

ADC HISTORICAL STUDY NO. 16

**AIR DEFENSE
IN THEORY
AND PRACTICE
1918-1945**

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The American experience in the war was shorter and less comprehensive than that of the other major participants, but it was of great significance for the future of American military aviation--and of air defense. The air arm saw only seven months of combat, missing the earlier stage of German air supremacy. When the Air Service took to the skies in April 1918, enemy aviation was passing to the defensive. By the time of America's most intensive involvement in combat in the fall of 1918, air supremacy belonged to the Allies.

Because of the diminished German air effort, the defense of ground troops against German aircraft gave American airmen little trouble. On one conspicuous occasion, however, rather elaborate preparations were made to prevent such attacks. In planning for the great offensive at Chateau-Thierry, the American air leader, General Mitchell, divided the front into sectors in which anti-aircraft batteries would report the presence of German aircraft to his headquarters by coded messages, giving their sector coordinates.¹ In addition to fighter airplanes on alert at their ground stations, Mitchell called for friendly fighters to fly combat air patrol at low level to prevent German planes from attacking ground forces. For air defense at night the defenders had to rely entirely on anti-aircraft fire aided by searchlights and sound locators. Nevertheless,

Mitchell was not optimistic about the merits of such preparations because of his overriding belief that a willing and resourceful aviator could almost always find his way through them to his target. As for the air defense of Allied cities, the subject was of little more than academic interest to American airmen and their own cities across the Atlantic were beyond the capabilities of German aviation.

Although it was acknowledged by American airmen that the instrument best suited to thwarting air attack was the airplane itself, the doctrine that emerged from this experience stressed the offensive role of the airplane. The job of combat aircraft was to gain air supremacy in order to carry the war to the enemy's rear, disrupt his efforts, and break the stalemate of trench warfare. In line with this, Mitchell was opposed to defensive fighter patrols as a misuse of a weapon whose true role was to seek and destroy, so that the bomber--"the sledgehammer of air power"--could break the back of the enemy effort.

There can be little wonder, therefore, that America's flyers lived in a world where air defense was seldom in their thoughts. Their faith in the offensive potential of the airplane was fanned to a flame by Mitchell's zeal. And they were convinced that they were well on the way to a conclusive demonstration of their beliefs when the war ended.

The transition from war to peace and from France to America was in many ways a traumatic experience for those

who remained to lead the air arm. The continuous sense of anxiety, caused by the proximity of a deadly foe, was replaced by the realization that America lay out of reach by air to any potentially unfriendly nation. Also, the relative freedom of action enjoyed by the Air Service in France was replaced by the War Department's firm policy that the air arm existed solely to serve the interests of the ground forces--at their direction. National policy and War Department policy coincided in that the nation was overwhelmingly dedicated to the principle of non-involvement in the affairs of Europe--the Department translating that wish into the doctrine of "defense only". Against the doubtful prospects of an attack by Britain and/or Japan, the Navy was to remain the first line of defense while the Army was to bar the way to any forces that succeeded in landing on our shores. The job of the Air Service was to assist the Navy by off-shore reconnaissance and the Army by observation and interdiction of enemy movements. The possibility of land-based enemy air attack was almost completely discounted. Not until the late twenties was a carrier-based air attack considered to be a fairly realistic possibility, but the Navy deemed itself capable of meeting that threat without the help of the Army air arm. Under these circumstances, the Air Service found itself deprived of the important role it coveted and believed it deserved because of the part it had played in France.

The stage was thus set for a confrontation with both the War Department and the Navy.

In the debate that ensued intermittently for two decades, the airmen were seriously hampered by semantical troubles. Unable to assert their philosophy of air power, with its accent on offense, they were obliged to camouflage their cause in the aesopic framework of a "defensive" terminology. Under that constraint, confusion in the public mind about what was and what was not necessary for the air defense of the nation was bound to flourish.

