 1944, in USAF HD 651.9051).

Mediterranean theater. Much of the lack of success in its use was attributable to laxity shown by the operators rather than to equipment weakness or failure. Without doubt, IFF, even if not absolutely reliable, contributed greatly to the success of the Allied air defense system in the Mediterranean area.

Chapter III

FIGHTER AIRCRAFT

The most effective means for intercepting enemy aircraft available to the Allies in the Mediterranean area was the fighter aircraft. Augmented by the use of radio and radar in the performance of Ground Controlled Interception (GCI) and Airborne Interception (AI), the fighter aircraft played a major role in the success of the Allied air defense effort.

As seen above,* Allied territory which required air defense was divided into large areas, each the responsibility of an air defense wing (RAF group). The wing areas were subdivided into two or more fighter control areas (sectors) each with a fighter control squadron and elements of a Signal Aircraft Warning Battalion. All fighter aircraft operating within the wing area in air defense were assigned to the wing commander and were controlled by the fighter control squadrons. By means of cooperation between the fighter pilot and the controller on the ground (Ground Controlled Interception), the fighter aircraft was able to approach attacking aircraft and make contact through the use of Airborne Interception.†

The Aircraft

Success of fighter interception, of course, depended to a great

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* See pp. 13-14.

† For a detailed account of Ground Controlled Interception and Airborne Interception see Appendix II.

extent on the available fighter aircraft. In regard to day fighters, the Mediterranean Allied air defense forces possessed both quantity and quality during the period of the greatest enemy bombing threat in the first half of 1943. TORCH plans had called for fighter defense to be provided by 5 day fighter squadrons in the Eastern Air Command area and 12 day fighter squadrons in the Twelfth Air Force area. MAC's fighter defenses were to be augmented by eight additional squadrons by D plus 47.[1] This fighter defense (composed largely of Spitfires) had proved effective during the first week and had contributed greatly to the enemy decision to bomb only at night.[2] With the formation of Northwest African Coastal Air Force in February 1943, 16 Allied squadrons were assigned to the new command. Seven of these were AAF, including one day fighter group, 350th (345th, 346th, and 347th squadrons), flying P-39's. As the commitments of NACAF were increased, additional squadrons were assigned to it until, at the peak of its operations in January 1944, it included in its 56 squadrons, 16 AAF squadrons, 9 of which were day fighters.* Thereafter, Coastal Air Force day fighter strength declined as the enemy air effort diminished.

The most effective Allied day fighter used in air defense during the early months of the North African campaign was the RAF Spitfire which was flown by both RAF and AAF squadrons. The remainder of the AAF squadrons assigned to Coastal Air Force--except 52d Fighter Group--were equipped largely with P-39's. By 1944 many of these obsolescent fighters had been replaced by P-47's and P-51's, the most effective AAF fighters. The Spitfire continued to be the best RAF fighter throughout the war and the

* In addition to the 350th Fighter Group, this total included 52d Fighter Group (Spitfires) and 81st Fighter Group (P-39's).

most widely used aircraft in the RAF groups working with Coastal Air Force.

Allied air defenses were less fortunate in regard to night fighter aircraft for no adequate American night fighter was developed until late in the war. In order to make up for this deficiency, AAF night fighter squadrons were outfitted with the two-place (pilot and radar operator) RAF Bristol Beaufighter. The necessity for equipping AAF squadrons, in turn, placed a strain on the British night fighter resources. The Beaufighter, which was the basic Allied night fighter until 1944, became operational late in 1940 to fill the RAF need--forcibly brought home during the Battle of Britain--for a fast, heavily armed, twin-engined night fighter with long endurance. Although operations with early models were hampered by a low service ceiling, the later Beaufighter model, Mark IV, which was widely used in the Mediterranean, had a service ceiling of 24,000 feet and a rate of climb to 20,000 feet of 13 minutes.* These factors made it particularly useful for scrambles.[3]

American efforts to produce a satisfactory night fighter were slow and halting. In 1942 AAF plans for night fighter defense were based primarily on day fighter-searchlight cooperation;[4] low visibility, of course, greatly hindered this type of defense. When RAF success with controlled interception became apparent, AAF tried to use available aircraft for similar operations by converting the A-20 light bomber to a

* The Beaufighter was an all-metal mid-wing monoplane equipped with two Bristol Hercules 1600 BHP motors. Its maximum speed was 330 mph at 16,000 feet and 290 mph at sea level. It was armed with four 20-mm. cannon in the fuselage and six .303-inch machine guns in the wing.

night fighter. It was expected that two squadrons of these P-70's would be ready for operations in North Africa by May 1943. All equipment and personnel in the P-70 squadrons were to be American.[5] Before any P-70 squadrons became operational in the Mediterranean area, however, the inadequacy of the aircraft as a night fighter--primarily because of its slow rate of climb--was recognized. As RAF was anxious for AAF to assume some of the air defense burden in North Africa, an offer was made to train and equip with Beaufighters three American squadrons of 18 aircraft each. In return, RAF was to retain 100 A-20's which had been allotted to them under a previous agreement. Beaufighter training for American personnel was to begin immediately in England so that AAF could relieve RAF night fighter squadrons by July 1943.[6] Headquarters AAF agreed to this arrangement except that it was decided to provide four squadrons of 12 aircraft each instead of the three suggested by RAF. Provision was to be made also for the training of replacement crews.[7] As a result, 414th, 415th, 416th, and 417th Night Fighter Squadrons were activated, assigned to Coastal Air Forces, and became operational in North Africa in the summer of 1943.

The Need for a Night Fighter Defense

Months before the arrival of these AAF night fighter squadrons, the need in North Africa for an effective Allied night fighter defense had been revealed. As seen above,* early warning and fighter control facilities did not function as planned during the initial Allied assault

* See above pp. 25-26.

on 8 November 1942 and for several days thereafter; nevertheless, day fighters were able to ward off, with slight damage to Allied installations, the few daytime attacks made by the enemy air forces. Night air defence was less effective; because offensive aircraft were accorded highest priority, no night fighters accompanied the NASCH air forces.[8] Moreover, when Beaufighters arrived from England, they were not equipped for night and all-weather interception and no GCI station was in operation for control purposes. As a result, German night air raids during the next two weeks were very costly to Allied positions. Raids on Maison Blanche and Bone, which were virtually undefended at night except by AA, resulted in damage to a number of aircraft including 10 of the scarce Beaufighters.[9] By 24 November, no improvement in the situation was apparent and General Eisenhower reported that he was "gravely concerned" at the inadequate night air defences; enemy night raiders were slowing up unloading operations and were depriving the Allies of badly needed airfields.[10] The Allied night air defense situation during the two weeks after NASCH pointed up the important fact that an attempt to set up a night fighter defense without proper aids was a waste of effort; while making such an attempt in North Africa the Allies "paid dearly in damaged and burnt out aircraft without effecting any kills amongst the Enemy."[11] This defect in Allied air defense was partially remedied on 25 November when the RAF 89 Squadron which had radar-equipped Beaufighters was transferred to North Africa from the Middle East. Operating with a GCI station, the night fighters experienced startling success by shooting down 11 out of 13 night bombers sent over Algiers by the enemy on the night of 27/28 November.[12] This success illustrated what experienced night fighter pilots flying properly equipped aircraft could accomplish.

Despite the success of this Beaufighter squadron, Allied night air defenses were weak for several months and AAF airfields in forward positions were constantly exposed to night bombing.[13] Furthermore, as the Allied build-up increased, ports crowded with shipping and warehouses filled with supplies offered tempting targets to enemy raiders. Allied Force Headquarters believed that the situation, particularly at Algiers, was serious and that a concentration of enemy effort could result in extensive damage. "Equally serious," Allied Force Headquarters reported, "is the certain effect upon civilian population throughout the whole region which, in spite of general sympathy, still feels that we have brought the war to this region and looks to us for protection." An increase in night fighter defenses was imperative, AFHQ asserted, and in the future each forward movement should be accompanied by adequate protection against night raiders.[14] Any improvement in the night fighter defense would have to result from RAF efforts, Headquarters AAF reported, for American night fighter squadrons would not be available for some time because of the lack of suitable aircraft.[15]

The first two months of operations in North Africa provided much valuable experience, although at a considerable cost, for Allied air defense planners.* German activities had indicated that heavy night air attacks would immediately be launched by the enemy on any port or vital area taken and occupied by Allied forces; therefore, future planners should include night fighters among the forces allotted to assault

* For an account of the problems encountered by 3d ADW in early warning and controlling see: Interview with Capt. August W. Mysing (controller and liaison officer with 3d ADW), Feb.-July 1943, in USAF HD 248.532-4.

operations. Details of night defenses should be completed before the assault which would permit immediate night fighter operations, including GCI cooperation, as soon as suitable airfields were captured. Provision should be made also for specialist personnel, such as testing and servicing units, to accompany the night fighter squadrons. In brief, any future operational plans should provide for early warning, GCI, AI, and related communications facilities.[16] Although this planning would entail a large addition to the personnel and equipment required for an assault operation, it could prevent damage or destruction of friendly facilities by enemy night air attacks.

The Growth of a Night Fighter Defense

In spite of these sentiments, night fighter strength grew slowly and, at the time of the formation of Northwest African Coastal Air Force, 18 February 1943, only three Beaufighter squadrons were operational in the theater: 153, 255, and 600 squadrons of 325 (RAF) Wing. These squadrons were assigned to Coastal Air Force[17] but were scarcely adequate to fulfill the widespread commitments taken on by the new command. Beginning in June, however, with the arrival of the 414th Squadron, the American Beaufighter squadrons, equipped with AI Mark IV, began to augment Coastal's night fighter strength and by August, all had arrived giving it a total of seven night fighter squadrons (600 RAF Squadron had been assigned to NATAF and was replaced by 219 Squadron).[18] For the next year these AAF squadrons, although assigned to Twelfth Air Force, continued to fly RAF Beaufighters under operational control of Northwest Allied Coastal Air Force headquarters; as one AAF officer reported: "Our procedure

was 100 per cent British: our equipment, our phraseology over the R/T, everything but our food and personnel." In his opinion, "That worked very nicely."[19]

The addition of these RAF-trained American Beaufighter squadrons to Coastal Air Force enabled the RAF to be relieved from much of its air defense responsibility.* As had occurred in the allotment of areas for radar coverage, the American squadrons were assigned to the less active sectors because, regardless of the fact that the state of their training was believed to be higher than that of the normal RAF night fighter squadron, the crews necessarily lacked operational experience. It was hoped that the enthusiasm of the American crews would compensate for much of their inexperience.[20] Later reports indicated that the American squadrons were performing their air defense functions adequately despite a weakness in recognition and a tendency among the aircrews to underestimate the capabilities of themselves and their aircraft.[21] By October 1943 Coastal reported that enthusiasm remained high among the American personnel and that 414th and 415th Squadrons had shot down five enemy aircraft by day and night. Among recommended changes in any future training of American night fighter personnel, it suggested more concentration on instrument flying training and air-to-air firing, in which functions American crews had shown weakness.[22]

* Training of American night fighter crews in England was stopped after a few months; beginning with a group of 12 replacement crews who finished training in the United States on 30 June 1943, all replacement crews were trained in the United States at the rate of eight per month and sent directly to North Africa. (TWX CG AAF, Hq. AFACT to CG USF Algiers, 7 June 1943, in AAF Policy Studies 4, p. 95.)

In addition to the handicap of a lack of combat training, American crews performed at first with an obsolescent radar set. All Beaufighters assigned to the American squadrons were equipped with AI Mark IV which, because of ground echoes, could not "see" at a distance greater than the altitude of the aircraft. Nevertheless, a Coastal Air Force request for Mark VIII equipment[23] was not approved in June 1943 because the supply of the superior Mark VIII AI sets was insufficient and operators and installation personnel were too limited to permit refitting at that time. Two courses were suggested to Coastal Air Force by which obsolescent equipment might be replaced: Beaufighters might be exchanged for new Beaufighter Mark VIII's from England--this was the procedure being followed by the RAF night fighter squadrons--or, P-61's, the long-awaited American night fighters, might be requested as replacement aircraft.[24] Nothing was done immediately, however, and the American squadrons operated throughout the summer of 1943 with obsolescent equipment. Finally in October Mark VIII sets began to arrive in sufficient quantities to allow the re-equipping of the American squadrons.[25] By the end of November 414th and 417th Squadrons had been completely converted to the newer equipment and refitting was in progress in 416th; it had been decided to continue 415th as a Mark IV squadron.[26]

Although the efficiency of the Beaufighter was increased to a considerable extent by the introduction of Mark VIII AI (and its predecessor Mark VII), restrictions on the use of the radar limited its radius of action. In order to make certain that no centimeter AI radar set would fall into enemy hands, it was announced in June 1943 that no aircraft equipped with Mark VII or VIII would be permitted to fly over enemy-held

territory. If it appeared that pursuit of an enemy aircraft would take a Mark VII or VIII-equipped aircraft away from friendly territory, the pilot was to break off the pursuit. If ditching became necessary near enemy territory, the pilot was to ditch in deep water, if possible.[27] This restriction was relaxed somewhat in September 1943 when permission was given to use Mark VIII in any situation, e.g., interception of low-flying enemy planes, in which Mark IV was not effective.[28] However, not until 2 May 1944 was Mark VIII released for general use over enemy territory, despite its admitted superiority over Mark IV as an interceptor device.[29]

Meanwhile, the Beaufighter had become the subject of much criticism, particularly in Headquarters AAF. Production of the aircraft had ceased about 1 January 1944 and all Beaufighter squadrons had been directed to eliminate all unnecessary flying; replacements for damaged or destroyed aircraft were to be made from rebuilt planes or from the reserve.[30] With no new aircraft available, the Beaufighters, many of which had been operational for as long as three years, quickly became war-weary and were expected to be prone to accident. However, when Lt. Gen. Barney M. Giles, Headquarters AAF,* complained "that numbers of Sector (MAAF) night fighter squadrons are equipped with obsolescent, worn-out aircraft, and are without reserves," a quick denial was voiced by Air Marshal Sir John Linnell, deputy to Air Marshal Slessor. Linnell pointed out that the "obsolescent, worn-out" aircraft were consistently shooting down enemy raiders as long as their radar functioned properly. Furthermore, reserve

* General Giles was Deputy Commander AAF and C/AS.

aircraft were plentiful for the eight Allied squadrons were backed up by a total of 71 aircraft either ready for action or being overhauled. The American squadrons, Linnell emphasized, were being treated exactly as the British in matters of supply; however, conversion to Mosquitos could not be promised for the quota of the new fighters for the Mediterranean theater was only three per month.[31] On the following day, 18 April 1944, General Baker, apparently in complete agreement with Linnell, informed Giles that the American squadrons were not being mistreated. They had 46 of their required 48 Beaufighters (all except one squadron being Mark VIII's) and Baker stated emphatically: "I wanted you /Giles/ to know the British are treating our squadrons the same as their own."[32] Operational data tended to support the opinions of Linnell and Baker. During March and April, three of the American squadrons (414th, 416th, and 417th)* suffered only 5 accidents in 2800 hours flown (operational and non-operational) or an average of 1 accident per 560 hours. This accident rate compared favorably with the accident rates of all Coastal squadrons.[33] On the credit side, aircraft of the same squadrons claimed to have destroyed three, probably destroyed two, and damaged one enemy aircraft during the two months at a cost of three Beaufighters.[34] Despite the age and condition of the Beaufighters assigned to the American squadrons, apparently they continued to give good service.

Regardless of this criticism of the aircraft and in spite of the development of better night fighters by both England (Mosquito) and the

* 415th Night Fighter Squadron was assigned to XII AsC 12 Oct. 1943 (Hist. 12th AC, Nov. 1943).

United States (P-61), the Beaufighter formed the basis of the Allied night fighter effort until late in 1944. Production of the new aircraft was slow in both countries and the priorities for the other theaters were higher than for the Mediterranean. It had been predicted in October 1943 that American night fighter squadrons in the Mediterranean would begin receiving P-61's as replacements for Beaufighters in February 1944;[35] however, by January 1945 only 414th Squadron had been equipped with the new fighter.* The new British night fighter, the Mosquito, began to arrive in the Mediterranean much earlier but, of the American units, only the 416th Squadron received the aircraft and its conversion was not completed until December 1944.† Thus it remained for dher theaters to test the new Allied night fighters extensively against active opposition.

Fighter-Searchlight Defense

In addition to night interceptions by radar-equipped night fighters, attempts were made in the North African theater to perform night interception by using searchlights in conjunction with either day or night

* The P-61, the only aircraft designed exclusively for night fighting by the Allies during World War II, was an all-metal monoplane with twin tail boom and two Pratt and Whitney 1850 horsepower motors. It had a crew of three (pilot, radar operator, and gunner), service ceiling of 31,300 feet, speed of 375 m.p.h., and was armed with four .50-caliber machine guns and four 20-mm. cannon.

† The Mosquito was a wooden monoplane with two 1280 brake horsepower Rolls Royce Merlin XXI motors. It had a speed of 360 m.p.h. at 12,000 feet, an absolute ceiling of 35,500 feet, a rate of climb to 20,000 feet of 10 minutes, a crew of two, and was armed with four 20-mm. cannon. Tests in the ETO indicated that the Mosquito and P-61 were approximately equal in performance with the P-61 being slightly faster (Memo to Vandenberg from Fighter and Air Defense Branch, OC&R, sub.: Report of Operational Test of P-61, 7 July 1944, in the ETO in USAF HD microfilm roll 278.)

fighters.* As early as 26 December 1942, Headquarters AAF sent an officer to North Africa to prepare a defense plan for day fighter-searchlight defense of Oran, Casablanca, and Algiers.[36] Apparently no fighter-searchlight defense resulted, but in June 1943 tests were conducted in North Africa using night fighters in conjunction with both searchlights and GCI in defense of a beach against high flying bombers. In these tests early warning was supplied by the GCI radar set; searchlight control then picked up the target. With the target illuminated, a night fighter radar operator picked up an enemy bomber and the pilot followed the usual AI procedure.[37] Further, and more extensive, tests were held on 8 July 1943,[38] the results of which were most favorable. The tests illustrated that, after being picked up by the searchlights, bombers were unable to evade the lights, and that the system of interception was extremely simple; pilots could learn the system on only one day and one night mission. Despite these advantages, it was proved that the system would not function properly if early warning was not furnished in time for fighters to scramble. Finally, as had been determined previously, the slower speed of night fighters in comparison to day fighters was a definite disadvantage in a defense system conducted with

* Other methods of intercepting enemy aircraft at night by the use of AI were attempted. When a large formation of enemy raiders were detected, night fighters were directed into the stream of bombers where they depended upon radar to contact individual targets. Also, if an enemy attack was expected or if an Allied target was especially vulnerable or important, night fighters occasionally "free lanced" (patrolled the area waitin for the enemy to come within AI range). This method was too expensive in time, gasoline, and aircraft wear to be used extensively. Positive identification was of vital importance in both these activities, for the possibility of firing on friendly aircraft was increased when previous attempts to identify by IFF had not been made by ground radar.

searchlights.[39] Regardless of the success of these tests, fighter-searchlight defenses were not used extensively in North Africa primarily because shipping space for the large number of necessary searchlights was never available.[40] All searchlights in the theater were needed to provide proper coverage for ports, which were the principal objects of enemy raids;[41] therefore, the defense of airfields in North Africa would have to be the responsibility of night fighters, using GCI and AI, and antiaircraft.*

In April 1944, with the shipping situation alleviated somewhat, the most extensive fighter-searchlight belt installed in the Mediterranean area became operational at Foggia, Italy.[42] This belt, which covered an area 31 miles long and 28 miles wide and enclosed 13 airfields, was composed of 130 searchlights and 78 SCR-268's (searchlight radars). Most of the searchlights, alone or with radars, were spaced around the belt at intervals of about 4,000 yards with a concentration of lights and radars in the center of the belt. Other searchlights were dispersed at various points to act as beacons for friendly aircraft. When early warning of approaching aircraft was received, fighters scrambled and were vectored to the beacons where they awaited further information from the Searchlight Operation Room. Any approaching aircraft entering the belt were illuminated by the searchlights; this enabled the airborne fighters to obtain AI contact and intercept the aircraft. Although this

* A fighter-searchlight belt had been in operation in the Telergma (Algiers) area in May, June, and part of July to cover several heavy bomber bases; not one hostile plane came in range! (Ltr., Brig. Gen. Hobart Hewett (AA&CD Section) to Brig. Gen. C. V. R. Schuyler, Hq. AA Command, Richmond, Virginia, 17 Oct. 1943 in DRB microfilm roll 91-C).

type of fighter-s archlight belt could operate efficiently, particularly in mountainous terrain where radar was limited, it had several disadvantages: it was uneconomical because of the vast amount of equipment required; its efficiency was lessened by adverse weather; and, the SCR-268 Searchlight Radar had a range of only 25 miles and was quite easily blanketed by "window."[43] The Forgia belt was further handicapped by the fact that only three Beaufighters were available for operations with the searchlights.[44] The limited success achieved by this fighter-searchlight belt notwithstanding, because of improved night fighters and the lessened threat from CAF, reliance in night interception in the Mediterranean theater continued to be placed on radar-equipped night fighters.*

German Tactics and Countermeasures

Throughout these months, as Allied fighter aircraft and fighter defense techniques improved, the enemy was forced repeatedly to alter his tactics in order to reduce his losses and to inflict more damage on his targets. During the early days of the North African campaign the success of Allied day fighters forced the enemy to resort to night bombing at which, as indicated above, he experienced considerable success until Beaufighters equipped with AI arrived in the theater.[45] At first CAF night tactics, "so elementary as to be almost suicidal," consisted of straight, high altitude approaches by small formations of low performance bombers at regular five minute intervals. When the Beaufighter

* The 427th Night Fighter Squadron equipped with P-61's served briefly in the Mediterranean theater. It arrived in Africa 6 August 1944, in Italy 29 August, flew several missions, and departed for the CBI on 22 September 1944 (Hist. 427th Night Fighter Squadron, 1 Dec.-31 Dec. 1944).

squadrons quickly took advantage of these tactics and shot down a large proportion of the raiders, the enemy changed his attacks to lower approaches with planes arriving at irregular intervals and taking evasive action. Although this resulted in fewer losses to the raiders, it also decreased his destructive potential; he then turned to attacking ports, convoys, and isolated ships, approaching low with fast aircraft (Ju-88's).[46] As these efforts offered little possibility of success, particularly after the completion of the Allied coastal radar chain, CAF divided its efforts for a time with "nuisance" raids at widely scattered points. This unsuccessful system apparently was designed to divide Allied night fighter efforts.[47] Thereafter, the majority of enemy raids on North Africa were directed against either ports or convoys.*

Despite the improvements in Allied night fighters and night fighting technique, the efficiency of Allied night defenses was lessened considerably after the fall of 1943 by the German Air Force's use of radar countermeasures (RCM), principally of "window" (Dueppel-Streifen). Window† was

* Because of the early success of Allied night fighters, the German bomber forces became reluctant to venture forth in areas protected by the Beaufighters. The Allies then attempted to use the controlled fighter as an offensive weapon in order to obtain the initiative by intercepting the bombers before they reached Allied territory. This procedure was recommended as early as December 1942 but a GCI station sited in May 1943 on Cap Serrat in Tunisia for offensive use failed because of local radio interference and because of a slackening of enemy effort at that particular time. Later attempts proved more successful and extensive use was made of the controlled night fighter operating offensively. (Ltr., NACAF to NAAF, subj: Tactics of Beaufighter Squadrons, 1 May 1943, in USAF HD microfilm roll 290; ltr., ACM Tedder to AVM Lloyd, 22 Dec. 1943, in USAF HD microfilm roll 283; Mare Nostrum, 14 Sept. 1944 (review of period Mar. 1943-Sept. 1944), p. 34.)

† Although the American equivalent was called "chaff," the word window seems to have been used more frequently by the Allies.

the code name given by RAF to metallic strips or small pieces of silver paper which, when dropped by aircraft, floated slowly (300 feet per minute) to earth. When window was encountered by the radar waves (for best results, the strips were half the length of the wave length which it was desired to jam), a blip appeared on the radar scope similar to that caused by an aircraft. Thus the use of window tended to saturate the receivers which made it difficult to pick out the actual aircraft and confused the radar operators.[48]

Window was first used by the Germans in the Mediterranean theater during a raid over Bizerte on 6 September 1943. Early warnings by Allied radar showed 200 enemy raiders approaching but when Allied fighters scrambled to meet the attackers they found nothing where radar indicated the enemy to be. Actually about 50 enemy aircraft approached low, climbed sharply over the target, and released window and bombs.[49] Although this initial trial with the countermeasure must have been disappointing to the enemy--12 bombers were destroyed, 5 by night fighters and 7 by AA[50]--thereafter, nearly all major German night raids were preceded by the dropping of window.

Enemy tactics in the use of window were simple at first; raiders merely tried to drop as much window--cut in different lengths in an attempt to jam all frequencies--as possible in order to cover the widest possible area. As the Germans became more familiar with the use of window, more scientific distribution methods were attempted, the most effective being: a general blanketing of the area by high flying aircraft a few minutes before the arrival of the bombers; releasing of the window by the bombers, themselves, as they neared the target area; and dropping of window only

when the presence of fighters was suspected.[51] In each case, according to Allied Intelligence, window was carried in cardboard or bomb containers--a bomber could carry one or two boxes of window without affecting its bomb load--and were easily released at any desired point.[52]

If the dropping and spacing of window were carried out correctly by German airmen, any of these methods was effective; Allied attempts to cope with the threat depended initially on mistakes made by the enemy.[53] As experience soon indicated that no Allied radar was completely immune to window interference, it remained for radar personnel to devise methods of overcoming RCM; this could be done by practice and experience on the part of radar operators.* It was discovered that gaps appeared frequently in window through which radar was able to "see" and that echoes from aircraft were often stronger than echoes from window. Furthermore, as window affected only the frequency for which cut, it could be "seen through" on other frequencies. Experience also indicated that the effect of window could be lessened considerably if all information were passed to the night fighters, if fighters were patrolled at right angles to the probable line of enemy approach and as far from defended target as possible, and if the GCI controller cooperated with the night fighter until the point of contact with the enemy aircraft.[54] If care were taken by both ground and airborne radar operators, the effect of all but the most

* Special training exercises designed to acquaint radar personnel with window were held in MAAF units using either captured GAF window or window especially constructed to jam Allied radars (Ltr., Hq. 62d FW to AOCMACAF, 23 Apr. 1944, sub.: Anti-Window Exercises, in USAF HD microfilm roll 290; Hq. MAAF Signal Instruction 25, 13 Jan. 1944, sub.: Employment of "Window" (US "Chaff") for Training Defensive Radar Personnel, in USAF HD microfilm roll 214).

complete saturation by window could be overcome.* By July 1944 Headquarters Mediterranean Allied Air Forces reported that, with later radar equipment, e.g., AI Mark VIII, radar operators were able to work through window with considerable success.[55]

In addition to the use of window, the enemy employed other countermeasures in order to nullify Allied interception efforts to the greatest extent. Various methods of jamming Allied radio communications were tried, with success varying according to Allied vigilance and experience. When Allied personnel had anticipated enemy jamming and had perfected and practiced operational methods for counteracting it,/ the effect of the enemy efforts was lessened considerably. Not so easily counteracted was the tail-warning radar which began to appear on German aircraft in 1944. This radar device (FUG 217) was installed in enemy aircraft so that a night fighter approaching from 1¼ to 2 miles behind within an area of 70 degrees on either side, 25 degrees above, or 60 degrees below the line of flight would trigger the set. With the presence of an enemy on his tail known, the pilot could take evasive action.//[56] Although several suggestions for counteracting the effect of the FUG 217 were advanced, such as jamming the tail warning radar by Allied ground jammers,[57]

* At times GAF saturated a target area so thoroughly that night fighters were unable to operate; this occurred during a raid on Naples in April 1944 (TWX 62d FW to CG MAAF, MACAF, 30 Apr. 1944, in USAF HD microfilm roll 270).

/ For detailed instructions on combatting enemy communications jamming see: Hq. XII Training Command, Special Signal Instruction 13, sub.: Tactics and Technique of Communications Anti-jamming, 27 Oct. 1943, in USAF HD 651.9031.

// A XII Fighter Command Intelligence report stated in July 1944 that all German bombers and twin-engined reconnaissance aircraft were equipped with the device. RAF signals history states, however, that by May 1944 the tail warning device was seldom used because German crews were confused by the indications from other bombers in the formation. (Intelligence Summary, July 1944, in Hist. XII FC, p. 7; RAF Signals, VIII, Radio Counter-Measures, issued by the Air Ministry, 1950, p. 54).

no effective countermeasures had been discovered by the time of the withdrawal of American units from Coastal Air Force.

The Microwave Early Warning Radar

The final interception aid to appear during the Mediterranean campaign was the Microwave Early Warning (MEW) radar, officially designated AN/CPS-1. The AN/CPS-1 was a huge, complicated radar--its total weight was 66 tons--which combined, with improved performance, the best qualities of other radar sets.* Despite its nomenclature, the primary function of this radar was fighter control and fighter direction although it served a variety of functions including early warning and raid reporting; also it acted as a navigational and meteorological aid.[58] Although the installation of the MEW radar in the Mediterranean area came too late to influence greatly the operations of AAF in air defense, it quickly showed its worth in the operations during the summer of 1944.†

Erection of the only AN/CPS-1 to reach the MTO was started on the northern tip of Corsica in April 1944, where it began limited operations under 63d Fighter Wing soon after.[59] The radar was sited in Corsica primarily to provide long range fighter control; from that point control could be exercised over fighter operations both in Italy and in the forthcoming ANVIL (renamed DRAGOON) operation, in support of which 15 airfields were constructed and others improved in Corsica. All of these airfields were to depend primarily on MEW for control.[60] Although limited enemy

* A similar RAF radar was the AMES (Air Ministry Experimental Station) type 16.

† For details on operations of an MEW see: "Sixty-Six Tons of MEW," Radar, 30 June 1944, pp. 3-11.

opposition was encountered by the Allied air forces in DRAGOON, AN/CPS-1 aided the operations materially by its long range and versatility.* The radar set, despite its bulk, gave promise of excellent results in future operations.

Evaluation of AAF Fighter Effort

On 14 September 1944 all AAF units were withdrawn from MACAF and RAF assumed the entire air defense burden for the Coastal Air Force area. Despite this withdrawal, the AAF night fighter squadrons--and day fighter units when the occasion demanded--that remained with the tactical air force in Italy, did not abandon their air defense functions. Nevertheless, defense of fixed installations and convoys became solely the responsibility of RAF in MTO outside the Tactical area.

An attempt to evaluate the operations of AAF day fighters in an air defense role during the Mediterranean campaign is virtually impossible while a similar evaluation of night fighters is difficult. Because of the high degree of Allied cooperation, which caused an intermingling of units and their records, and because of constant shifting of AAF day fighter units, statistics either for combat victories or for defensive operational sorties of the day fighters cannot be compiled with any accuracy. As the night fighters operated more as national units with

* The equipment situation in the Mediterranean was amply illustrated following DRAGOON when General Baker stated that the MEW should be moved to Southern France. General Cannon disagreed, pointing out that it was the only MEW in the Mediterranean while the ETO possessed at least two sets. Cannon stated: "We are being milked and milked, and the old cow is about dry. We are almost reaching the stage where we can turn the herd out to pasture and go hunting. Suggest the crowd up north get their supplies from the United States and not the Mediterranean Theater." (TWX, Baker to 12th AF, MATAF, MACAF, 63d FW, 21 Aug. 1944, in USAF HD microfilm roll 117; TWX, Cannon to Baker, 3 Nov. 1944, in USAF HD microfilm roll 61.)

fewer changes of assignment, some indication of their operational activity may be gleaned. In neither case, however, may the true value of these fighters be determined from statistics.

During the period of about 18 months from their arrival in the theater to the end of 1944 (to October in the case of 416th Squadron), the AAF night fighter squadrons flew a total of 4,937 sorties of a defensive type. On these sorties the night fighters claimed to have destroyed 25 enemy aircraft, probably destroyed 9, and damaged 14 at a cost of 48 night fighters*-- not an impressive record when compared with day fighter operational statistics.[61] However, these figures do not reveal the number of raids which were broken up by the night fighters or the number of bombs which went astray when the enemy bombers jettisoned their loads before reaching their targets. Nor do they reveal the effect of constant harrying on the morale of the enemy aircrews or the many operational plans which were changed by GAF because of the presence of the night fighters.† All of these important factors are immeasurable as is the factor of the effect of the presence of the night fighters on the morale of Allied personnel. Although AAF night fighter squadrons were few in numbers and were able to show little in the way of combat victories, their contributions, both toward the outcome of the actual battle and in the experience gained and lessons learned, were invaluable and greatly aided the ultimate Allied victory.

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* The breakdown on these figures shows 414th making 1,151 sorties, destroying 7, probably destroying 2 and damaging 1 enemy planes at a cost of 12 aircraft; 415th, 1,051 sorties, 6-0-2 with 11 losses; 416th, 1,151 sorties, 6-2-0, 7 losses; 417th, 1,584 sorties, 6-5-10, 18 losses (Operations of the 12th AF).

† According to prisoner of war reports, the night fighter was the most effective deterrent to enemy bombing operations. The presence of the night fighters caused enemy crews to weave, change course and height, and hurry over the target, all of which lessened bombing accuracy. (Ltr., NAAF A-2 to S/L Francis MAC, sub.: Defence of Algiers Region against E/A, 17 Feb. 1943, in USAF HD microfilm roll 30.)

Chapter IV

Antiaircraft Artillery

Another major element in the Allied air defense system in the Mediterranean area was antiaircraft artillery (AA).* In the American military organization—unlike the British AA which was part of the Royal Artillery—all AA was contained in the Antiaircraft Command, an element of the Army Ground Forces.≠ As such, AA was not part of the AAF but was made available to air units or installations when required. This organizational concept existed also in the Mediterranean area where all American AA outside the combat zones was initially assigned to Allied Force Headquarters. Such a command arrangement, which placed an air defense weapon outside of air force control, was to be the cause of considerable inter-service controversy in the American forces.

AA in Early North African Operations

Plans for the employment of AA in TORCH partially illustrated how it was expected that AA would function. Among its tasks were: cover for the troop landings; establishment of AA defenses as soon as the landings were secured; use of any enemy AA equipment or installations available; and, provision for a searchlight defense.[1] For the carrying out of these tasks, AA batteries were assigned to each assault infantry regiment and

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*According to Allied Force Headquarters, the role of AA weapons was "to make sustained attack on any objective by hostile air forces so expensive as to be not worth the enemy's while, and/or to force them to fly at such a height that they cannot be certain of making their attack successful." (Memo for Maj. Gen. Pargiter, MAAOD from AFHQ Off. C/S. sub.: Review of AA Defense, 15 June 1944, in MAAF HD microfilm roll 10).

≠The Antiaircraft Command came into being 9 March 1942 with Maj. Gen. Joseph A. Green as commanding general. It was responsible for activating, organizing, equipping, and training AA units for combat. (AGF Study 26, The Antiaircraft Command and Center, p. 3.)

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combat team. After the landings had been secured, part of this AA was to remain with the infantry as it moved inland, while the remainder was to protect captured territory.[2] Additional AA batteries were to land as the invasion progressed so that adequate AA protection would be available to meet any need. Although these preparations appeared adequate on paper, because of major enemy air action during the initial assault, they were not put to the test. In view of the absence of adequate early warning, as seen above,* AA would undoubtedly have been the principal air defense weapon during D-Day if the enemy air arm had been extremely active.

Soon after the landings, the enemy air force increased its offensive activities and, within a few weeks of the invasion, as Allied forces were moving inland rapidly, Twelfth Air Force forward bases were being bombed frequently. In view of this situation, General Doolittle recommended that the best solution to the problem--one which would provide more coordination and more protection for advance bases--would be the assignment of all air defense weapons, including AA, to the air defense wing in which the weapons were operating;[3] this recommendation was not approved.[4] When requests by Doolittle's Chief of Staff, Col. Hoyt S. Vandenberg, for AA protection for Twelfth Air Force bases produced no results, Vandenberg warned that "if immediate action is not taken on this request, enemy high altitude bombing, dive bombing and ground strafing will result in serious losses on the ground and will render these essential airdromes unavailable."[5] This still did not produce action and on 5 January 1943, Vandenberg repeated

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*See p25 ff.

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his request, again without immediate results.[6] On the same day Brig. Gen. Gordon P. Saville, an AAF air defense expert, reported that ground force control of AA in North Africa was not working efficiently. Saville believed that AA and fighter aircraft as weapons of air defense should be under a single command, otherwise their capabilities could not be known and exploited.[7] In Washington the same views prevailed and, in February, G-3, War Department General Staff proposed that AA be transferred to the AAF; this proposal was concurred in by General Arnold. Although Chief of Staff Lt. Gen. Leslie J. McNair believed that AA units should be trained with air units, he also now agree with a complete transfer and the proposal was dropped.*[8] Thus despite these views and despite the existence of War Department publications indicating that AA within air defense areas should be controlled by air force commanders,[9] American AA was continued by ground force officers, a situation which produced a divided command to carry out a single mission.

As seen above,† this problem was not peculiar to the American forces for the need for coordination of all Allied air defense weapons had been foreseen by TORCH planners. An Antiaircraft and Coastal Defense (AACD) Section, which later became part of Army, consisting of an Allied staff under Col. Aaron Bradshaw (USA), had been set up in London as a coordinating agency.[10] In addition, an antiaircraft and Coastal Defense Committee, headed by G-3 Allied Force Headquarters and composed of representatives

*The question arose again in September 1943 when an AA survey board, appointed to examine the command situation following the shooting down of friendly aircraft by AA in Sicily, recommended the transfer of AA training to AAF. This proposal was also disregarded although some improvement in combined training was made.