The early stages of the debate were dominated by the personality and polemics of "Billy" Mitchell. His many writings on air power are replete with references to "air defense" and "coastal defense". As Mitchell saw the role of American air power in the twenties, America would soon be vulnerable to attack by both land-based and sea-based aircraft. As aviation technology progressed, he pointed out the danger to the "vital area" of the Northeast. Not only did carrier-based aircraft pose a distinct threat, according to him, but bombers could attack the "vital area" directly from Europe. He discounted the value of anti-aircraft artillery to defend and recommended that pursuit aircraft units be assigned to the local defense of strategic points in the "vital area".²

Among other objectives, Mitchell's air power crusade sought to obtain for the Army air arm the mission of coastal

defense. At stake was not only the prestige which went with being the first line of continental defense against an invader, but the opportunity to develop and procure the long-range bomber. Because of the strong isolationist attitude in the United States at the time, the opportunity for the Army air arm to obtain the funds needed for development of the bomber were slim, but the coastal defense mission with its prerogative of ranging far out to sea from land bases to bomb enemy ships approaching our coasts was adequate justification for long-range bombers. In the course of his campaign to obtain the coastal defense mission, Mitchell's planes successfully demonstrated their ability to do lethal damage to warships at sea. Eventually, his impatience and zeal resulted in his court martial and resignation from the service.

The campaign was continued by his colleagues but it was only partially successful. In 1931, the Navy acknowledged the right of the Army air arm to employ its land-based bombers out to sea for coastal defense without, however, diminishing its own efforts in that task from its land-based Naval air stations or its sea-based carrier force. Soon thereafter, even this acknowledgment was repudiated by the Navy. In 1934, the Baker Board, organized to investigate the conflicting claims of the services, shut the door on the airmen by reporting that³

The "air invasion of the United States" and "air defense of the United States" are conceptions of those who fail adequately to consider the effect of ocean barriers and other limitations. Aircraft in sufficient numbers to threaten serious damage can be brought against us only in conjunction with sea forces or with land forces which must be met with forces identical in nature and equally capable of prolonged effort.

As the twenties gave way to the thirties, advances in aviation technology closed the performance gap between the bomber and fighter that had existed during the late war. Thus, the B-10 bomber of the early thirties had a service ceiling of 24,400 feet compared to 7,700 feet for the MB-2 bomber of the early twenties. The latter's maximum speed of 98 miles an hour was superseded by the 213 mph speed of the B-10. The normal bomb load had progressed from 1,040 to 2,260 lbs.⁴

The dramatic improvement in bomber technology reinforced the conviction among military airmen that the true role of air power was offensive. At times their enthusiasm pushed that conviction to the limits of credibility, as when the Chief of the Air Corps, Major General Oscar Westover, stated that "no known agency can frustrate the accomplishment of a bombardment mission."⁵

Although the advocates of bombardment doctrine were in the saddle in the early thirties, there were some military airmen who took up the cause of fighter aircraft.

The place where doctrine and tactics were most articulated in the Air Corps was in the Air Corps Tactical School at Maxwell Air Force Base, Alabama. There, the pursuit section was headed by Captain Claire Lee Chennault. A daredevil flyer and enthusiastic advocate of pursuit aviation, Chennault questioned the prevailing doctrine that a bomber attack could not be stopped by pursuit. Chennault lost no opportunity to rebut such claims in the classroom or outside. His problem was difficult. Without knowing where an airborne bomber or formation of bombers was, it was impossible to place defending fighters on the ground or in the air with sufficient precision to enable them to make a proper interception. When it was considered that the fighter enjoyed only a very small speed advantage, if any, over a bomber, the difficulties in the way of interception by pursuit became almost insurmountable.

Chennault's solution to the problem was early warning. In the early 1930s, the detection of aircraft by mechanical devices had made little or no headway since World War I. Research was continuous, largely as a result of efforts by the Signal Corps at its research laboratory at Fort Monmouth, New Jersey, to provide mechanical target acquisition for anti-aircraft artillery, but the necessary breakthrough had not been made. In view of the still

primitive state of the art of mechanical early warning, Chennault had no recourse but to rely upon the classic procedure utilized by most major participants of World War I--the employment of ground observers.