†See p. 5 ff.

of AA&CD Section, naval and air staffs, signal section, and other interested groups, had been established as soon as the assault phase of the invasion was completed. Among the functions of this committee was to study and recommend action for the allocation of AA.[11]

The Antiaircraft and Coastal Defense Section was reorganized and its responsibility in AA matters broadened in February 1943 when all AA defense outside of the battle areas of the British and American armies was placed under the operational supervision of Major General Pargiter, the British officer chosen to head AA&CD Section.* Command of this AA was retained by Allied Force Headquarters under which Pargiter exercised general operational control.ƒ This step relieved the armies from concern with AA protection in rear areas and provided a means for closer supervision and coordination of all resources, American, British, or French. Pargiter's position (his official designation was MG AA&CD) was clarified on 7 March when he was designated as chief adviser to Eisenhower on all Allied AA matters and as the authority for coordinating all antiaircraft and coastal defense policy among the Allied services. His responsibilities included fixed coastal defenses of all areas under Allied control behind the battle areas; AA and coastal defenses in areas occupied by American armies was to be the responsibility of commanding general, Fifth Army.[12]

In common with other Allied groups concerned with air defense, the area of responsibility of Pargiter and the AA&CD Committee in AA matters increased with each successive advance of the Allied forces. Following

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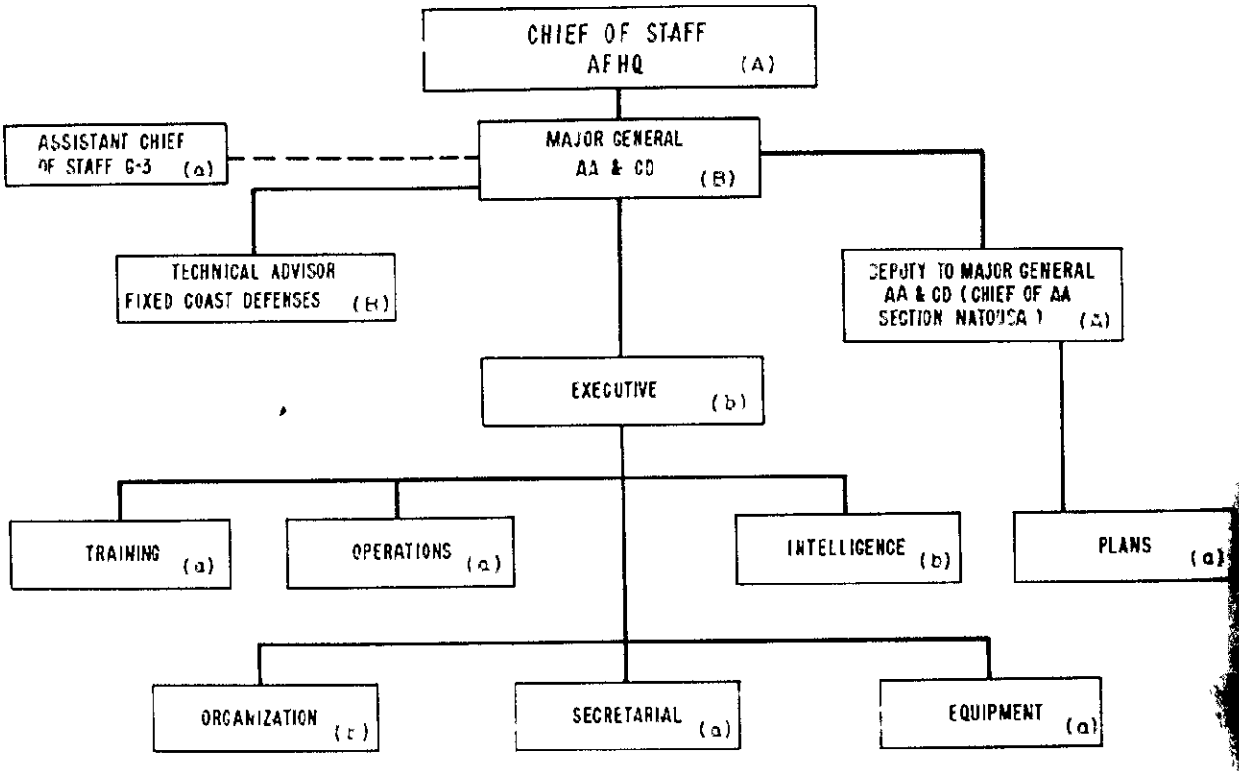
* See operational charts on following pages.

ƒ Because of the great distances involved, slow communications, and differences in the command structure of British and American units, General Pargiter believed that his control of AA had to be of a general nature. (Maj. Gen. Pargiter's report on the command system, n.d., in (RAF) Cabinet Historical Archives ref. H.S. A.F.H.Q. /361/2)

ANTIAIRCRAFT AND COAST DEFENSE SECTION AFHQ-NATOUSA

SEPTEMBER 1943



LEGEND

——— COMMAND

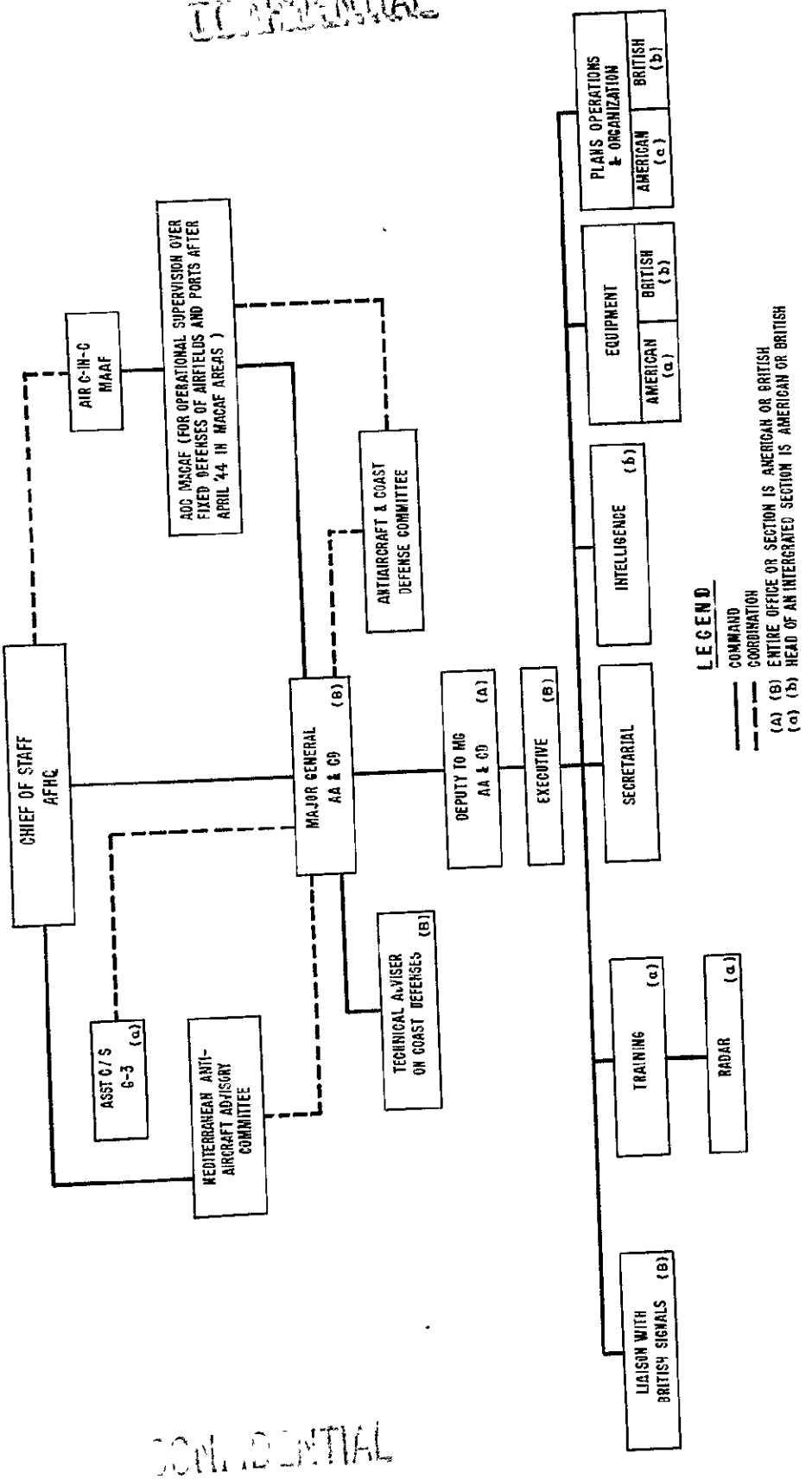
– – – COORDINATION

(A) (B) ENTIRE OFFICE OR SECTION IS AMERICAN OR BRITISH

(a) (b) HEAD OF A SUBSECTION IS AMERICAN OR BRITISH

ANTIAIRCRAFT AND COAST DEFENSE SECTION AFHQ

JUNE 1944



the expulsion of the enemy from Tunisia and Sicily, Fargiter became responsible for all Allied AA defenses and coast defenses in North Africa and in the rear of the 15th Army Group as it moved forward; however, AACD Committee replaced him as the authority for coordinating AA and coast defense policy among the various Allied services.[13] By 5 November 1943, Corsica, Sardinia, and part of southern Italy had been added to Fargiter's area of responsibility.[14] In addition to exercising operational supervision over AA in these areas, Fargiter's section performed such other AA functions as: liaison with the British War Office, American War Department, and the other Allies; planning for future operations; collation and dissemination of intelligence; and, the formulation of AA training and equipment policies.*

Increase in AA Responsibilities

As General Fargiter's area of responsibility for AA defense increased, it was necessary for him to delegate authority for operational supervision and control. For this purpose the fighter control sectors were utilized. Within the boundaries of the sectors, operational supervision of AA defense was exercised by Fargiter though the AA Brigade Commanders. Operational control of AA weapons within the sectors, on the other hand, was exercised by the Sector Air Defense Commander who was an RAF or AAF officer appointed by Marshal Lloyd. In turn the sector commander exercised his control through Antiaircraft Defense Commanders, one for each defended area, who

*AACD was given the added task in December 1943 of inspecting AA defense organizations throughout the theater (Ltr., AFHQ G-3 to AA AACD, 14 Dec 43, in AAF HD Microfilm roll 39).

were appointed by the air brigade commanders.[15] Thus, although local operational control of AA at the sector level was exercised by an air officer, the sector commander,* operational supervision and operational control above and below the sector level were in the hands of ground officers.

As a result of this arrangement, although Bloya had been given the responsibility for planning the air defense of Northwest Africa and for controlling the operations of all units allotted to Coastal Air Force for air defense purposes,[16] AA, an integral part of air defense, was controlled by General Laniter, a ground officer in Allied Force Headquarters. A unified air defense command did not exist and the divided responsibility for the accomplishment of the AA mission led to competition in the allotment of air defense weapons and to cumbersome staff machinery. Furthermore, this organizational structure violated both American and British doctrine which gave the responsibility for air defense in a theater to an air force command. As a solution to this problem, Coastal Air Force proposed in November 1943 that the AA part of Antiaircraft and Coastal Defense Command be reestablished as Mediterranean Antiaircraft Artillery Command and that this command be assigned to Coastal Air Force.[17] Headquarters Mediterranean Air Command concurred[18] and, at the request of General Eaker, the matter was investigated by Air General Slessor. In his report Slessor agreed with the need for a reorganization which would place the control and direction of all air defense matters in the theater under the Air Commander in Chief; furthermore, he recommended the creation of a

*The sector commander was also responsible after 17 January 1944 for the allotment of AA within his sector.

Mediterranean Antiaircraft Advisory Committee, with the Deputy Air Commander in Chief (himself) as Chairman, composed of representatives of the Navy, Army, MAC-in-C Middle East, AOC Malta, AOC Eastern Mediterranean, and Lt Gen Doolittle. The functions of this Committee would be to advise Allied Commander-in-Chief on air policy and the allocation of air resources. Marshal Lloyd would assume operational command of all air, except in the forward areas, Alexandria Sector, while General Spaatz would become responsible to Lloyd for the operational efficiency of air defenses. Lloyd would allocate air, upon recommendation of the Air Advisory Committee, in bulk to areas, with the Sector Air Defense Commanders retaining the responsibility for distribution of the weapons. Adoption of this operational structure, which corresponded to the successful structures in England and the Middle East, Tedder pointed out, would vest primary responsibility for the general direction of air defense in one man (Marshal Lloyd), would set up a high level committee on which all interested "customers" for air were represented, and would simplify the chain of command in air matters.[19] These recommended changes were fully concurred in by Eaker who, in a letter to General Arnold, had expressed the opinion that there might be a "Pearl Harbor" in the Med as a result of the unsatisfactory Air Command arrangement; if such a disaster had occurred under the old structure, Eaker believed that it would have been difficult to fix responsibility.[20]

On 5 April 1943, the proposed changes were placed in effect substantially as suggested by Tedder. Control and direction of all Allied air defense matters were vested in the theater air commander in chief (Eaker) who in turn delegated direction and control of air forces, except those in forward areas, to Air Marshal (Lloyd); directions within the

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Air Defense Instruction 1 which remained the basic document for the employment of AA in the Mediterranean area.* According to these instructions, any area which could be defended best by AA was designated an Inner Artillery Zone (IAZ) over which operation of friendly aircraft was prohibited. Any aircraft not clearly recognized as friendly was to be fired upon by all AA weapons in an IAZ. The only exception to this procedure was that the Sector Operations Room might order "Hold Fire" By day only. If such an order were in effect, AA was not to fire on approaching aircraft unless they were definitely recognized as hostile or committed a hostile act. Less important areas which relied primarily on AA for protection were called Gun Defended Areas (GDA). Friendly aircraft were to avoid flying through a GDA, but when necessary, could do so after identifying themselves. Aircraft identified as hostile or committing hostile acts were to be engaged. If any vital point appeared vulnerable to a surprise attack thus making it unsafe to delay AA fire for recognition purposes, it was designated a Special Area which friendly aircraft entered at their own risk. Although the Sector Air Defense Commander was responsible for issuing alerts, the officer in charge of an AA gun in a restricted area had the final responsibility for the decision to engage any particular target. The final type of restricted area was the airfield which depended on fighter aircraft as well as AA for its defense. Initially, it was felt that, because airfields presented so many varied problems, no rules

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*According to one American AA officer, this was one of the finest documents ever written by a large headquarters and was considered the "Bible" by AA officers (Lt. Col. L. D. Deville, AA in Mediterranean Air Defense, in AAFMTO Special Intel. Rpt. 32, May 1944, in AFSHO 245.711-14).

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sectors would continue to be ruled by the sector air defense commander. The Mediterranean Antiaircraft Advisory Committee was established, as Slessor had recommended, to advise the Supreme Allied Commander and air commander in chief on policy and allocation of resources. General Eaker was to retain the area board, to maintain close contact with Allied Force Headquarters and Headquarters Coastal Air Force, and to assume responsibility for the operational efficiency, operational supervision, and technical training of all AA material and personnel under the control of Coastal Air Force. All American and British AA in the theater which was not operating with the armies or naval forces was assigned to Eaker for administration and to air officers commanding, Level for operational control.[21] According to General Eaker, this new arrangement would place under Marshal Lloyd approximately 50,000 AA personnel in the Mediterranean, or 59 per cent of the total AA strength. Although Eaker regarded this reorganization as far from ideal, he believed that it was a long step in the right direction.[22]

Controlling AA Fire

Regardless of its command structure, the actual success of AA depended upon its performance when in range of enemy aircraft. In order to establish uniform control of AA operations and provide AA with rules of engagement, an Allied Force Headquarters letter dated 1 May 1943 specified that four types of defended areas might be designated; in these areas operation of friendly aircraft would be restricted or prohibited so that AA might function freely.[23] The contents of this letter later became

that these rules were placed in effect, each airfield commander was in-
structed to submit a long-range plan for the defense of his airfield.*28

Such rules for AA engagement would have been useless unless AA personnel could identify their targets; therefore, in order to prevent friendly aircraft from being fired upon, rules were formulated to govern the recognition and identification of aircraft. Except when flying through an inner artillery zone, any aircraft was to be considered friendly until it committed a hostile act if the plane: was recognized as friendly by its appearance or by the route which it was following; displayed the correct recognition signals; approached with its landing gear down;/ or showed the proper IFF signal. On the other hand, despite recognition or identification of an aircraft as friendly, any plane was to be considered hostile if it: attacked ground targets, ships, or friendly aircraft; dropped flares at night; dived on troops, ships, or vulnerable points; or flew directly toward ships at sea without establishing identity.[29] Later, in early 1944, when the use of Window by the enemy became common, the appearance of Window was automatically considered a hostile act.[30]

Although these recognition and identification rules for AA were explicit, mistakes could occur; therefore, cooperation between air force and AA personnel was vitally necessary. Constant liaison was conducted between AA and air force units so that both were kept informed of all changes in policy and procedure. In most cases, mutual respect was gained and, in

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*For example of the plans submitted see: Defense Plan for Catania Airport, Headquarters 3__th Bombardment Group (M), Office of the Intelligence Officer, 5 September 1943, in USAF HD microfilm roll 125.

/Assuming that an approaching aircraft with its landing gear down was friendly could be dangerous. Several instances are on record of hostile planes using this maneuver to catch Allied defenses unawares. For example see: Air Force General Information Bulletin 21, March 1944, p. 25.

were feasible for the use of their AA. Classification and extent of all restricted areas were to be laid down by Mediterranean Air Command (later AAF), none was to be set up unless absolutely necessary and, so that the existence of a defended area would be known to all concerned, its boundaries were to be coordinated by the Sector Air Defense Commander with the necessary naval and AA authorities, subject to confirmation by General Eisenhower.[24]

Before Air Defense Instruction 1 went into effect on 2 July, the soundness of the proposed policy for airfields from the AA point of view was questioned. Without definite firing directives, AA defending airfields had often been in doubt concerning the wishes of the air forces and had been in a position which might have had serious consequences if enemy attacks had taken place before air force desires became known. To prevent such an occurrence, the 2026th GA Brigade (AA) proposed a series of firing orders for AA when defending airfields.[25] These orders, which were similar to the rules pertaining to AA in Gun Defended Areas, were published as an HAAF operational order 24 July 1943.[26] The AA defending airfields henceforth was to be governed by rules similar to those set forth in Air Defense Instruction 1 for GDA's; AA was to be fired at any aircraft which was identified as hostile or which committed a hostile act. Much of the responsibility for proper use of AA was given to the airfield commander; his was the responsibility to withhold fire or cease fire, to authorize the type of fire to be used, and to prescribe flight instructions for friendly aircraft.[27] By this operational order, explicit firing rules were laid down to cover AA in the defense of airfields; to make certain

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the American forces, and-an cooperation--aided by personal contact between pilots and AA officers--was excellent.[31]

Allocation and Other Studies

Once precise operational rules and firing procedures for an antiaircraft unit, the mission could not be fulfilled without an adequate, properly distributed, supply of weapons and personnel. An adequate AA defense consisted of enough weapons and personnel to keep men on a continuous watch basis. The kind of defense which would ensure adequate protection varied, however, with the installation to be defended and the type of attack to be expected. Port air defenses required weapons to check all forms of air attack, high level, low level, dive bombing, or strafing; thus, both heavy and light AA guns and searchlights, with centralized control, were required.* Although airfield defense also required weapons for repelling any type of attack, an assigned to an airfield normally consisted of only light AA, usually less concentrated than that protecting a port, and was more dependent on cooperation with the air forces. In defense of more forward areas, mobility was the primary consideration. Enemy attacks on forward bases were usually low level, dive bombing, or strafing; thus light AA and machine guns were the most effective weapons.[32] Performance of both heavy and light AA guns in all types of defense has increased considerably by the development of electrical and radar fire control (gun laying) and tracking equipment.†

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*Heavy AA consisted of the 90-mm. gun (British 3.7"), although some 120-mm. guns were used late in the campaign. Light AA guns were 37-mm. and 40-mm. (British 2-pdrs) and .30- and .50-cal. machine guns.