Utilizing data drawn from an Air Corps-antiaircraft artillery exercise held at Fort Knox, Kentucky, in 1933, Chennault prepared a pamphlet entitled, "The Role of Defensive Pursuit", in which he avowed that with early warning provided by a military-manned system of observers, pursuit could efficiently intercept enemy bombers enroute to the target. Chennault's manual was not officially adopted by the Air Corps Tactical School and though he continued to advocate the cause of pursuit aviation, his cause made little headway either at the Tactical School or at Air Corps headquarters.

Nevertheless, pursuit aviation, and consequently, air defense, experienced a revival. Significant was the creation in 1935 of the GHQ Air Force. This organization represented the aims of air power enthusiasts like Billy Mitchell. The GHQ Air Force, though still subordinate to the War Department general staff, represented a victory for those who sought to integrate all combat aircraft under one air commander. By 1935, the deteriorating situation in Europe, the growth of long-range aviation technology, and

the unremitting campaign in behalf of air power, had produced official and public acknowledgment of Air Corps demands for a larger role in warfare. A green light was given to the Air Corps for the development of the long sought bomber.

Now that they had obtained this desired objective, bomber advocates were content to share defense doctrine with pursuit. In GHQ Air Force's first statement of mission, a doctrinal niche was found for both bomber and fighter. Military aviation was to operate both as a striking force against enemy targets far beyond the range of other land-based weapons, and provide the necessary close-in air defense of the most vulnerable and important points in the United States.⁶

With the establishment of the GHQ Air Force, a reappraisal of Army defense plans became necessary. Although the new Air Force was still subject to the authority of the Army general staff, it was free from the control of field commanders in operations taking place before the action was joined on the ground between opposing armies. Under the new circumstances, air combat tactics had to be reexamined and in May 1935, the War Department directed its Army commanders to prepare detailed plans for defense against an air attack.

The War Department guide lines were necessarily broad. The weapons of air defense were recognized as guns and airplanes, but, for the latter, the only advice given was that they were to be employed by the GHQ Air Force "in accordance with the development of the situation." Army commanders were directed to provide for an aircraft warning service during the period of an emergency, employing civilian spotters and using commercial communications.⁷

Thus, the mission of air defense was split between ground and air commanders, the former responsible for anti-aircraft artillery and the establishment of aircraft warning services, the latter responsible for deployment and operation of fighter aircraft.

Among the elements of air defense, the least familiar to those responsible for implementing the War Department's directive was the aircraft warning service. That was defined as including ground observers, or spotters, and the people who operated the filter centers and information centers that sifted and converted their observations to the tactical information upon which the air defense commanders were to make the decisions concerning employment of anti-aircraft artillery and fighter aircraft. Obviously, before firm plans could be proposed, additional

experience was required in the operation and recruitment of an aircraft warning service. While those concerned were satisfying their need for more information about aircraft warning services, the establishment of air defenses were delayed. In 1936, a crude exercise took place in which bombers radioed their positions to the defenders, who plotted the bomber courses--allowing pursuit to make timely interception. A more realistic test was held at Muroc, California, in 1937, confirming the feasibility of using civilians as observers and the value of commercial communications to alert pursuit and AAA. The most ambitious exercise before World War II was held at Fort Bragg, North Carolina, in 1938, again demonstrating that an aircraft warning net could provide invaluable aid to pursuit.

While the merits of an aircraft warning service were being confirmed and experience gained, the inevitable question arose as to which military agency should organize, equip and train the civilian volunteers. After the Muroc test, discussions on this subject produced divergent opinions. Among the agencies recommended were the Air Corps, the War Department itself, and the Signal Corps. Top Air Corps officials were not eager to assume responsibilities for the aircraft warning service. The question

remained unsolved until 1941, when the Air Corps was given the responsibility.