†For details on the development and operation of this equipment see AAF Study 26, pp. 163-79.

Proper allotment of these AA weapons was particularly important in the Mediterranean theater because, according to many observers, there was never enough Allied AA for defense of all vulnerable areas.[33] In fact, it was the opinion of General Pargiter that only the waning strength of the German Air Force saved AA-defended Allied installations from severe punishment.[34] This shortage of AA meant that allotments had to be made carefully in strict accordance with the need for protection.* Responsibility for the allotment of Allied AA rested with General Pargiter, acting upon recommendation of the AA&CD Committee, until the reorganization of 5 April 1944. After that date responsibility for bulk allotments was given to General Lloyd after recommendation by Mediterranean AA Advisory Committee. This allotment was in bulk to areas. It was then the responsibility of the AA Brigade Commander (after 17 January 1944 of the Sector Air Defense Commander) to dispose of the area resources to the best advantage.[35] Following the expulsion of the enemy from Africa, proper allotment of AA assumed greater importance when it was decided to send no more Allied AA to the Mediterranean area.[36] Thereafter, any additional guns for one point could be found only by releasing guns in another area.† Henceforth, available Allied AA units were constantly shuffled as AA&CD Section (later MAAF) attempted to use them to best advantage while making certain that maximum defense against any possible air attack was maintained.[37]

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*AA responsibility in North Africa was turned over to the French as soon as possible after the end of the Tunisian campaign. This relieved the manpower shortage somewhat but, as most of the AA weapons used by the French were American or British, it did not help the weapon shortage ([illegible] AA&CD to [illegible] G-3, sub.: AA Defense of North Africa, [illegible] 1943, AHS microfilm roll [illegible]).

†AA&CD Section proposed a [illegible] possible scale of AA defense for airfields that large valuable fields be assigned 8 heavy and 16 light AA guns, large well-dispersed fields 16 light guns, and well-dispersed fields in the rear, 8 light guns. In the main, this scale was followed in the disposition of AA resources (Ltr., AA&CD Section, sub.: AA Defense of Airfields, 4 Dec 1943, in [illegible] AHS microfilm roll [illegible]).

many other problems arose throughout these years of Allied air activity in the Mediterranean theater that may be touched on only briefly here. Use of night fighters in conjunction with restricted fire areas was a source of considerable controversy. Coastal Air Force proposed in May 1943 that a ceiling be placed on AA fire in an inner artillery zone or thin defended area to allow night fighters to operate over the area; General Eaker opposed the idea. According to Eaker limiting AA fire would not only waste resources but endanger the night fighters more than might be given into the fire if included in a change.[38] When a proposal was made to experiment with restricting AA fire at Bone, the local committee decided that the city was too important for experimentation.[39] Aircraft recognition of Allied AA personnel was a constant problem which was of official concern as late as October 1944. As General Eaker pointed out "ability to serve this weapon quickly and accurately is of little avail to the artillerymen if precious rounds are wasted in destroying friendly aircraft."[40] Reorganization of aircraft called for considerable training if AA personnel were to remain proficient. Another problem was presented by radar-controlled AA which, like other radar equipment was affected by window; after September 1943 many aircraft usually dropped window whenever AA opened fire. Early AA radar, therefore, was often rendered virtually useless by window but the later version, SCR-584, worked well through interference, particularly if personnel were properly trained and concentrated on the targets.[41] In order to keep AA personnel properly trained, practice in "tracking through" window was carried on by the various AA units in the Mediterranean theater.[42]

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As had happened [illegible] AA units encountered great difficulty in securing aircraft to use for towing targets for AA fire practice. Because of lack of practice facilities and the decrease in German Air Force strength, the AA gunners had few chances to fire; in December 1943, it was reported that some AA units in North Africa had not fired for six months. Under these circumstances, AA firing skill deteriorated rapidly. The problem had been recognized as early as January 1943 and a request had been made for tow target aircraft; however, it was September before Antiaircraft and Coastal Defense Section received five [illegible] aircraft for tow target purposes. Despite poor maintenance, scarcity of equipment, and lack of an administrative unit, all of which hindered operations, repeated requests from General Pargiter for better facilities were denied. Finally, Pargiter was promised nine American A-35's to be delivered in March 1944 for British use as tow target aircraft.[43] For operations with American AA, Headquarters AAF was requested to provide a tow target squadron of 15 aircraft which could be used throughout the theater.[44] The request was approved and the 1st (U.S.) Tow Target Squadron was assigned to Allied Force Headquarters on 26 March 1944.[45] Although the arrival of this squadron and its RAF counterpart, 25 AA Co-operation Unit,[46] alleviated the situation somewhat, low priority for tow target equipment handicapped operations throughout the Mediterranean campaign to the detriment of AA operational efficiency.

Late in the Mediterranean campaign, serious consideration was given by Allied AA personnel to a problem which has special significance today—how to combat enemy-directed pilotless missiles. Although the possibility was

not greet that the German air force would use V-1 and V-2 rockets in the Mediterranean, reports of enemy manufacturing sites in northern Italy kept Allied planners aware of the problem. According to antiaircraft and coastal defense section, a heavy concentration of both heavy and light AA guns would be required, as well as an adequate early warning system consisting of ground observers, airborne radar, and patrol boats to cover the sea approaches.[47] When Allied intelligence indicated that the appearance of German rockets in the Mediterranean was improbable, further AA requirements were issued; nevertheless, commanders were instructed to prepare provisional passive air defense plans to provide an adequate defense in case rockets were used.[48] By the time of his departure from the theater in December 1944, General Partridge feared that Allied AA defenses would be unable to combat enemy rockets as they were fired at any Italian targets.[49] Despite Allied apprehensions, no German rockets were fired on Mediterranean targets; in fact, postwar interrogation of German officers indicated that no plans existed for the use of rockets in the theater.[50] Nevertheless, an illustration of future concern can be found in the Allied correspondence pertaining to an air defense against guided missiles.

Other problems which were encountered were primarily a result of the inexperience of American AA personnel. According to a report made in June 1943, American AA doctrine had been proved sound in North Africa yet operations had indicated that U.S. training standards--especially recognition of aircraft--were too low. Passive defense measures had not been properly utilized and although much improvement had been shown, liaison between AA and other services was weak. Also, the report continued, the other services

were inclined to misunderstand the proper role of AA—they expected too much or too little from AA defenses. Finally, in order to derive the maximum benefit from AA, it was learned that it should be located where the enemy was most likely to strike; enemy intentions could be determined by a careful study of his methods of attack.[51] Other observers in North Africa and Italy reported that the American soldier was not prepared to withstand air attacks; therefore, he tended to expect too much from American air defense, particularly from AA.[52] American troops were also overly eager to fire any available weapon at any approaching aircraft. In an attempt to halt this practice, instructions were issued in September 1943 directing that only AA personnel were to fire on aircraft unless the aircraft were positively identified as hostile or were actually attacking friendly forces.[52] All of these weaknesses were primarily the result of a lack of combat experience among American personnel who, lacking the battle-testing of the British units, profited greatly from operational experience. Most of the deficiencies were remedied gradually as the campaign progressed.

AA Reductions in 1944

More important than these problems, perhaps, was a shortage of manpower in the Mediterranean and other theaters, particularly in the British forces, which forced Allied planners to call upon the less essential services for combat replacement personnel. In view of this manpower requirement and of the reduced German air force threat, the entire AA situation in the central and western Mediterranean areas was reviewed at the first meeting

of the Mediterranean AA Advisory Committee on 11 April 1944.* As a result, vast reductions in AA protection in North Africa and Italy, which would produce a saving of 3,820 American and 7,550 British personnel, were recommended.[54] Although this reduction was substantial, additional manpower savings were needed. In requesting that the committee consider further reductions, Chief of Staff, Allied Force Headquarters pointed out that it was impossible for AA to prevent an occasional sneak attack which was all that could be expected from the weakened enemy air force; also, AA efficiency could not be maintained at its peak when gunners went weeks without firing a shot. Therefore, it was felt that many AA defenses were serving no useful purpose and could be reduced or abolished. These factors, in addition to the need for infantry and field artillery replacements, were to be considered at the next meeting of the committee.[55]

The Mediterranean AA Advisory Committee held its second meeting in June and made recommendations for further reductions which would result in a saving of 2,500 American and 10,000 British AA personnel; this action was taken despite strong representations for a proportionate reduction according to American and British strength in the theater by Maj. Gen. Lowell W. Rooks, Deputy Chief of Staff to the Supreme Allied Commander. In order to accomplish these manpower savings, the committee recommended the removal of AA defenses, including searchlights, from southern Italian ports, the reduction of Mediterranean Allied Strategic Air Force heavy

*AA&CD committee was replaced about this time by the AFHQ MACAF Anti-aircraft Committee which had its initial meeting 15 April 1944 (USAF HD microfilm roll 10).

bomber base defenses to 12 light AA guns per field, and withdrawal of AA from its fighter airfields and all Coastal Air Force bases.[56] At a Supreme Allied Commander's conference a week later, the recommendations of the committee, except for the withdrawal of the searchlights, were approved.[57] By the time of the third committee meeting in September, these reductions had been made and southern France and the combat zones in Italy had become the primary consideration of the committee members.[58] By January 1945 the only American AA units remaining in the theater were two gun battalions and three automatic weapons battalions operating with the Fifth Army in Italy.[59]

Evaluation of AA

Aside from the experience gained in solving these problems, the value of AA during the Mediterranean campaign, like the value of fighters in an air defense role, is difficult to assess. In terms of enemy aircraft destroyed or probably destroyed, the statistics for American AA are impressive; 1,127 aircraft were claimed destroyed and more than 253 probably destroyed.[60] As each AA claim had to be sustantiated by independent witnesses,[61] these figures are undoubtedly minimum. In addition, it is impossible to determine how many enemy aircraft jettisoned their bombs or turned aside to bomb unimportant targets in the face of AA fire. At any event AA, whether or not under direct control of the air forces, was an essential element in the Allied air defense system and successfully filled its role in compiling the impressive record of Allied air defense in the Mediterranean.

In compiling this impressive record the Allied air forces obtained much valuable experience from AA operations in the Mediterranean campaign. As had been known previously, a high degree of cooperation between AA and the air forces was essential. However, actual combat was necessary to convince some AA and air force personnel of the extent to which cooperation was required; in fact, many AAF officers such as Generals Eaker and Saville believed that the assignment of AA to the air force was a necessity. To a great extent air force control was achieved in MTO when all AA behind the combat zones was placed under General Eaker who, in turn, assigned operational control to Marshal Lloyd. The Mediterranean campaign also illustrated the necessity for mobile AA; static AA defenses were of little value in a fluid situation in which the opposing air forces were rapidly losing their striking power. Furthermore, the absolute need for tow target squadrons was proved; AA efficiency deteriorated rapidly without combat firing or practice. Lastly, the importance of AA protection for forward airdromes, particularly during the initial stages of the build-up following a successful invasion, was brought home to Twelfth Air Force personnel.*

*Although outside the scope of this monograph, much improvement was made in the control of AA fire during amphibious operations (ltr., Hq. MAAF to CG AFHQ, sub.: Control of Antiaircraft Fire during Amphibious Operations, 10 Mar. 1944, in USAF HD microfilm roll 287).

Chapter V

BARRAGE BALLOONS, SMOKE, AND PASSIVE AIR DEFENSE

Although radar detection and identification devices, fighter aircraft, and AA constituted the principal weapons of Mediterranean air defense, several other means were available for deterring enemy raiders or minimizing the effect of enemy bombing. Among these, barrage balloons and smoke screens were considered active air defense measures even though they were passive in their static roles. Passive air defense (PAD), on the other hand, consisted of those measures "designed to counteract the effects of enemy action such as those caused by air attacks, bombardments, delayed action mines and booby traps."[1] Like AA in the American forces, balloons, smoke and PAD units were not part of the AAF yet their proper use was of vital importance to a successful air defense system.

Barrage Balloons

Although the Allies recognized the value of barrage balloons under certain conditions,* because of limitations on shipping space, TORCH planners decided to place balloons very low on the priority list for the invasion forces. It was felt that the available personnel and shipping would be used more advantageously if devoted to AA and automatic weapons units.

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*According to the AAF, the purpose of barrage balloons was the denial of air space, to the operating height of the balloons, to enemy aircraft through physical obstruction and psychological effect. The advantage of the balloons over other types of air defense weapons was primarily that they could not be surprised by low-flying, undetected raids. Their disadvantages, however, tend to offset their usefulness in most situations; they are vulnerable to hostile fire and electrical storms, they cannot be flown in high winds, they need a great deal of shipping space and equipment, and they may be used only in areas where they will not interfere with the operations of friendly aircraft. (AAF FM 1-25, 15 June 1943.)

As a result of this decision, balloons played a relatively small part in TORCH air defense.[2] Later, as ports were captured and opened for Allied use, balloons were used extensively as part of the air defense system, particularly in areas lacking adequate AA or fighter defenses. In August, for example, 2689th Air Defense Region, which was responsible for air defense in the Oran sector, reported that fighter and AA defenses were inadequate in its area. It requested 60 balloons for its sector in order to discourage torpedo, dive bombing, and low level bombing attacks.[3] Scarcity of personnel and equipment, however, made the filling of such requests difficult.

By October 1943 the situation had improved and three American Barrage Balloon Batteries (102d, 103d, and 104th batteries), each consisting of 45 balloons, were operational in the Mediterranean under Allied Force Headquarters control. These balloons were assigned wherever required with 102d Battery assigned to Fifth Army for a time.[4] British barrage balloon units, although nominally controlled by RAF, were also dispersed, with some units assigned to Desert Air Force. Because of this divided control of both British and American units,* several recommendations that all barrage balloons be placed under the control of Coastal Air Force were made.[5] Despite these recommendations only part of the Allied balloon units were assigned to Coastal Air Force during 1943 with the remainder continuing on assignment to the Allied armies;[6] however, during 1944, Marshal Lloyd

*WD FM 100-20, 21 July 1943 stated that all barrage balloons operating in air defense of an area with aviation should be controlled by the air commander responsible for the area. Until April 1944 this directive was not closely followed in the Mediterranean theater.

obtained control except in certain cases when control was retained by armies, over most balloon units.[7] At all times, direct operational control of the balloons was vested in the sector air defense commanders and the balloons were normally flown permanently in an Inner Artillery Zone or a Gun Defended Area. In other types of air defense areas, they were flown when needed as long as their presence did not endanger friendly aircraft.[8] As had been true with regard to AA, operations in the Mediterranean indicated that American balloon units could function most efficiently under air force control. Also, as was true of several other air defense weapons, American balloons played a secondary role to those of the British in the Mediterranean area. Nevertheless, although American barrage balloons were not of primary importance in the Allied air defense system, they were undoubtedly valuable as a supplementary device to fighter aircraft and AA.

Smoke Screens

A second air defense measure which is considered active despite its passive nature is the smoke screen. Two types of smoke screens may be used: the area smoke screen which is designed to conceal combat areas from ground observation, and the AA smoke screen designed to conceal ground targets from air observation. The latter type of screen is the concern of an air defense. Like AA and barrage balloons, American smoke generating units, although essential to air defense, were not components of the AAF; instead, they were part of the Chemical Warfare Service. Also similar to other American air defense weapons, American smoke units

lacked experience and were few in numbers and therefore assumed a secondary role to the British throughout the campaign in the Mediterranean.

According to TORCHplans, captured ports in North Africa were to be equipped for AA smoke screening at night while daytime defense would be entrusted to fighter aircraft. Because of a shortage of smoke units, no attempt was to be made to cover entire port cities; only ships and special targets were to be concealed. As soon as the landings were secured, 78th Smoke Generator Company--the only American smoke unit available to the invasion forces--and various experienced British units were to begin screening the major ports. British units began operations immediately but, although the American company arrived at Casablanca on 13 November, four of its five generators were washed off the unloading pier during a severe storm and it was not prepared to make smoke until 20 November. The full company was not operational until 1 December. From this meager beginning, by September 1943, 14 major and 5 minor ports in North Africa and Sicily nad been screened by smoke.[9]

Initially the Navy was given the responsibility for planning and making smoke at the captured ports. When this arrangement proved unsatisfactory, the responsibility was given to the port defense commander regardless of his branch of service.[10] Later, in March 1943, an Allied Force Headquarters operation memo set up rules for smoke protection of ports; these rules prevailed throughout most of the Mediterranean campaign. Operational control of smoke units was given to the Antiaircraft Defense Commander who was to make his decisions on the use of smoke in consultation with the naval commander of the port. He was made responsible

for planning the smoke defenses, issuing the executive order to make smoke, coordinating smoke with other defensive agencies, and deciding the duration of the smoke screen. He was to report on the use of smoke to the Antiaircraft and Coastal Defense Committee, which included a representative of the Chemical Warfare Service; the committee then advised G-3 Allied Force Headquarters, who had the responsibility for the distribution of smoke resources. Air force commanders were responsible for informing AA Defense Commanders when they did not desire smoke to be made.[11]

By the terms of Allied Force Headquarters Operation Memo 49, 5 April 1944, AA smoke screening, as an active air defense function, came under the control of the theater air commander (AOC, MAAF) who delegated this control to the commanding officer of Coastal Air Force. All smoke units not assigned to armies were included under this directive. Local operational control was henceforth to be exercised by the Sector Air Defense Commander with the AA Defense Commander retaining the other responsibilities enumerated above.[12] Close cooperation was necessary between the sector and AA defense commanders for the former was responsible for issuing air raid alerts (including blackouts) and the latter for making smoke; the effect of one would be lost without the other.[13] Thus, after April 1944 an air force officer, Marshal Lloyd, controlled all smoke units outside of the combat zones.

The use of smoke screens in airfield defense was not as satisfactory as in port or other fixed installation defense. According to one air force officer, smoke in airfield defense was a "two edged sword." It

could not be used at an airfield which was occupied by operational aircraft for smoke would blind friendly pilots as much as enemy pilots. More smoke equipment was necessary in airfield defense than in port defense, winds were usually more variable, and the smoke might drift over nearby fields.[14] Therefore, in airfield defense smoke was best employed on fields which were used for dispersal of aircraft or fields not carrying on night operations. As these conditions existed on few fields, AA smoke screens were employed for the most part in port defenses. Like barrage balloon units, American smoke units received valuable training and experience in the Mediterranean theater and made a significant, although small, contribution to the success of Allied air defense.*[15]

Passive Air Defense

According to AAF air defense doctrine, "passive air defense includes all measures taken to minimize the effects of hostile air action."[16] For the fulfillment of this function PAD utilizes such measures as dispersal and camouflage of materiel and personnel (including civilian), blackouts, air raid warnings, fire and damage control, and first aid. Because of the nature of these measures, it is virtually impossible for one central military agency to control both military and civilian personnel; however, in the Mediterranean area, regulations and suggestions were made by military agencies to enable PAD to function at peak efficiency.

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*In addition to being employed with fighters, searchlights could also be used as part of an active air defense. A searchlight layout might illuminate targets for AA, deter low flying raids, and, by glare, hinder enemy aircrews in their attempts to bomb accurately. (AA&CD, North African Theater Liaison Letter 7, 16 Mar.-15 June 1944, App. D, Searchlights in GDA's, 5 July 1944, in DRB microfilm roll 118-C.)

The need for control and coordination of PAD and its adjunct, Civil Defense (CD), in North Africa was recognized at the time of the invasion and in November 1942 General Eisenhower requested the services of a British expert for the theater. Two experienced men, W/C E. J. Hodsoll and Capt. L. B. Franks RN (Ret.), were sent from England early in December to survey the situation and to recommend an organization which would reduce the effect of air action so that military operations would be hindered as little as possible. Hodsoll's report of their survey included recommendations for the reorganization of the existing civil defense agencies, the expansion of PAD to include all areas of importance to the military, and the appointment of a PAD&CD adviser to the commander in chief, to operate under AC/S, G-3. All of Hodsoll's recommendations were adopted and Captain Franks was appointed Passive Air Defense and Civil Defense adviser on 13 December 1942.[17] Franks and a small staff of experts--known as PAD&CD Section after 21 September 1943--were given a variety of responsibilities in addition to Franks' primary functions as coordinator of all Allied PAD&CD activities and adviser to the commander in chief. The staff was to reorganize civil defense of North Africa, to develop PAD&CD plans and policies, to supervise training, and to advise on the procurement of equipment. Lastly, it was to introduce passive air defense into the American Air Forces in the theater.[18]

Because of American inexperience and because no War Department directive covered passive air defense matters in the American forces, British personnel initially were assigned the major share of the PAD&CD

burden. However, on 25 January 1943, Franks suggested the appointment of an American as Assistant Civil Defense Adviser and the assignment of other American officers to passive air defense and civil defense work. This suggestion was followed--although as late as August 1944 no War Department directive had appeared[19]--and thereafter American personnel assumed many PAD&CD responsibilities.[20] Col. Harry Lee White (CE), who was appointed as assistant to Captain Franks, 6 May 1943,* was to form a PAD&CD staff for the American forces and was given the task of coordinating passive air defense and civil defense west of Algiers;[21] by June 1943 a total of seven American officers had been assigned to PAD&CD Section.[22]

During the North African phase of the Mediterranean campaign the Allies made much progress in the provision of passive air defense and civil defense measures. Those cities which were essential to military operations were furnished PAD&CD schemes which were to be implemented by the military in cooperation with civilian committees.† Air raid wardens, fire fighters, and casualty and rescue services were organized among civilian and military personnel on the theory that any disruption of civilian life would hinder Allied military activities.[23] Blackout regulations, designed to cause a minimum of interference with the activities of military and civilian workers, were promulgated;[24] nevertheless, considerable friction developed between the Allied armies and the

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*Colonel White also served as Civil Defense Adviser NATOUSA from 20 June to 19 November 1943.

†For a PAD&CD plan drawn up for the Tunisian ports see: ltr., AFHQ CDA's Section to Civil Affairs Section, sub.: Outline of PAD and Civil Defense Plan for Occupation of Tunisian Ports, 6 Apr. 1943, in DRB microfilm roll 61-G.

French who believed that the troops were violating the regulations.[25] Although British or American personnel contributed greatly, the major share of the Civil Defense burden in each city was assumed by a British-trained French officer.[26]

As far as the Allied armies in the combat zones were concerned, normal security measures were sufficient.* In rear areas, however, each large headquarters employed a full-time PAD staff while smaller units had part-time PAD personnel. Despite the lack of a provision for such personnel in American manning tables, Allied Force Headquarters directed that they could be appointed at the discretion of American commanders.[27] In the air forces, as most air bases were located near base areas or other large headquarters which could aid them in emergencies, no special passive air defense measures were considered necessary during the North African operations; normal security measures at the bases were deemed sufficient.[28]

Despite improvements in Allied passive air defense activities, Headquarters Coastal Air Force reported in May 1943 that AAF units were lax in one of the normal security measures--camouflage. According to Coastal Air Force, in the preceding months the operations of the AAF had been such "an open book to the enemy" that the Axis had complete information about AAF activities. In an attempt to remedy this weakness, Coastal Air Force pointed out two advantages which were gained by the use of camouflage: deception, and practice in the use of camouflage.[29]

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*Normal security measures consisted of blackouts, camouflage, air raid warnings, first aid, fire prevention, and personnel protection. It was expected that units would carry out these measures without special supervision. (AFHQ PAD Manual, 1 Feb. 1944, in LRB microfilm roll 63-G.)

To make full use of camouflage, which was a responsibility of the sector air defense commanders,[30] plans were necessary so that personnel concerned knew what was to be camouflaged and what type of attack they were to camouflage against.* Coastal Air Force believed that a camouflage officer was required at each airfield to assist in drawing up these plans and fullest cooperation was needed on the part of all personnel to insure that camouflage plans were carried out properly.[31] Despite this admonition, improvement in passive air defense matters in the American Air Forces was slow./

Their North African experiences notwithstanding, the Allies did little passive air defense planning for the Sicilian campaign. In general, Allied commanders appeared not to appreciate the need for coordinating passive air defense measures. As a result, when Colonel White and Franks' deputy surveyed the Sicilian situation in August 1943, they found that the lack of PAD planning was having an adverse effect on military operations. They reported that only two ports had PAD officers and PAD plans in operation and those plans were below the North African standards. Because of this failure to profit by past experience, both American and British forces were experiencing difficulties in moving troops and supplies which might have been avoided.[32]

Somewhat more attention was given to passive air defense by the Allied prior to the invasion of southern Italy. American Fifth Army

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*For details on camouflage see: AFCW Camouflage Pamphlet 1, Concealment from the Air View, Mar. 1943.

/In addition to camouflage of airfields, the Allies attempted to deceive the enemy by the use of dummy aircraft. (Ltr. MACAF to 63d FW, sub.: Employment of Dummy Fighters in Corsica as diversionary targets, 18 Oct. 1943, in USAF HD microfilm roll 283.)

requested and received several PAD officers while, just before embarkation, other officers were appointed to institute PAD measures in Naples. However, no time remained for actual planning or coordination before the invasion.[33]

With the Allies established on the mainland, the passive air defense lessons learned in North Africa and Sicily were finally put to use. According to an Allied Force Headquarters training memo published in November 1943:[34]

> Military operations which involve the occupation of areas including cities or ports are affected by the extent and efficiency of Passive Air Defense and Civil Defense measures. Proper and effective measures will facilitate military operations in occupied territory. Inadequate measures can seriously impede them.

With this in mind, a passive air defense controller* was to be appointed to the staff of each Base commander for all future operations. This officer, and a small staff, was to formulate plans, set up a PAD Report Center within an hour of the arrival of the Base headquarters staff in a newly occupied location, and coordinate his plans with such Civil Defense organizations as were available. Each PAD officer was also to issue interim orders so that all military personnel would understand the essential passive air defense measures as soon as they arrived in his area.[35]

In addition to the need for such PAD officers, several other lessons were learned from the North African and Sicilian operations and applied after the invasion of Italy. For PAD to be most effective the assignment of officers to passive air defense work should be made at the beginning

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*It was the responsibility of the PAD Controller to get his control center connected to the nearest Ground Operations Room in order to obtain warnings and raid information. (Ltr. AA&CD Section to all concerned, 17 Dec. 1943, in DRB microfilm roll 60-G.)

of the planning phase of any operation to allow sufficient time for proper preparation; also, it was realized that coordination was essential among all passive air defense and civil defense personnel. Furthermore, it was learned that an appreciation of the worth of PAD measures had to be instilled in all personnel and that proper training of unit and part-time PAD officers was necessary.[36] According to Allied Force Headquarters, proper passive air defense and civil defense could be obtained only if all of these precautions were taken. By the middle of December 1943 these precautions had been heeded and it was reported that the PAD situation in Naples was much improved. British and American cooperation was satisfactory and coordination between American PAD officers and local Civil Defense personnel was excellent.* The supply of PAD officers also had increased; a school for passive air defense training was being conducted by Fifth Army and at least 24 officers who had been trained in the United States had arrived in the theater.[37]

In addition to the need for these improvements in passive air defense among the Allied forces, the movement of large air force formations to Italy necessitated the adoption of passive air defense measures at air bases. Following a Mediterranean Allied Air Forces survey of American air bases in Italy in January 1944, recommendations for the assignment of PAD officers to various air force headquarters were made.[38] None was assigned immediately for it was felt that, because of the reduced

*By the end of January 1944, PAD schemes were in operation in 17 areas, largely in Italy, Sardinia, and Corsica. (Ltr. Franks to General Rooks, DC/S, 29 January 1944, in DRB microfilm roll 64-G.)

enemy air threat, full-time PAD officers were not required; instead the practice of attaching PAD officers to air force headquarters was continued.[39] Later Capt. G. S. Lang, formerly of PAD&CD Section, was assigned to assist both Twelfth and Fifteenth Air Forces* in passive air defense matters.[40]

Despite the development of passive air defense planning and control, military personnel were inclined to become lax in the absence of enemy air activity. As Headquarters Coastal Air Force believed in May 1944 that the enemy was still able to mount skillful and determined air strikes, commanders were directed to review immediately the passive air defense situation to make certain that the proper measures were available for use in case of an attack.[41] Moreover, in order to impress the need for passive air defense more strongly on all personnel, a new Allied Force Headquarters memorandum was issued in June which reviewed the responsibilities of commanders for the control of passive air defense and civil defense measures.[42] Consequently, despite the greatly diminished German air threat, from this time until the close of the Mediterranean campaign--PAD&CD Section continued to function until 31 May 1945[43]--passive air defense and coastal defense operations were gradually improved among the Allied forces.

In the American forces in the Mediterranean theater passive air defense was a "new Army requirement"; no War Department directive on the subject existed and no provision for PAD personnel was included in the

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*For blackout regulations at Fifteenth Air Force bases see: Hq. 15th AF Operations Memo 15-2, 17 Jan. 1944, in XV Air Force Operations Memos, USAF HD 670.663.

manning tables. As a result, the entire PAD organization in the American forces had to be devised from cooperation with the British or from bitter experience. Some success was attained in North Africa yet the lessons learned were not applied to Sicily; however, the Italian invasion produced the beginning of an efficient passive air defense system for all ports and installations which were needed by the Allied military establishment. By the middle of 1944 passive air defense had become an integral part of Allied defensive warfare, American personnel had become cognizant of the need for passive air defense, and successful efforts had been made to introduce passive air defense into the American Air Force.

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Chapter VI

ALLIED AIR DEFENSE IN ACTION

As previous chapters have been concerned with the organization and effectiveness of Allied air defense, accounts of actual operations have been largely ignored. In order to complete the story of Mediterranean air defense, some illustrations of the air defense in action should be presented. For the most part this is an Allied account because operations, particularly within the Coastal Air Force, are difficult to break down into those conducted by either AAF or RAF personnel. For the sake of clarity, air defense operations will be discussed in four sections: defense of ports, airfield defense, defense of convoys, and defense against enemy reconnaissance aircraft.

Air Defense of Ports

One of the first lessons learned by the Allies in North African operations was that heavy enemy air attacks would be launched immediately on any port or vital area which was captured by Allied forces.[1] Since the maintenance of Allied land forces would be largely dependent upon sea transportation, unhampered operation of the major North African ports would be essential to the success of the invasion; therefore protection of those ports from air attack had been considered by Allied planners, and a policy for port defense--both from air and ground attacks--had been announced 10 days before TORCH D-day. This policy stated that it would be necessary for port personnel to be prepared to defend against all forms of air attack, including parachute operations, and attack from land or

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sea. Initial plans and arrangements for port defense were to be made by Task Force commanders who, in regard to air defense, were to set up immediately AA defenses and air raid warning organizations, using French defenses and instituting PAD measures. Later, as the invasion progressed, it was planned that these functions would be taken over by Allied Force Headquarters.[2]

These plans were seriously handicapped during the early weeks of the invasion when, as pointed out above,* Allied air defenses left much to be desired. Algiers, a major port and the site of Allied Force Headquarters, was particularly vulnerable to night attack and it was feared at AFHQ that a successful enemy raid would have "serious consequences." For example, on 26 November 1942, over 50 Allied ships were in the harbor and essential docks and railroads were unprotected at night except for AA.[3] This vulnerability to a possible air attack existed despite the fact that the air defenses for the city had been organized ahead of schedule; the principal cause for apprehension was the absence of night fighters.[4] As a result of this defensive weakness, Algiers was raided successfully, but with slight damage, several times before adequate night fighters arrived.

As the Allied invasion progressed and Algiers became a major port in the rear area, defenses were taken over by Allied Force Headquarters and a more permanent air defense system was organized; this system may serve as an example of an Allied air defense of a major port. The operational control of the air defense of the city was in the hands of

* See p. 47 ff.

the Sector Air Defense Commander at Maison Blanche, the city's airfield. This field possessed both day and night fighters and a filter room to handle raid information and issue raid warnings. AA, smoke units, and an RAF barrage balloon squadron were arranged at strategic points around the port. Ships in the harbor were instructed to cooperate with shore defenses in AA fire and making smoke and were authorized to fire in self defense. Such an elaborate air defense system required a high degree of cooperation and to promote cooperation, Algiers was designated an Inner Artillery Zone.[5] The effectiveness of the Algiers air defense system was indicated by the fact that, although subjected to many enemy raids--the last raid on the city occurred the night of 27 August 1943--damage, particularly to military targets, was small.

Despite the rapid build-up of Allied air defenses--all major North African ports organized systems similar to that of Algiers--enemy air raids were heavy during the first six months of 1943. In April, for example, 14 raids involving 146 aircraft were flown against Allied ports. Initially the enemy had used simple tactics such as straight, high altitude approaches but as Allied defensive effectiveness increased, his tactics changed; soon he discovered that his most effective tactic was a low approach with fast aircraft. Regardless of the use of this method of attack, 24 of the 146 aircraft attacking in April were claimed as destroyed or probably destroyed by Allied defenses. The damage to Allied installations was not severe enough to compensate the enemy for this high loss ratio.[6] Except for a renewed effort during August, by which the Germans attempted to saturate Allied defenses with mass air attacks,[7] the enemy air effort against North African ports diminished during the

defender[illegible] By [illegible]

of reconnaissance missions.

to reduce the air defenses of North African ports considerably

over [illegible] of the air defense responsibility to the French.

Following the Allied occupation of Sardinia, Corsica, Sicily, and southern Italy, the ports became vital to Allied success and the Germans turned their attention to them. Among these ports, Naples was the most important in the Allied line of communications; during January 1944 the port handled more tonnage than any other port in the world with the exception of New York. In setting up the air defenses for Naples--it was captured in October 1943--the experiences gained in North African port defenses were utilized. The 62d Fighter Wing was assigned to the air defense of the city and the port area. It established an Inner Artillery Zone by night and a Gun Defended Area during daylight. The fighter control center was established at Capodichino airfield, six miles from the city, and the Gun Operations Room was located in the city; early warning was provided by 502d AW Battalion. Among the guns available to the defenders were over 50 x 90-mm. AA guns, about 200 x 40-mm. and .50-caliber automatic weapons, a battery of American barrage balloons (104th) and a squadron of AF balloons, all the latter companies. For fighter aircraft, the Wing was assigned 81st Fighter Group (P-39's), 2 Spitfire squadrons (one American), and 255 (later 2 February 1944, 4146th) Night Fighter Squadron.[9] Passive air defense and civil defense measures had been preplanned and functioned efficiently with cooperation between the air forces and AA was excellent. According to an officer on 62d Wing, the Naples air defense

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r mainder of 1943. In October no attacks were reported by North African defenders and subsequent German Air Force activity in this area consisted of reconnaissance missions.[8] By the end of 1943, the Allies were able to reduce the air defenses of North African ports considerably and turn over much of the air defense responsibility to the French.

Following the Allied occupation of Sardinia, Corsica, Sicily, and southern Italy, the ports became vital to Allied success and the Germans turned their attention to them. Among these ports, Naples was the most important in the Allied line of communications; during January 1944 the port handled more tonnage than any other port in the world with the exception of New York. In setting up the air defenses for Naples--it was captured in October 1943--the experiences gained in North African port defenses were utilized. The 62d Fighter Wing was assigned to the air defense of the city and the port area was declared an Inner Artillery Zone by night and a Gun Defended Area during daylight. The fighter control center was established at Pomigliano airfield, six miles from the city, and the Gun Operations Room was located in the city; early warning was provided by 502d AAW Battalion. Among the weapons available to the defenders were over 90 x 90-mm. AA guns, about 200 x 40-mm. and .50-caliber automatic weapons, a battery of American barrage balloons (104th) and a squadron of AF balloons, in two whole companies. For fighter aircraft, the wing was assigned 81st Fighter Group (P-39's), 2 Spitfire squadrons (one American), and 255 (after 2 February 1944, 416th) Night Fighter Squadron.[9] Passive air defense and civil defense measures had been preplanned and functioned efficiently while cooperation between the air forces and AA was excellent. According to an officer of 62d Wing, the Naples air defense

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organization was one of which AAF could be proud.[10] Operations bore out this contention for, despite the proximity of Naples to the combat zone and despite many German Air Force raids, damage from enemy raids was slight and the port continued operating at capacity.[11] Besides providing an effective deterrent to enemy bombing, the Naples air defense illustrated the types of weapons which were required for an efficient port defense. According to the Fifth Army AA officer, there were seven requirements for a good port defense: a dependable early warning system, sufficient smoke, barrage balloons in depth, strong gun defenses, strong automatic weapons defenses, searchlights, and a plan of deception, e.g., a varied firing plan to confuse the enemy.[12] And, he should have added, strong fighter defenses, both day and night, an adequate communications network, and an efficient PAD organization were essential. The success of the Naples air defense system indicated that all of these elements were necessary for a dependable port air defense.

On the other hand, failure of any of these elements could reduce the effectiveness of an air defense system as was well illustrated in the Bari raid, the most destructive raid made by the Luftwaffe on an Allied Mediterranean port. Although the severe damage to the port was largely the result of Allied misfortune and the raid was usually referred to as a "freak," the subsequent investigations served to indicate that air defenses could always be improved and to increase Allied comprehension of the problems involved in air defense development. For this reason, a detailed account of the raid and its aftermath is of interest.