Fighter design was a relatively unknown art in the United States at the end of World War I--the war having been fought with French and British aircraft. American designers got their first good opportunity to enter the pursuit field in 1922, when the air service asked four manufacturers to design entries for the Pulitzer Trophy races of that year, hoping that one or more could be converted to military use. The competition was won by the Curtiss biplane at an average speed of 205.8 miles per hour, establishing a pattern for the design of American pursuit aircraft for the following decade. Production aircraft of this era--the Curtiss PW-8, P-1, and P-6; and the Boeing PW-9 and P-12--were all derived from the Curtiss racer. The next major breakthrough in fighter design came in 1932, when Boeing successfully developed an all-metal monoplane that became known as the P-26. In the development of pursuit aircraft during the period between wars, the most notable characteristic, however, was the continual improvement of power plants. Successive fighters flew higher and faster as a result. By 1939, the Air Corps possessed two relatively modern pursuit aircraft--the P-35, designed by Alexander de Seversky and the Curtiss P-36. Both were all-metal monoplanes capable of speeds of about 300 miles per hour and altitudes of about 30,000 feet. On the drawing

boards before the war in Europe began, were aircraft of more promising performance. Among these were the Lockheed P-38, the Bell P-39, and the Curtiss P-40.

As the 30s came to an end, the improvements in pursuit technology caused a revision to take place gradually in doctrine concerning pursuit tactics. Belittled in the early 30s because of the inadequate performance of pursuit in the face of improved bomber performance, by the closing years of the decade pursuit was gaining more adherents and bomber enthusiasts were toning down their claims of bomber invincibility. At the Air Corps Tactical School, the fountainhead of Air Force doctrine, efforts were being made to place pursuit instruction on an equal-time basis with that of bombardment theory and practice.

While the aircraft warning service was being whipped into shape and fighter aviation was making rapid progress and gaining influential supporters, an additional means of early warning came into being with the development of radar. Though much research in aircraft detection had been conducted by the Signal Corps during and after World War I, principally in searchlighting and in sound and thermal detection, none of these techniques offered much promise. During the Fort Knox exercise in 1933, the searchlight and the "ear trumpet" were still the primary tools of early warning.

The solution to the problem was eventually found in the technique of radiolocation. Study of this principle began at the Naval Research Laboratory in 1930, when the Doppler technique was successfully demonstrated. Aircraft were detected when they penetrated a radio-wave barrier between transmitter and receiver, but the technique did not reveal the altitude or location of the aircraft. Since the Signal Corps was interested in the problem of detection for anti-aircraft needs, the Doppler principle was not pursued further. The Signal Corps turned with higher hopes to short-pulse emission of radio waves. Pressure on the War Department for research authorization and funds was successful and a first priority for anti-aircraft detection research was set up by the War Department in fiscal year 1937.

In December 1936, using short-pulse techniques, the Signal Corps succeeded in tracking an aircraft to a distance of seven miles and, in May 1937, the prototype of the short-range radiolocator for controlling searchlights was demonstrated. The Air Corps saw the value of the latter device for early warning and requested the Signal Corps to develop a similar set with a range of 120 miles. Development was successful and service trials of the first early warning set, the SCR-270, were held late in 1939--the device being officially adopted in May 1940.

Thus, by 1939, the ingredients for an effective air defense were coming into being. Much progress had been

made in the development of fighter aircraft, an aircraft warning system had been demonstrated as feasible, and steps had been taken to incorporate both in Army plans for air defense. Radar was in existence and the Signal Corps was working on the invention for both antiaircraft and early warning of pursuit. Much remained to be done; the aircraft warning service needed refinement and training, the radars had to be manufactured and deployed, pursuit pilots had to be trained in the tactics of ground-to-air teamwork and all of the ingredients had to be integrated into a smoothly functioning system.

Nevertheless, military planners did not envisage a large-scale bomber assault on the continental United States. In spite of a deteriorating world situation, War Department planners were of the opinion that precipitous preparations for air defense were unnecessary. As General George C. Marshall testified before the Senate in May 1940:⁸

What is necessary for the defense of London is not necessary for the defense of New York, Boston, or Washington. Those cities can be raided. . .but. . . continuous attack would not be practicable unless we permitted the establishment of air bases in close proximity to the United States.

Germany's aggression in Austria and her open and rapid rearmament endowed General Marshall's fear of the establishment of any enemy bases close to American borders with more than academic significance. In preparations to prevent acquisition of German bases in Central and South

America, a leading role was allocated by the War Department to the Air Force with a consequent stimulation to the procurement of additional bombers.

Continued German expansion in 1939, and the Luftwaffe's annihilation of the Polish air force on the ground in September 1939, caused Major General H. H. Arnold, Chief of the Air Corps, to recommend to the War Department the establishment of special agencies in each of the four continental army areas to operate air defense systems to be established there. But, since implementation of air defense plans was a slow process, the War Department agreed only to create an organization to study in detail the air defense needs of the nation prior to implementation of the air defense systems. On 26 February 1940, the Air Defense Command was established, a unit composed of Air Corps, Coast Artillery, and Signal Corps personnel. It was based at Mitchel Field, New York, under the commanding general of the First Army. Its mission was to study the entire air defense problem, embracing "the development of a system of unified air defense of an area and the determination of tasks within the capabilities of the various combinations of tactical units which might be assembled for the air defense of cities, continental bases, manufacturing and industrial areas, or armies in the field."⁹

In the little more than one year in which this first ADC existed, it was involved in an extraordinary range of

tasks, characterized by intensive activity for its small staff of ten officers. In August 1940, it was assigned the task of air defense in the First Army maneuvers in upper New York State, and in January 1941, it conducted the largest air defense test held in the United States up to that time. In both exercises, the new SCR-270 radars were employed, and radar plots and observer reports were relayed to information centers which alerted and vectored pursuit planes via high-frequency ground-to-air radio.

Both exercises were deemed successful although the high-frequency radio was sadly deficient in range and clarity. The civilian volunteers who operated the information center plotting boards performed well, but ADC was disappointed in the performance of the spotters, though it was realized that they did not have the benefit of adequate training in reporting or in recognizing aircraft.

Participation in these exercises was invaluable to the Air Defense Command staff in developing tactics and procedures, but at least as beneficial was the experience of some of its staff members in observing at first hand the Battle of Britain during the fall of 1940. The organization of British air defense under the RAF Fighter Command made a strong and favorable impression on ADC's commander, Major General James E. Chaney. His report to the War Department sang the praises of British organization, techniques, and equipment.

ADC's concentrated experience, by early 1941 caused General Chaney to arrive at certain very definite conclusions about the air defense needs of the nation. Although greatly impressed by the British integrated system, he believed that an identical system was impracticable for the United States. Because of the great geographical areas involved, a homogeneous, nationwide air defense system was unnecessary. More realistic, in his opinion, was a number of self-sufficient and tailor-made air defense networks to service the needs of "strategic air areas." ¹¹

Though the techniques of air defense operations had been fairly well established by the New York exercises and the observation of the Battle of Britain, ADC was seriously concerned over the inadequacy of air defense organization and the allocation of responsibilities. In Chaney's opinion, the British system of placing full responsibility and authority in the hands of the commander of pursuit aviation was the proper one, and he stressed to General Arnold the need for drastic reorganization of the domestic air force to that end.

The matter of whether the air defense commander should be a ground forces officer or an airman constituted a major stumbling block to a rapid solution of the organizational problem. Discussions between airmen and ground forces officers were stalemated until General Marshall, impressed by the glowing reports from Britain, settled the issue in favor of the airmen.