On 2 December 1943 at about 1900 hours early warning of approaching unidentified aircraft was picked up about 30 miles north of Bari, a major port on the east coast of Italy. Approximately 30 aircraft appeared over

the port, preceded by window-dropping planes, and bombed at about 1930. Because of the window, positive identification of the raiders as hostile was delayed. As a result, port lights continued to burn after AA began to fire, smoke ordered only a few minutes before the raid was not effective until bombs had been dropped, and the air raid sirens remained silent. Four Beaufighters that scrambled to intercept the raiders were ineffective although two of the attackers were accounted for by AA. According to the RAF, it was "the clev rest and best executed raid yet experienced."[13]

Damage inflicted by the raiders was greatly out of proportion to the number of aircraft taking part in the raid. Bombs dropped on the badly overcrowded harbor hit 2 ammunition ships; these ships exploded and the resulting fires destroyed 17 ships totalling 62,000 tons loaded with 36,000 tons of cargo. Heavy damage was caused to port facilities and casualties amounted to about 1,000.*[14]

Because of the severity of the damage inflicted by the supposedly weakened German Air Force, an immediate investigation was ordered and an investigating committee headed by General Partridge and including representatives of Coastal Air Force, the Navy, and PAI&CD Section was designated. The committee discovered many weaknesses which contributed to the vulnerability of the port; the greatest weakness, of course, was the overcrowded condition of the harbor. As the decision to work Bari at capacity had been a calculated risk authorized by the supreme Allied

* For a graphic description of the raid see: Hist., Headquarters and Headquarters Squadron, Fifteenth Air Force, War Diary, 3, 5, 7-14 December 1943, in USAF HD 670.071; For pictures of the damage see: Impact, II, No. 3 (March 1944), pp. 10-11.

command, the committee stated that the port congestion was not the responsibility of air defense personnel. Chief among the weaknesses which were the responsibility of air defense was a general feeling of complacency among Allied personnel throughout southern Italy; this feeling lowered the efficiency of the air defense system. Several changes in command had caused confusion and operational control of air defense had not been adequately supervised and coordinated; in fact no Sector Air Defense Commander had been specifically appointed for the area. Although window was the primary reason for the failure of adequate early warning, the radar set which should have detected this particular raid was out of action because of technical difficulties. Furthermore, the committee found that communications between the Sector Operations Room and Bari were faulty and that the entire system for passing air raid warnings was not based on sound principles; the information had to pass through too many hands. Fighter defense and AA operated satisfactorily when not blanketed by window, operation of balloons and smoke was adequate but PAD&CD was not properly supervised and planned. The committee recommended that all of these weaknesses be remedied immediately.[15]

The committee's report was not accepted without protest; both Air Marshal Tedder and Mediterranean Allied Tactical Air Force believed that the air defense organization at Bari was better than indicated by the report.[16] According to Tedder, the principal defect had been the crowded condition of the harbor. He believed that the committee should have investigated that aspect of the raid for he was not certain that the air defense personnel could be held responsible unless they had been informed of the risks involved. Tedder indicated that the report was valuable in

that it brought out certain weaknesses in the air defense system yet it had not stressed "the fact that even had the defences not had the defects noted, the effect of the raid would in all probability have been probably the same in the circumstances existing /the overcrowded harbor/." He desired to emphasize that the extent of damage done in Bari harbor should not be used as a measure of the effectiveness of the air defense of the port for, he pointed out, "even when the defences are 100% efficient risks such as were accepted in the port of Bari on this occasion must result in damage proportionate to the risk taken."[17] In any event the Bari disaster benefited the Allies for several months; the Luftwaffe could not be dismissed as long as the memory of the damage to the crowded port remained. Of more immediate concern was the effect on the military situation at Bari. Air defenses were strengthened at once by the addition of AA batteries and a more efficient communications network within the sector. As a result, a second attack by 12 to 20 enemy aircraft on 13 December was given a different reception--2 raiders were destroyed by AA and only slight damage was caused.[18] Later, perhaps as a result of the Bari disaster, two further changes were made by Headquarters Coastal Air Force. The investigating committee had recommended that the duties of the Sector Air Defense Commander be more specifically set forth so that each commander would fully understand his responsibilities. Also, the committee believed that air defense personnel should be allowed to consider the appearance of window as evidence of a hostile attack and to alert the defenses at once. Some of the confusion at Bari had been caused by a delay in recognition because the raiders had dropped window. Both of these needed changes were included in a MACAF directive which

appeared on 22 May 1944.[19]

The Bari raid proved to be the last major enemy success in port bombing and, despite the overcrowded condition of most ports used by the Allies, during 1944 German attacks on ports decreased in number and intensity. By June 1944 Coast l Air Force was able to report that no attacks had been made during the month on any port defended by its forces.[20] Thereafter, most GAF effort was directed at airfields and convoys. During the period from 11 January 1943 to 1 September 1944 the enemy made 84 bombing raids in the Mediterranean (exclusive of convoy attacks), on targets, primarily ports, defended by Coastal Air Force. Of the 1,309 aircraft taking part in these raids, 158 were claimed destroyed by AA and night fighters, 8 probably destroyed, and 13 damaged. With the exception of the Bari raid of 2 December 1943 and attacks on 2 Corsican airfields on 12 May 1944 (in which 23 Allied aircraft were destroyed, 82 damaged, and 156 casualties inflicted[21]) damage to Allied military installations was slight; only 7 ships were sunk in ports in addition to the 17 sunk at Bari. Although some of this successful air defense could be attributed to the weakness of the opposition,* most credit must be accorded to the Allied air defenses. Coastal Air Force reported that[22]

> In spite of the extent of the area to be defended, and the consequent wide dispersal of scattered defence forces, the Luftwaffe, in its attacks on ports and airfields in the Mediterranean, suffered heavier losses proportionately than those inflicted on Allied bomber formations in their attacks on heavily defended Axis targets in Europe.

* German bombing attacks on Algiers and Bone in 1943 were so poorly carried out that it was often difficult to discern the targets. Bombs were so widely scattered at times that, according to one historian, it "must have made the rustic population of North Africa feel that it had somehow incurred the wrath of Kesselring and his air staff." (Asher Lee, The German Air Force (New York and London, 1946), p. 136.)

Airfield Defense

Among the potential targets available to the Luftwaffe, Allied airfields ordinarily were accorded a low priority because convoys and ports filled with ships were more accessible and more vulnerable than inland targets.[23] As a result except during the initial stages of amphibious landings, Allied airfields were seldom subjected to more than nuisance raids. Nevertheless, as airfields had to be prepared for any eventuality, airfield air defense was an important phase of the Allied air defense system.

According to an Allied Force Headquarters operational memorandum published before the TORCH landings, the same factors were to be considered in airfield defense as in defense of ports.* Task force commanders were to make the initial plans and set up AA and other air defense weapons as soon as possible after taking over an airfield.[24] Despite such directives, as seen above, Allied air defense suffered during the early weeks of the invasion because of confusion and lack of night fighter aircraft.† The inevitable result was that the enemy scored heavily on Allied airfields until Allied night fighter defenses became strong enough to ward off the raiders. Before this build-up could be accomplished, Twelfth Air Force forward bases had been subjected to severe night attacks while a number of Allied aircraft were destroyed at other bases;†† for example, a raid on Maison Blanche 20 November 1942 cost the Allies 14 aircraft.[25] Arrival of radar-equipped Beaufighters soon reversed this trend and, when raids

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* See pp. 47-49.

† See chap. III.

†† For a description of an attack on an RAF airfield which had no early warning and insufficient AA, see: David Hame, Road to Tunis (New York, 1944), p. 108.

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on airfields proved too costly to the enemy, he altered his tactics to attacks on ports and convoys.

Airfield defense was primarily the responsibility of each airfield commander;[26] however, airfields were included in sector and area defense systems. Rules for AA fire at airfields were the same as for other defended areas[27] and defense plans were prepared by airfield commanders.[28] AA guns, which in many cases were the principal weapons at airfields, were allotted in bulk to areas and assigned to airfields according to such factors as size of the base and the number of aircraft operating from it.[29] Light AA guns were assigned to all airfields but heavy guns were provided only for the most important and most vulnerable bases. Other means of airfield air defense were smoke, fighters, and fighter-searchlight belts, all of which contributed to the protection of Allied aircraft.* Passive air defense, also a concern of airfield commanders, consisted primarily of dispersal and blackouts; absolute concealment of an airfield was impossible.[30]

As German air strength waned, airfield defenses were gradually diminished. By 31 December 1943, AA was withdrawn from North African fields and AA in Sicily was reduced to a minimum. On the mainland, each Italian airfield was to have a minimum of 12 Light AA guns with 8 Heavy guns to be provided for each field from area defense allotments.[31] Regarding fighter aircraft for defensive purposes, the 63d Fighter Wing requirement was typical; each airfield was to maintain four of its operational aircraft for defense.[32] Thereafter, these AA and fighter

* See pp. 56-57.

scales remained approximately the standard for airfields in Italy.[33]

In spite of the numerous Allied airfields and their occasional vulnerability, the Luftwaffe--after the early weeks of the North African invasion--was seldom able to inflict serious damage in airfield attacks. Perhaps the most successful enemy attack occurred 12 May 1944 when Poretta and Alesan airfields in Corsica were bombed. Twenty to thirty raiders attacked Poretta inflicting 50 casualties, destroying 15 and damaging 70 aircraft, and destroying many military vehicles. Window was used extensively and only one raider was claimed as destroyed, one probable, and one damaged. Several hours later 15 enemy planes hit Alesan with similar results; 107 casualties, 8 B-25's destroyed and 12 damaged, and a fuel dump destroyed. Air defense claims were three destroyed, one probable, and two damaged.[34] Despite the comparative success of these raids, they were the final major efforts for the Luftwaffe against Mediterranean area airfields. Thereafter, the German Air Force declined rapidly in strength and used its slim resources against targets other than airfields. Nevertheless, it was necessary to retain air defenses at Allied airfields as long as there was a possibility of enemy attacks.[35]

Defense of Convoys

As both Allied and Axis forces were dependent for their existence on supply sources outside the Mediterranean theater, shipping was of paramount importance and the power which controlled the convoy routes possessed a decisive advantage. Until the spring of 1943 the Axis enjoyed this advantage and the Mediterranean was virtually closed to Allied

shipping. With the expulsion of the Axis from Tunisia the scales were turned and, on 29 May, the first Allied convoy sailed from the Middle East to Gibraltar. Then the problem of keeping open the sea lanes passed to the Allies; specifically the task was delegated to Coastal Air Force. Among the duties assigned to Coastal Air Force in February 1943 were control of air operations for the protection of shipping against air attack and control of antisubmarine air operations.[36] Only the former, of course, was an air defense function.

During the period from TORCH D-day to the end of the land campaign in North Africa, Allied convoys continued to be restricted in their activities. Convoys experienced relatively little trouble sailing to Casablanca and Oran but any convoy bound for points east of Oran could expect to be attacked at any time. Moreover, the danger increased in February 1943 when it became evident that the enemy, having suffered unacceptable losses in his attempts to bomb airfields and ports, was turning his full attention to the Allied supply line. To meet this threat, one of the major responsibilities of the five air defense sectors set up in North Africa after the formation of Coastal Air Force was the protection of convoys as they passed between their sector boundaries.* Also, the coastal radar chain, which was gradually being erected along the coast, was designed to aid convoy protection, both by early warning and fighter control. For maximum protection all convoys received fighter escorts during the day while night fighters patrolled in the vicinity of large convoys and ports during darkness. Further

* The sectors were centered at Casablanca, Oran, Algiers, Bone, Tunis, and Djedeida.

aid was given by Allied bombers and offensive fighters in attacks on airfields from which enemy antishipping units were flown. Cooperation with the convoys and naval personnel was essential and sector commanders were subject to orders from the Joint Operations Room, Allied Force Headquarters.[37]

By April 1943 the NACAF coastal defense system was functioning smoothly and during the 45 days following 1 April Coastal fighters flew 1,991 sorties in convoy protection. During this period several Axis attacks on convoys were thwarted although most were made by low-flying torpedo bombers at dusk, the most difficult type of attack to combat.[38] Following the expulsion of the enemy from Tunisia it appeared that a new phase of the supply battle was to begin when the reorganized Luftwaffe antishipping units--which had escaped from North Africa and established new bases in Sardinia, Sicily, and southern Italy--launched a concentrated air assault on a large eastbound convoy off Cap Bon, Tunisia. Approximately 190 aircraft took part in the attack which lasted from the afternoon of 26 June throughout the night. Despite the severity of the attack, no ships were sunk, although two LST's were damaged, while six of the attackers were claimed destroyed and two damaged. In addition to this score, Coastal fighters forced many of the raiders to jettison their bombs before they reached the convoy.[39] The lack of success of this raid apparently caused another change in the German offensive plans; raids were concentrated for a time on ports, and convoy raiding was not resumed by the enemy in the Western Mediterranean until the middle of August.[40]

Following the end of the Tunisian campaign on 15 May, Allied efforts were directed toward the build-up for the Sicilian invasion, scheduled for early in July. Ports were crowded with shipping yet the Luftwaffe was unable to inflict serious damage by air attack. Nor were enemy attempts to interfere with the convoys bound for Pantelleria successful; Coastal fighters flew 244 sorties in protection of the convoys which lost only two small vessels.[41] The capture of Pantelleria and Lampedusa was quickly followed by the invasion of Sicily; Coastal Air Force's responsibility in this assault included protection of convoys up to a line 50 miles from Malta. In covering the invasion fleet of over 2,000 vessels, Coastal fighters flew 1,426 sorties during the nine days preceding 10 July. Throughout the remainder of the Sicilian campaign to 17 August, the fighters flew 6,572 sorties while protecting 140 convoys which sailed almost one million ship-miles. The only casualties from air attack suffered by these convoys bound for Sicily while protected by Coastal Air Force were four ships damaged.[42]

Capture of Sicily, followed by the invasion of Italy and the occupation of Corsica and Sardinia, opened the Mediterranean to Allied convoys and again forced the Luftwaffe to reorganize its ship-strike forces. Without convenient island bases the enemy moved his long range, anti-shipping forces--estimated to be 100 bombers--to southern France. As was anticipated by Allied Intelligence, a renewed attack on convoys in the Western Mediterranean followed. On 13 August 46 enemy bombers attacked a west-bound convoy in the first of 19 major attacks--the last of which took place 1 August 1944--from French bases. Although the raiders were able to sink 18 ships and damage 13 others in these 19

attacks, over 100 of the attackers were claimed destroyed or damaged by Coastal fighters or AA fire from the convoys.[43]

At the beginning of these raids from southern France it appeared that, after many experiments, the Luftwaffe antishipping forces had evolved tactics which promised to produce satisfactory results. Torpedoes had become the most effective antishipping weapons--although after October glide bombs were frequently employed--and tactics were designed to make best use of the torpedo bomber. A typical enemy raid came at dusk and was preceded by several reconnaissance missions and two pathfinder aircraft; the latter marked the approach route with white flame-floats. A few minutes before the attack planes arrived, several target illuminators approached at sea level and dropped flares near the convoy. A director aircraft (Master of Ceremonies) then arrived at about 9,000 feet, to make certain all preliminaries had been completed. The attack force--ordinarily consisting of 20 to 50 aircraft composed of 60 to 70 per cent torpedo bombers (Ju 88 and He 111) and 30 to 40 per cent bomb/glide bombers (Do 217)--then approached at 200 to 500 feet climbing to the desired height when the convoy was reached. Following the attack the raiders usually returned to sea level and proceeded to their bases as rapidly as possible.[44]

In spite of these tactics, slight damage was inflicted by enemy raiders on Allied convoys; however, in November 1943 the Luftwaffe apparently launched an all-out effort to disrupt Allied shipping. During the month three major attacks were made in which the raiders employed torpedoes and rockets with telling effect. Eight merchant vessels and

a destroyer were sunk and a merchant vessel was damaged. Of the 85 enemy aircraft taking part in the three attacks, 20 were claimed destroyed, 2 probably destroyed, and 7 damaged.[45] Despite these aircraft losses, this was one of the most successful months for the Luftwaffe antishipping forces.

The comparative success of this German effort in November caused the Allies to re-examine their convoy protection system. Air Marshal Tedder acknowledged that the protection of convoys off the North Africa coast from attacks by bombers based in southern France was one of the most difficult defense problems encountered by the Allies because the effectiveness of Allied air protection was hampered both by enemy tactics and the position of the convoy routes. As the favorite enemy tactic was a low approach at dusk, radar warning and visual observation were reduced; furthermore, Allied convoys sailed at such a distance from the coast that radar coverage was lessened. Since the only solution to the convoy defense problem was to make the attacks too costly to the enemy, Tedder stated that attempts were being made to remedy some of the weaknesses in the system. Orders had been issued to strengthen weak spots in the radar chain and check radar equipment and personnel, to increase offensive action against the bases in southern France, to make greater attempts to intercept reconnaissance aircraft, and to equip night fighter aircraft with Mark VIII AI as soon as possible. In addition to these improvements, Tedder suggested that convoys should take as many precautions as possible, that the employment of Fighter Direction ships should be considered, and that the possibility of having ships sail individually rather than in

convoys should be taken into consideration.[46]

Although some of these suggestions were not acceptable, a meeting at Headquarters, NACAF early in December resulted in a series of changes designed to increase convoy protection. Instead of breaking up convoys it was decided to bunch the ships as much as possible; convoys would assume the shape of a rectangle with a short side exposed seaward, i.e., away from the North African coast, which would afford the enemy less striking room. Fighter Direction ships, when they became available, would accompany the more important convoys while smaller convoys were encouraged to maintain R/T contact with fighters. In order to aid identification, fighter patrols were to avoid flying near convoys as much as possible and were to stay in specified patrol areas; anything outside of the areas could then be considered hostile.[47] These measures proved effective and in five convoy attacks during the next three months only one Allied ship was sunk and two damaged.[48]

A comparatively successful month for the enemy in April 1944--four Allied ships including a troop ship were sunk in three attacks--again created apprehension in the Allied high command and dissatisfaction was expressed regarding the work of Coastal Air Force. In reply to this criticism Air Vice Marshal Lloyd stated: "I do not think everyone realizes how lucky we have been." He pointed out that German tactics, e.g., flying reconnaissance planes low, made radar coverage difficult. Also, Allied convoys persisted in flying barrage balloons although they simplified the enemy task of spotting the convoys. Coastal Air Force was further handicapped, Lloyd reported, because convoys under attack were usually within range of only two radar stations. As each station

could control only one fighter, the number of controlled fighters available for each convoy was strictly limited. When these limitations and the number of ships requiring protection were considered, Lloyd believed that the efforts of his command in 1944 constituted "a remarkable achievement."[49]

Dissatisfaction with Coastal Air Force's efforts in convoy protection gave rise once again to the need for more adequate means of fighter control. A great extension of the coastal radar chain would have been the most effective method but its cost would have been prohibitive. As a more practical solution, Lloyd had proposed as early as 11 December 1943 that three British vessels be outfitted with GCI; one of these could accompany each major convoy during the time the convoy was in striking range of the enemy's bases in southern France.[50] Although there was general agreement on the feasibility of this proposal,[51] the actual outfitting of the ships was long delayed. Also as a result of enemy activity in April, the formation of a Seaborne Fighter Control Board was suggested to General Baker.[52] The suggestion was acted upon and the first meeting of the board, with Lloyd as chairman, was held 9 June 1944. The board was to have advisory and recommendatory functions only.[53] Although the belated arrival of fighter direction ships* and the creation of the Fighter Control Board promised a more effective means of fighter control in convoy protection, they came too late to affect the situation materially. After 1 August 1944 Luftwaffe convoy attacks

* For a plan to outfit submarines with GCI see: Ltr., Hq. MAAF to Hq. MAAF, sub.: Night-fighter Control from Submarines, 14 May 1944, in USSF HD microfilm roll 277.

ceased and, for the remainder of the war, Allied convoys sailed unmolested from the air throughout the Mediterranean.*

This total absence of the enemy air forces from the sea lanes during the last months of the Mediterranean campaign climaxed the efforts of MAC in convoy protection. From April 1943 to September 1944, Coastal fighters escorted 13,001 ships in 344 major convoys with day fighters flying 92,734 sorties and night fighters flying 10,985 sorties. Twenty-five enemy attacks developed in which 680 aircraft took part; of these, 93 were claimed destroyed, 9 probably destroyed, and 37 damaged. Losses among Allied ships totalled 42; 14 merchant vessels, 3 transports, 2 destroyers, and 3 LST's.[54] Moreover, as in the case of other air defense systems, these statistics did not include the number of bombs jettisoned, the number of raids canceled or redirected, or the intangible factors of morale in both Allied and Axis air forces. Allied air defense of convoys in the Mediterranean--largely the work of Mediterranean Allied Coastal Air Force--compiled a truly impressive record and was a major factor in the ultimate Axis defeat.