The mission of air defense was now allocated to the GHQ Air Force. To carry out its new tasks, it was given four continental air forces, each of which contained an Interceptor Command, charged with the air defense of its area. Thus, the British organization was approximated. The Interceptor Commands were given the job of organizing and operating the aircraft warning services, including the siting and operation of the radar stations, and the operational control of such AAA units as were specifically assigned the mission of local air defense.

Staffing the new Interceptor Commands with air defense specialists was a difficult matter in view of the acute shortage of experienced personnel. The sole repository of such experience was the Air Defense Command. Anticipating the shortage, ADC conducted an intensive course in air defense at Mitchel Field, during March and April 1941, for 63 officers, most of them Air Corps personnel. The graduates were assigned to the staffs of the new Interceptor Commands. The work of ADC being virtually completed, in June 1941 it was discontinued and most of its personnel assigned to the First Interceptor Command. The doctrines established by ADC were to guide air defense operations for the remainder of the wartime era.

The participation of the United States in World War II resulted in a major expansion of air defense facilities. Ninety-five radar stations were eventually completed; 65 on

the Pacific coast and 30 on the Atlantic, although about 75 was the maximum number in operation at any one time. The radars in use during the war were the SCR-270 (mobile) and the SCR-271 (fixed); both providing data only as to the direction and distance of approaching planes. They were vulnerable to jamming and suffered from poor site selection and lack of calibration. During 1943 Ground Control Intercept (GCI) was added for close-in coverage of tracking and for controlling fighters from the ground.

The radar network along the West Coast consisted of 10 stations at the end of December, 1941. A program calling for 72 stations had been prepared by the Fourth Interceptor Command to provide overlapping coverage with special emphasis on the defense of Seattle, San Francisco, and the Los Angeles--San Diego area. Eventually, 65 of these were completed, though final operational configuration consisted of 38 by June, 1943. Both Canada and Mexico cooperated in securing the flank approaches by allowing stations to be set up in their territory.

Along the East Coast, the First Fighter Command¹² programmed 15 stations covering the coast from Maine to Virginia. These were completed by the end of August, 1942. An additional 15 stations from North Carolina to the tip of Florida were completed late in 1943.

The pioneer work of ADC in evoking a ground observer network in the two air defense exercises of 1940-1941 stood

the First Fighter Command in good stead in the Northeast. By February, 1942, 9,000 observation posts had been set up along the East Coast. An additional 2,400 posts along the West Coast, and 3,000 along the Gulf Coast, gave a total of 14,000 posts with an estimated one to one and a half million civilian volunteers enrolled as observers and filter center operators. Deficiencies in the training of the observers, their inability to recognize the types of aircraft and a lack of standard procedures in reporting, often rendered their work useless. Congestion of the plotting boards as a result of indiscriminate reporting of plane movements was also noted. A filtering process was provided by setting up filter centers which relayed their information to a network of information centers (which also received plots directly from the radar stations). The information centers linked together all the elements of the air defense system, alerting air units, AA batteries and civilian defense agencies.¹³

The maximum size of the information net during the war was 15 information centers along both coasts and four standby centers along the Gulf Coast.

Fighter wings, subordinate to the fighter commands, were represented at the information centers by controllers who alerted the fighter units, and by intercept officers who directed fighters in the air. Ground-to-air communication was achieved through high-frequency (HF) radio stations. In mid-1942, the inadequate HF was replaced by Very High

Frequency (VHF). Information centers were gradually replaced by fighter control centers located strategically along both coasts, with the first center beginning operations in the summer of 1944.¹⁴

During the early part of the war, the shortage of fighter planes seriously crippled the air defense effort. For example, in mid-January 1942, there were only 12 pursuit planes available for the defense of New York City. Most available planes were concentrated along the West Coast to meet what was considered a more serious threat by Japan. A typical alert order on the East Coast early in 1942 called for one four-plane flight per squadron to be kept on alert from dawn to dusk. Alerts were seriously distracted by the need for training. Lack of all-weather aircraft made the success of interception at night, or in inclement weather, highly doubtful.

AAA underwent drastic changes during the war. Whereas the Coast Artillery had trained scattered AAA units in 1941, after Pearl Harbor, unified AAA commands emerged on both coasts. The new AAA commands were put under the operational control of the interceptor commands immediately after the attack on Pearl Harbor and subdivided into regional commands to correspond with the air defense regions.

Effective coordination of guns and planes proved to be a delicate matter. The tactical rule in the spring of 1942 was that AAA could open fire on a target thought to be

hostile, except where the controller ordered gunfire withheld in order to protect friendly planes. In the opinion of the fighter commands, this was not sufficient protection for friendly aircraft. In September, 1942, the First Interceptor Command was recognized as coordinator of all air defense operations, including AAA. On the West Coast, on 1 May 1944, the War Department placed the Fourth AAA Command under the Fourth Air Force for administration as well as operational control, a move which aroused considerable opposition among ground forces personnel. That experiment continued until the end of the war. By 1943, Army doctrine had accepted the tenet that control of AAA belonged to the air defense commander, but combat readiness of AAA was low because of inadequate training, and shortage of weapons hindered the deployment of AAA. Radars for AAA were also in very short supply. Barrage balloons were employed in the early years of the war, but were discontinued in August 1943.

The elaborate air defense system, fortunately, never had to operate against a major air attack. Until the Battle of Midway, air defenses were on a high degree of alert; after Midway, those who favored a calculated risk obtained the upper hand and the defenses were progressively de-emphasized. In April, 1943, coast defenses were reduced in degree of alert. Finally, in September 1943, the First and Fourth Air Forces were relieved from their primary air defense

mission. All observation posts and filter centers were put on a standby status. In October 1943, the Joint Chiefs of Staff reduced the coasts to a modified category "A" ("probably free from attack, but defenses to be retained for political reasons"). Under this category, air defenses remained organized, but for operation at intervals only. In November, Pacific coast radars and all those on the east coast south of Kitty Hawk, North Carolina, ceased 24-hour operations. In April 1944, the Joint Chiefs of Staff dissolved the ground observer posts and filter centers, reduced the radar net, and transferred operations from the information centers to a few fighter control centers. Fighter wings were disbanded during June and July 1944. By war's end, there were three control centers on the East Coast receiving reports from nine radar stations, while on the West Coast 22 radars reported to three control centers.

NOTES

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3. "Organization of Military Aeronautics, 1907-1935," (AAF Historical Study No. 25, 1944) p. 15.
4. W.F. Craven and J.L. Cate (eds.) The Army Air Forces in World War II, (Chicago, 1948) I, 40.
5. Craven and Cate, I, 65.
6. Craven and Cate, I, 68.
7. Ltr, AG to First Army, "Antiaircraft Defense of the Continental U.S.," 21 May 1935 (Appendix I to History of the Air Defense Command, 26 Feb 1940-2 Jun 1941).
8. Mark S. Watson, Chief of Staff: Prewar Plans and Preparations, (U.S. Army in World War II, Washington, 1950) pp. 44-45.
9. History of ADC, 26 Feb 1940-2 Jun 1941, ch. 1.
10. Gen Chaney to WD, "Observations on Trip to England," 15 Dec 1940 (Appendix XXX to History of ADC, 26 Feb-2 Jun 1941).
11. History of ADC, 26 Feb 1940-2 Jun 1941, p. 61ff.
12. The interceptor commands were redesignated fighter commands in May 1942 when the word "fighter" was also substituted for "pursuit".
13. Denys Volan, The History of the Ground Observer Corps (ADC Historical Study No. 36) ch. 3.
14. P. Alan Bliss, "Air Defense of the Continental United States, 1935-45," (MS in USAF Historical Research Division, Maxwell AFB, Ala.) Very thorough account of air defense operations in World War II.