Defense Against Reconnaissance Aircraft

The last type of enemy air action against which a special air defense was required was the reconnaissance mission. As the primary purpose of reconnaissance aircraft is to observe enemy activity, reconnaissance missions must be carried out rapidly and safely; information gained is

* During the invasion of southern France, 15 August 1944, no ship was sunk or damaged by enemy air action. (Mare Nostrum, 14 Sept. 1944 (review of period Mar. 1943 to Sept. 1944), p. 11.)

valueless unless the aircraft is able to return to its base. Because of the nature of the reconnaissance missions--and the fact that reconnaissance aircraft normally operate singly--the prevention of German air reconnaissance of Allied activities in the Mediterranean area was one of the most exacting responsibilities of Coastal Air Force. Every enemy reconnaissance aircraft destroyed or otherwise prevented from observing Allied activities materially lessened the burden on the entire air defense system. Also, a reconnaissance crew was more valuable to the enemy than a bomber crew because of a higher standard of training and experience;[55] therefore, destruction of a crew placed a great strain on Nazi training facilities.

Prior to the end of the North African land campaign, the enemy enjoyed several advantages in the employment of his reconnaissance aircraft. Sardinia served as a convenient base for reconnaissance units; these units were well dispersed to handicap Allied efforts to seek out the aircraft on the ground. Initially the Luftwaffe relied on the twin-engined Ju-88 and attained some success because of the low performance of the available Allied interceptors, Hurricanes, Spitfire V's, and P-39's. When Allied pilots overcame this disadvantage by superior tactics, the Luftwaffe began to employ single-engined FW-190's and Me-109's specially fitted with long-range tanks and able to fly fast at high altitudes. The addition of P-38's and Spitfire IX's to Allied squadrons effectively countered these aircraft and, following the retreat of the Axis forces to southern France and northern Italy, the German Air Force again resorted to the longer range Ju-88's. During the remainder of the Mediterranean campaign the enemy employed for reconnaissance purposes any aircraft

available in his dwindlin air force.[56]

As the Allied advance continued, the area of enemy reconnaissance activity increased proportionately. By the middle of 1943 the Luftwaffe found itself with a depleted supply of reconnaissance aircraft and crews, yet expected to cover vastly more territory than ever before. Soon it was necessary to use inexperienced crews which resulted in less efficient operations. By the time of the Sicilian and Italian invasions, Allied anti-reconnaissance efforts had become so effective that the average enemy reconnaissance crew survived no more than 12 operational flights.[57] Despite this Allied defense, it was never possible to shut off completely enemy observation of the invasion build-ups.

Beginning in October 1943 German reconnaissance activity increased greatly as the enemy attempted to discover where next the Allies would strike. Shipping reconnaissance during day or night usually was carried out by low flying aircraft; by this tactic the enemy hoped to avoid radar detection.[58] As convoy attacks often followed the sighting of the ships by reconnaissance aircraft, destruction of the aircraft was considered the "key" to the protection of convoys.[59] Attempts to observe Allied activities in ports or on land were made by fast, high flying aircraft;* speed and height were counted upon to nullify radar detection and fighter interception.[60] These tactics proved so successful during October and November that only one CAF reconnaissance aircraft was intercepted. In

* All SADC's were reminded in June 1944 that heavy AA was effective against high flying aircraft; AA should be used if fighters were unable to reach the height of the enemy. (Ltr., MACAF to all concerned, 8 June 1944, sub.: AA Defenses, in USAF HD microfilm roll 284.)

order to bring an end to this relative freedom of action, Allied units began a system of day and night anti-reconnaissance patrols both at high altitude and in the area of the usual approach routes. This policy proved very effective when seven enemy reconnaissance planes were shot down in December.[61]

During 1944 Allied fighters continued to exact a heavy toll on Luftwaffe efforts to observe what was taking place despite the adoption by reconnaissance pilots of evasive tactics, window, and tail-warning radar devices.[62] Two indications of the effectiveness of Allied anti-reconnaissance efforts were available. Despite the tremendous build-up for the invasion of southern France during the summer of 1944, the enemy was kept in the dark concerning the actual point of invasion. An effective reconnaissance organization should have aided in the detection of the invaders' intentions. Also, German prisoners stated that a reconnaissance mission on the Mediterranean shipping routes was considered "an extremely hazardous operation."[63] This was a fine tribute to the Allied air defense against enemy reconnaissance.

Chapter VII

SUMMARY

Despite the initial predominance of RAF in air defense, the air defense organization in North Africa was allied from the beginning. During the actual invasion (TORCH), no central air defense command existed and air defense was provided by Eastern Air Command (RAF) and Twelfth Air Force (Western Air Command) for the units operating in their respective sectors. In the following weeks, although temporary organizations were established to provide defense for the newly-won territory, the enemy was able to inflict considerable damage on the Allied land forces and shipping, primarily because of a scarcity of night fighter aircraft and other vital equipment. While steps were being taken to improve Allied defense, all Allied air forces in the Mediterranean area were completely reorganized on 17 February 1942. All air forces were united under Mediterranean Air Command, a policy-making and planning staff, commanded by Air Chief Marshal Tedder. Chief among the operational commands set up under MAC was Northwest African Air (NAAF) commanded by General Spaatz; NAAF in turn was divided into five air forces, each of which was allied in personnel and equipment. Among these was Northwest African Coastal Air Forces (NACAF) to which was assigned responsibility for all air defense behind a line 50 miles from the bomb line. Initially, NACAF was assigned only 18 fighter squadrons (7 of which were American); this number increased to a peak of 56 squadrons (16 American) by January 1944.

As the Allied campaign progressed in the Mediterranean area, the task of Coastal Air Force in air defense increased proportionately. Ordinarily, the more experienced British defensive units operated in the forward areas of Coastal responsibility with AAF units in the less exposed areas. As the British moved forward with each successive advance of the front lines, AAF air defense units replaced them. Continuity of operations was maintained by this procedure while American forces were gaining valuable combat experience. By the end of 1944 63d Fighter Wing was in Sardinia and Corsica, 62d in the Naples area, and 64th (under XII Air Support Command) was responsible for the west coast of Italy north of Naples. The remaining areas were defended by the British air defense units.

Meanwhile, in December 1943, the entire command structure of the Allied air forces underwent a change. Mediterranean Air Command and Northwest African Air Force were combined, along with all other Allied air forces in the theater, into Mediterranean Allied Air Forces (MAAF) under General Spaatz (soon to be replaced by General Eaker). Despite this command change, the structure and functions of Coastal Air Force--henceforth known as Mediterranean Allied Coastal Air Force (MACAF)--were unchanged.

In September 1944, since the enemy air threat had practically disappeared in the Mediterranean area, air defense functions outside of the tactical areas were turned over to the British forces. During the period of American participation in air defense, Coastal Air Force had

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performed its mission well in terms of the relatively small amount of damage done by the enemy air forces. To this record the American forces had contributed immeasurably. In addition to sharing command responsibilities with RAF, AAF had borne up to approximately 40 per cent of the air defense burden; furthermore, American air defense personnel and equipment were thoroughly battle-tested. Long before AAF units were withdrawn from air defense in the Mediterranean area, all personnel had become aware of the necessity for an effective air defense in the conduct of any successful military campaign.

For the successful performance of its mission an air defense depends upon four primary functions: detection, identification, interception, and destruction of enemy aircraft. As finally developed in World War II, detection of approaching aircraft depended primarily on the most significant development of the early war years: radar. By the use of early warning radar, air defense personnel were able to detect approaching aircraft at great distances in all kinds of weather. In order to employ early warning radar efficiently, a mobile radar system was developed by US Fighter Command School for use in the TORCH landings. Early warning in this system was provided by the Signal Aircraft Warning Battalion, three of which (560th, 561st, and 562d) participated in the assault. Although many misfortunes and misunderstandings contributed to render attempts to furnish early warning ineffectual during the invasion, the basic system proved sound.

Following the successful invasion, Allied attention was turned to the development of early warning facilities for fixed installations.

Control of all early warning radar was vested in Coastal Air Force after 17 February 1943, and by April, a radar chain had been installed along the North African coast as far east as Bone. For air defense control purposes, Allied territory was divided into sectors (Fighter Control Areas), each with a Sector Air Defense Commander (SADC) who was responsible to the Air Defense Wing commander. Within each sector, early warning radar was placed to cover all approaches--gaps were filled with human observers where necessary--and information of oncoming aircraft was relayed to fighter control squadrons, AA, Passive Air Defense organizations, and all other units that required warning. Efficiency of the early warning system depended primarily upon the degree of cooperation attained between air defense personnel and the quality of the vast essential communication net.

Although, in general, the early warning system functioned efficiently in North Africa and later in Sicily and Italy, many problems arose, some of which were difficult to solve. A scarcity of commercial telephone lines, particularly in North Africa, meant that all communications facilities had to be provided by signal companies; furthermore, transportation for mobile radar was often inadequate. Also, it was discovered that American radar personnel were not selected as carefully as their RAF counterparts. Lack of education and appropriate civilian backgrounds among American radar personnel was believed to have contributed to inefficient operations. Siting and calibration of radar sets created additional problems. Because of the characteristics of radar, sites had to be selected with care so that no object would interfere with the transmission of the radio waves. This problem was solved largely by

the designation of radar siting officers who selected sites in advance by means of maps or personal reconnaissance. Calibration--testing and coordinating of the radar sets--was less easily accomplished because of a lack of aircraft for testing purposes. Repeated requests during 1943 for calibration flights resulted in the assignment of only a few well-worn aircraft which were inadequate for the task. Finally in 1944 calibration flights for both AAF and RAF radar arrived in the theater and calibration was placed on a periodic basis. Nevertheless, calibration of radar was never completely satisfactory in the Mediterranean theater.

By early 1944, the threat from the Luftwaffe had decreased to the extent that radar cover could be reduced in the less vital areas. Successive reductions continued to be made until September when all American radar personnel and much American equipment was withdrawn from Coastal Air Force. This withdrawal closed a period in which Allied early warning radar operations and equipment had been tested and improved; for American personnel it provided valuable experience.

In filling the second air defense requirement--identification--radar again provided the most reliable means. In the Mediterranean identification friend or foe (IFF)--was based primarily on IFF Mark III, the most reliable World War II system. The most serious defect of the IFF system was (and continued to be) that it positively identifies only friendly aircraft. Despite the possibilities of IFF as an identification system, it often functioned improperly in the Mediterranean theater; its lack of success resulted, for the most part, from faulty equipment or failure of the airborne personnel to turn on the IFF transponders. As a result of improper identification, Coastal Air Force reported in March 1944 that

40 per cent of its scrambles were against friendly aircraft. Nevertheless, although IFF never fulfilled its vast potential in spite of many attempts to improve the system, it was the best means available for identification and it aided greatly in the success of the Allied air defense system in the Mediterranean area.

During World War II the most effective weapon for interception was the fighter aircraft. However, by itself the fighter would have failed in its task; radar again made possible the reliable fulfillment of an air defense function regardless of weather conditions. Interception, particularly at night or in inclement weather, depended upon two functions made possible by radar, Ground Controlled Interception (GCI) and Airborne Interception (AI). When both ground and airborne radar and personnel functioned smoothly, interception was possible, regardless of the weather, up to the limit of the fighter's performance. Although several other methods of night and all-weather interception were tried such as the fighter-searchlight belt and free-lancing patrols, during the Mediterranean campaign the GCI-AI method of interception proved most effective.

Since the most effective interception weapon was the fighter aircraft and since the majority of enemy raids occurred at night--several day fighters such as the P-51 and RAF Spitfire were effective as day interceptors--much of the success of the air defense system depended upon the caliber of the night fighter aircraft. During most of the Mediterranean campaign no effective American night fighter was available--experiments designed to convert the A-20 into a night fighter were unsuccessful--and Allied reliance was placed on the RAF Beaufighter,

a twin-engine monoplane with a crew of two. Four AAF Beaufighter night fighter squadrons (414th, 415th, 416th, and 417th) became operational in North Africa during the summer of 1943 which, added to the NAAF Beaufighter squadrons, gave NACAF a total of eight night fighter squadrons. These AAF squadrons continued to form an integral part of the Allied air defense system (415th was transferred to AII ASC in October 1943) and, despite obsolescent aircraft and AI equipment, performed well until transferred from Coastal Air Force in September 1944.

Meanwhile, both the United States and Great Britain were developing new night fighters, the P-61 and the Mosquito, which were superior to the Beaufighter. However, low priority for the Mediterranean theater and production difficulties delayed receipt of the new aircraft until too late to affect materially the outcome of the air campaign.

As Allied interception efforts improved, the enemy adopted new tactics and developed Radio Countermeasures (RCM) for the protection of its bombers. High losses to Allied fighters in daytime operations caused the Luftwaffe to rely on night attacks during the early months of the North African campaign. Later, as Allied night interception techniques and equipment improved, the enemy resorted to evasive tactics and to low altitude raids in order to avoid radar detection. In September 1943 the Luftwaffe began to use its most effective RCM-window. Although it was possible for Allied radar operators to work through window, its use by enemy raiders was effective, particularly when they perfected distribution methods such as saturating the target area. Other RCM developed by the

Nazi included a radar tail-warning device, for which the Allied discovered no countermeasure, and radio and other communications jamming.

In spite of enemy evasive tactics and RCM, the night fighters contributed greatly to the successful Allied air defense effort. Although combat statistics revealed no outstanding victory for the night fighters, their deterrent effect--as well as their effect on morale of both enemy and friendly forces--was great.

Although Antiaircraft Artillery (AA) was not a part of the air force, a discussion of it is necessary for the completion of the Mediterranean air defense story. Employment of AA had been considered by TORCH planners and provision was made for AA batteries to accompany the landing forces. However, in the weeks that followed the assault there was not sufficient AA for the protection of all potential targets. As a result, Twelfth Air Force forward bases were bombed repeatedly, a situation which led General Doolittle to request that AA be assigned, along with all air defense weapons, to the appropriate air defense wing. This proposal, as well as similar proposals made later, was not approved.

In addition to AA plans for the actual assault, long-range plans had been made by TORCH planners for the coordination of air defense weapons in the campaign to follow. As the coordinating agency, Antiaircraft and Coast Defense (AA&CD) Section was set up; this section later became part of Allied Force Headquarters. Also, an AA&CD Committee was formed to recommend the allocation of air defense personnel and equipment. In February 1943, at the request of General Eisenhower, a British officer,

Maj. Gen. R. B. Pargiter, was selected to head the section. Pargiter's section, which was to control all AA outside of the battle areas, was allied and, in his opinion, was the most completely integrated section in Allied Force Headquarters. Also, as was true with other air defense organizations, the commitments of AA&CD Section increased as the Allied armies moved forward.

In order to control AA fire and enable AA to cooperate with other air defense weapons, rules for firing were published and provision was made for restricted areas in which AA was allowed freedom to fire. Recognition and identification training was stressed and liaison established between AA and air force units. Nevertheless, mistakes could and did occur although every effort was made to hold them to a minimum.

Among the many problems which confronted AA in the Mediterranean area was a shortage of AA; according to many observers, there was never enough for defense of all vulnerable areas, and as a result proper allotment was essential. Also several attempts were made to transfer American AA to the AAF without success. However, another problem was solved when a proposed reorganization of AA in the Mediterranean theater was adopted. On 5 April 1944 control of all AA matters was vested in the Air Commander in Chief (General Eaker) who, in turn, delegated control outside of battle areas to AOC MACAF (Marshal Lloyd). Also, Mediterranean Antiaircraft Advisory Committee was established to advise the Supreme Allied Commander and General Eaker on policy and allocation of resources. By this reorganization--although General Pargiter retained responsibility for operational efficiency and supervision of AA--operational control was

placed in an air force commander.

Meanwhile, because of the reduced enemy threat and a shortage of manpower, reductions in AA protection were authorized. At its first two meetings, the Mediterranean AA Advisory Committee recommended reductions and, by the time of its third meeting in September, AA outside of the tactical areas had been largely withdrawn. By January 1945, only five battalions of American AA remained in the theater.

AA operations during the Mediterranean campaign afforded vast experience for American AA personnel and illustrated the value of air force control of all air defense means. Furthermore, American AA combat statistics are impressive--1,127 enemy aircraft destroyed and over 253 probably destroyed. Regardless of which headquarters controlled AA, it contributed greatly to the success of the Allied air defense system.

Two other active air defense weapons played a minor role in the air defense of the Mediterranean area: barrage balloons and smoke screens. Neither was initially under the control of the air forces but both were placed under operational control of Marshal Lloyd during 1944. Weaknesses of both weapons--balloons were vulnerable to enemy fire and the weather and required a great deal of shipping while smoke could not be used where friendly aircraft were operating--prevented their use on a wide scale except in defense of ports. Nevertheless, operations with balloons and smoke units contributed to the over-all success of the air defense system and gave American units valuable battle experience.

Passive Air Defense (PAD)--including all measures taken to minimize the effects of hostile air action--was also introduced and improved

during the Mediterranean campaign. Shortly after TORCH a Passive Air Defense and Civil Defense Section was set up in North Africa under a British officer, Capt. J. B. Franks RN (Ret.). PAD&CD Section was to develop passive air defense and civil defense plans, supervise training and procurement of equipment, and introduce PAD into the American Air Force. Although, because of their experience, the British predominated in PAD&CD Section, American personnel were later added to the staff.

Much was learned concerning passive air defense and civil defense during the North African campaign. PAD&CD schemes were furnished to the major cities and cooperation was achieved with the civilian population. Among the combat troops, it was expected that units would provide PAD measures themselves while air force bases, located as they were near large headquarters, were not provided with special PAD measures; they also were expected to provide normal security measures. Despite the improvements in PAD&CD and the realization that disruption of civilian life could seriously hamper military operations, PAD&CD was neglected in the Sicilian and southern Italian operations. Finally, after the Allies had become firmly established on the Italian mainland, adequate provision was made for PAD&CD in all phases of military activity.

Introduction of Passive Air Defense into the American forces in the Mediterranean theater was particularl significant because it was a "new Army requirement." No War Department directive on the subject existed and no PAD personnel were provided for in the manning tables. Appreciation of and provision for passive air defense measures in the American forces came, therefore, from cooperation with the British

or from bitter experience. By mid-1944 PAD had become an integral part of American defensive warfare.

In a consideration of the use of these various air defense weapons, it is apparent that allied air defense activities in the Mediterranean area included four major types of defense: defense of ports, airfield defense, defense of convoys, and defense against enemy reconnaissance aircraft. Each type of defense required different augmentation by Allied defenders and each type varied in importance as the Luftwaffe altered its objective. During the opening months of the North African campaign, the enemy expended most of his bombing effort against airfields and ports with considerable success until Allied night fighter defenses were strengthened. Because of prohibitive losses and because of the realization that the most profitable Allied target was shipping, the Luftwaffe concentrated after August 1943 on convoys. Ports became a secondary target and airfields were seldom attacked. Finally, as German strength waned while Allied air defenses improved, enemy air activity was largely confined to air reconnaissance in an attempt to watch the Allies.

Despite concentrated efforts, new tactics, and widespread use of window and other ECM, the Luftwaffe was never able to delay seriously the Allied campaign. After the expulsion of the Axis from North Africa, only two raids resulted in major damage to Allied personnel or materiel; the Bari raid of 2 December 1943, and the raids of 12 May 1944 on Poretta and Alesan airfields in Corsica. On the other hand, German aircraft losses were high and, as morale fell, more and more Luftwaffe raids were ineffectual. A fitting tribute to the operational effectiveness

of Allied air defenses was included in a Coastal Air Force report to the effect that, despite the vast area to be defended, the Allied Mediterranean air defenses accounted proportionately for more Luftwaffe aircraft in raids on ports and airfields (and convoys might have been included) than were lost by the Allied bomber formations over the heavily defended and concentrated Axis targets in Europe.

From the records pertaining to Allied air defense in the Mediterranean theater, two factors appear to have been of paramount importance: the extent and effectiveness of Allied cooperation, and the knowledge gained by the American forces in general, and the AAF in particular, concerning air defense. From the beginning of the North African invasion, cooperation between the American and British forces was outstanding; later the French and Italians also contributed to the joint effort. Although this cooperation extended to all phases of the campaign, according to participants, it was particularly effective in air defense. The British, having considerable experience in defense against air attack, took the lead in air defense while the Americans assumed more and more responsibility as they gained experience and accumulated weapons and personnel. Much of the success of the air defense system in the Mediterranean area must be attributed to the effective teamwork of the Allies.

As far as the AAF was concerned, much was to be learned about air defense when the invasion began. Many Americans did not appreciate the value of active air defense while passive air defense was virtually unknown. Such essential ingredients of a successful air defense as ground observers, transportation for mobile equipment, highly trained operating personnel, radar calibration and siting facilities, and liaison between all elements of air defense and between air defense units and those requiring air defense were either non-existent or inadequately

provided for. Often the need for these air defense requirements was realized only after time, effort, or lives were lost because of their absence. Above all, the vital lesson was brought home that, as soon as friendly forces occupied an important military objective, enemy air attacks could be expected; therefore, erection of a complete air defense system--including night fighters--should be accorded a high priority. This important lesson was later applied to the victorious Allied assaults on German and Japanese held territories.

Appendix 1

IDENTIFICATION

The identity of approaching aircraft may be determined by two methods: "recognition," which is by visual observation, or "identification," which is by any means other than visual. Prior to the advent of radio and radar, recognition was the only method available; thus no enemy aircraft could be detected or identified who could not be seen or heard by the defenders. As aids to visual observation, personnel depended upon several factors such as the markings of the aircraft,* the characteristics of the aircraft, the behavior of the pilot, or at night, the lights or colors flashed by the aircrew. Despite these aids, the task of identifying aircraft by recognition was unreliable in the daytime and virtually hopeless at night or in inclement weather. An efficient, all-weather air defense system based on the recognition method of identifying aircraft was impossible of achievement.

Before the development of reliable radar identification equipment, three non-radar methods of identification were devised; reliance is still placed on these methods to some extent. Identification may be made by the coordination of information received from radar detection devices with the reports of observers who have recognized the aircraft by visual means. Another method involves a process of elimination; the movements of friendly aircraft are known, therefore, any other aircraft in the vicinity is assumed to be hostile. Finally, identification may be made by radio contact with or without a code system. Although these methods may be effective in peacetime, in a theater of war they are not sufficient because of the coordination and time involved. It remained for radar to provide the potential means for the accurate, instantaneous identification which is vital in wartime.

The radar devised by the Allies which, when properly operated, may remove much of the guess-work from identification, is known as IFF (identification friend or foe). The earliest IFF system consisted merely of equipping friendly aircraft with antennae which would return, in regular patterns, the pulses sent out by an early warning radar. When the ground radar received this altered echo, ground operators considered the aircraft as friendly. Although this system had the virtue of simplicity, its inadequacy was soon recognized: it was not dependable (the enemy had no difficulty placing similar antennae on its planes); it did not provide a large enough identification range; and, because an antenna responded only to radar operating on its own frequency, new radar which operated on different frequencies did not fit into the system.

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*Because USAAF stars were occasionally confused with the Nazi swastika, a yellow circular band was painted around the stars on AAF aircraft in June 1943--all Allied markings then bore a similar circular pattern (TWX MAC to all concerned, 7 June 1943, in USAF HD microfilm roll 30).

Further research in the development of IFF resulted in the introduction of an improved version, IFF Mark I; this was a combined receiver-transmitter (transpondor) installed in the aircraft. When the transpondor received pulses from early warning radar, it automatically emitted a signal which, along with the normal echo, was picked up by the ground radar. The combination of this signal with the returning echo caused a distortion which was interpreted as evidence of a friendly aircraft. Range of identification was improved because IFF Mark I "swept" through a band of frequencies used by ground radars; thus, as the transpondor in a passing friendly aircraft moved through a frequency band, it would emit a signal at regular intervals on the frequency of a particular ground radar. Later developments, which were necessary to keep pace with an expanded number of frequency bands employed by ground radar, produced an improved device, IFF Mark II. This transpondor was able to sweep through three frequency bands, including the band covered by IFF Mark I. Variants of IFF Mark II were also produced to operate on bands, other than the three regularly covered, which were used by particular early warning radar sets. Furthermore, IFF Mark II was equipped with a six-position switch for the transmission of six different codes; however, difficulty in distinguishing between the six codes rendered this device ineffective.

As radar sets became more specialized, the number of their operational frequencies increased proportionately; soon the production of an IFF set which would operate on all frequencies was impracticable. To enable an aircraft to identify itself to all radar, installation of several IFF Mark II sets operating on different frequencies would have been necessary. As this would have increased dangerously the weight of the aircraft, some other method was required. The adoption of a universal IFF frequency band appeared to be the most feasible method for, although this would require extra equipment, most of the equipment would be attached to ground apparatus.

IFF Mark III, as this new system was known, designated the entire system rather than merely the airborne device. In contrast to previous systems, the initiation of the identification procedure in IFF Mark III was made by the ground radar. The ground device (interrogator-responsor), attached to the early warning radar sets, emitted a challenge in the form of pulses on the universal frequency band; this challenge was picked up by the airborne receiver (transpondor) which, in turn, responded by a signal to the ground radar. If the ground transmitter received no reply or an incorrect reply, ground operators assumed that the aircraft was hostile. IFF Mark III offered several advantages: airborne equipment was limited to one instrument (SCR-595 for use in bombers and transports, SCR-695, equipped with GCI frequency, for use in all aircraft but usually used in fighters) thus reducing weight;*

*Later an airborne interrogator-responsor, SCR-729, which was installed in night fighters to aid in identification of other aircraft, was introduced.

the six-position code switch was retained, although only one position was normally used; both interrogator-responsor and transpondor could be turned off when not needed; and, as the challenge could be made only from the ground, the system was less susceptible to compromise by the enemy. Despite some defects, IFF Mark III remained the standard identification system throughout most of the Mediterranean campaign.

Appendix 2

INTERCEPTION

Successful interception of enemy aircraft by defensive fighters depended primarily on the radar devices which made possible the carrying out of Ground Controlled Interception (GCI) and Airborne Interception (AI). The principal task of GCI was to guide an airborne fighter close enough to a hostile plane to enable the fighter pilot to approach, by either visual or AI means, within striking range. GCI was accomplished by cooperation of the fighter pilot (or radar operator in the night fighter) with a Signal Aircraft Warning battalion operating early warning radar and a Fighter Control squadron operating Very High Frequency (VHF) radio. When the early warning radar operator picked up information (number, height, and range) of approaching unidentified aircraft,* he transmitted this information by means of radio or telephone through a filter room to the Sector Operations Room. Here the sector controller took over, scrambled his fighter aircraft (or perhaps they were already on patrol), and transferred control of individual aircraft to a GCI controller in whose range the raiders appeared. The GCI controller determined the exact position of the bogies (unidentified aircraft) on the plan position indicator (PPI), a cathode ray tube on which a map of the area (each PPI scope covered a distance of 50 miles in radius from the set) had been superimposed. All aircraft picked up by the PPI appeared as "blips" (spots of light) on the tube and, by IFF or other identification means, friendly aircraft were identified, bogies were pinpointed, and the GCI controller was able to follow both unknown aircraft and the fighter he was controlling.† With this knowledge, the controller sitting by the PPI selected a target toward which he directed his fighter by VHF radio. As the controlled fighter neared the bogey--a good controller could place his fighter two miles or less from the suspected enemy aircraft--he was "vectored" (informed by a compass reading of the bogey's position and direction of flight) into position by the controller. For best results the fighter was placed slightly lower than the bogey with an overtaking speed approximately 20 miles per hour greater. When the fighter reached this position, the controller's task (except to direct the fighter back to

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*For best results a GCI station was placed in a shallow depression surrounded by a plain approximately one-half mile wide. Such a site would avoid ground echoes caused by buildings or other objects, but would not interfere with echoes from aircraft. (Hq AAF Manual, The Tactical Employment of Night Fighters, 1 Mar. 1943 in USAF HD microfilm roll 290.)

†Because of a dearth of AAF GCI controllers, many RAF personnel were used by AAF units during the early months of the Mediterranean campaign. This shortage was alleviated later when AAF personnel attended an RAF GCI school in Cairo where they underwent two weeks of instruction. (Hist. 82d Fighter Control Sq., p. 163; Mare Nostrum, 16 Dec. 1943, p. 14.)

its base) was finished. The fighter pilot took over visually, or the radar operator in the night fighter took over with AI, and continued the pursuit of the unidentified aircraft.

During daylight hours of good visibility, identifying and closing with the suspected aircraft were comparatively easy for the fighter pilot. For night and all-weather interception, however, dependence in approaching close enough for identification and attack was placed on the airborne radar set (a small scope similar to the PPI) which made possible Airborne Interception. Like other radar sets, this radar was improved gradually throughout the war years by cooperative Allied efforts. The first operational set, RAF AI Mark III (Marks I and II never became operational) gave a maximum range of two miles but was handicapped by fading of the echo. An improved version, Mark IV, did away with the fading and increased the range to four miles while Mark V had a five-mile range. Although this progressive increase in range was beneficial, each of these sets was handicapped by the fact that, because of ground echoes, it would not operate at a greater distance than the distance of the aircraft from the ground. By using microwaves (centimeter) which could be emitted in a narrow beam, Mark VII* did away with this limitation while Mark VIII increased maximum range to six and one-half miles. By early 1945, Mark X (AAF SCR-720) had become the standard AI radar set.

Once a fighter had established radar contact with the bogey, two problems remained; the fighter pilot had to identify positively the aircraft as hostile, and he had to bring his plane close enough to employ his weapons. AI contact, which was handled by the radar operator

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*Mark VI, a version of Mark V for single-seater fighters, saw only limited service. Mark VII was a hand-built set; Mark VIII with a slightly greater range was its manufactured equivalent.

/One handicap experienced by all night fighter pilots was the difficulty of seeing in the dark. The following "Ten Commandments of Night Vision" were designed to increase the pilot's ability to see his quarry.

"1. Keep your eyes dark adapted, avoid bright lights.
2. Keep your windscreen spotless and unscratched.
3. Do not use the cockpit lighting.
4. Use oxygen from the ground up. Remember that the average increase in range of night vision by using oxygen is 10% at 6,000 feet, 20% at 10,000 feet, and 40% at 16,000 feet.
5. Practice using the 'corners of the eyes.' Night targets are best picked up by not looking directly at them.
6. Know the tactical value of light conditions, always approach the target from the darkest part of the sky.
7. Keep your eyes out of the cockpit as much as possible.
8. Be adequately dressed, and comfortable in the cockpit. See that your heating is working properly.
9. Know your silhouettes and positions of exhaust flames.
10. Keep at it, practice at every opportunity. You will be surprised how much your night vision improves.

IT DOES NOT SUFFICE TO KNOW THESE RULES; IT DOES NOT SUFFICE SIMPLY TO PRACTICE THEM SPASMODICALLY: ONE MUST LIVE THEM CONSTANTLY IF ONE IS TO LIVE CONSTANTLY."

(MACAF Tactical Instruction 1, no date, in USAF HD microfilm roll 290.)

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in night fighters,* was maintained until the pilot actually saw the aircraft. When visibility was limited, identification might not be possible until he was 250 years from the plane. As soon as the pilot was certain that the aircraft was hostile, he attempted to approach the enemy close enough (200 yards or less) to fire his weapons.† Probability of a "kill" depended upon the ability of the pilot to out-maneuver the enemy in order to get in the best firing position. When the fighter was in this position it remained for the pilot to press home the attack.

Although no two AI chases were ever identical‡‡ the above is an over-simplification of the factors involved--all were similar in one respect. At night or in periods of low visibility a pilot could expect an opportunity for only one "pass" at his quarry. If his initial attack did not succeed in destroying or crippling the enemy, the fighter pilot found it virtually impossible to regain contact, for the alerted enemy undoubtedly would have taken evasive action and flown away at top speed. It was imperative, therefore, that the fighter pilot concentrate on making his initial attack as successful as possible.

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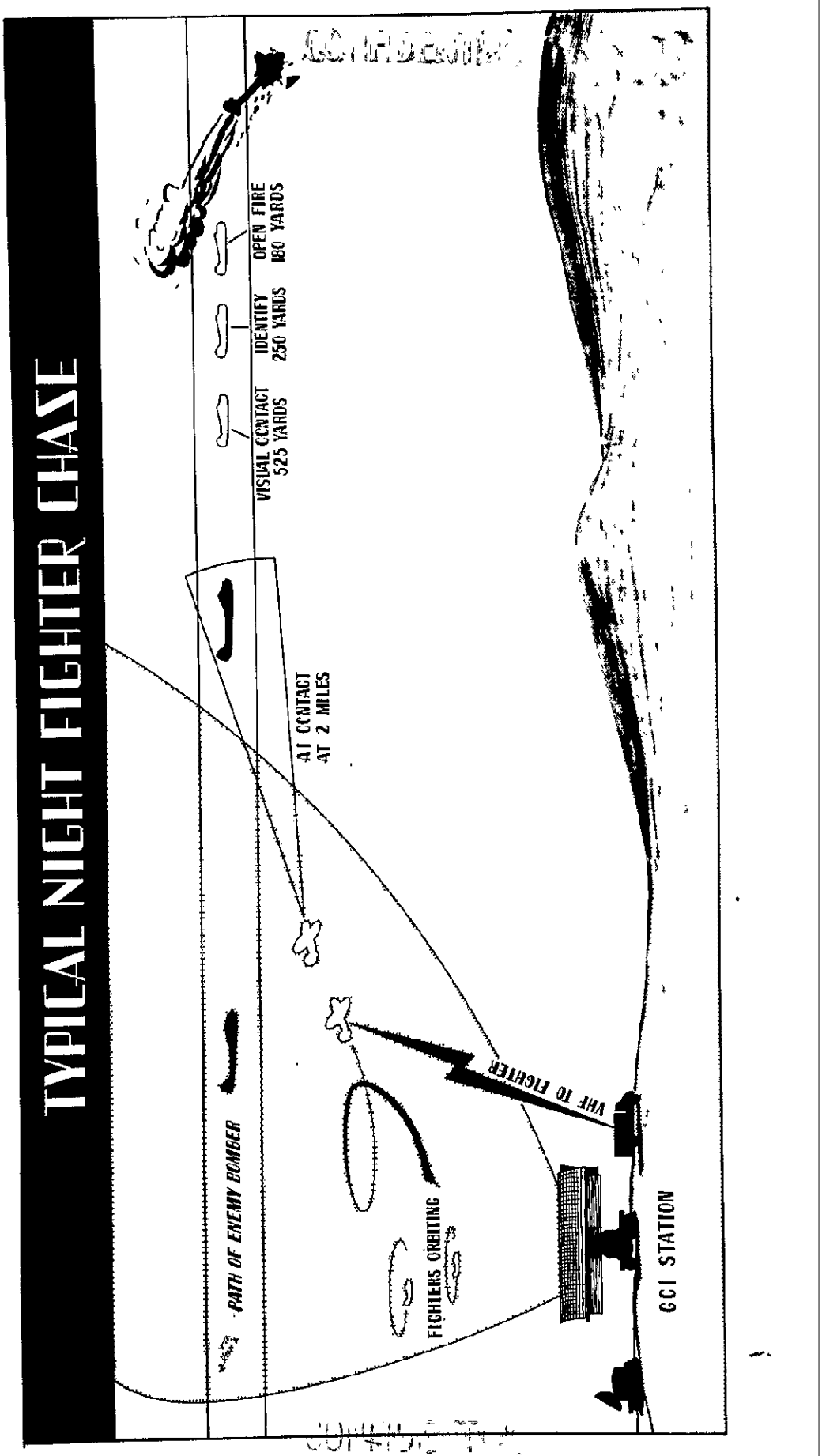
*If the enemy used "window" or evasive action, the task of the radar operator was made more difficult.

†Although the construction of blind firing AI radar was considered possible, it could not have been used without more reliable IFF ("The Nighters," Radar, no. 8, 23 Feb. 1945, p. 44).

‡‡See chart on following page.



G L O S S A R Y

AA	Antiaircraft Artillery
AA&CD	Antiaircraft and Coastal Defense
AADC	Antiaircraft Defense Commander
AAF/MTO	Army Air Force Mediterranean Theater of Operations
ADW	Air Defense Wing
AFHQ	Allied Force Headquarters
AI	Airborne Interception (radar)
AOC	Air Officer Commanding
AWS	Air Warning Service
DRAGOON (ANVIL)	Code name for Allied invasion of Southern France
EAC	Eastern Air Command (RAF)
GCI	Ground Controlled Interception (radar)
GDA	Gun Defended Area
GOR	Gun Operations Room
HUSKY	Code name for Allied invasion of Sicily
IAZ	Inner Artillery Zone
IFF	Identification friend or foe (radar)
MAAF	Mediterranean Allied Air Forces
MAC	Mediterranean Air Command
MACAF	Mediterranean Allied Coastal Air Force
MASAF	Mediterranean Allied Strategic Air Force
MATAF	Mediterranean Allied Tactical Air Force
MEW	Microwave Early Warning (radar)
MTO	Mediterranean Theater of Operations
NAAF	Northwest African Air Forces
NAASC	Northwest African Air Service Command
NACAF	Northwest African Coastal Air Force
NAPW	Northwest African Photographic Wing
NASAF	Northwest African Strategic Air Force
NATAF	Northwest African Tactical Air Force
NATC	Northwest African Training Command
NATOUSA	Northwest African Theater of Operations, United States Army

OVERLORD	Code name for Allied invasion of France
PAD	Passive Air Defense
PAD&CD	Passive Air Defense and Civil Defense
PPI	Plan Position Indicator (radar)
RADAR	Radio detection and ranging
RCM	Radio countermeasures
RDF	Radio direction finding (AAF) Radar (RAF)
SAW	Signal Aircraft Warning (battalion)
SCR	Signal Corps Radio
SADC	Sector Air Defense Commander
SOR	Sector Operations Room
TORCH	Code name for Allied invasion of North Africa
VHF	Very High Frequency (radio)
Window	Metallic strips which, when dropped from an aircraft, produce false echoes on radar scopes.

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