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THE COMBINED BOMBER OFFENSIVE

1 JANUARY TO 6 JUNE 1944

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FOREWORD

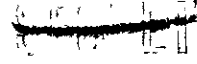
This study was prepared during the winter and spring of 1946 by Capt. Joe L. Norris. It is preceded by AAF Reference Histories: No. 18, The Early Operations of the Eighth Air Force and the Origins of the Combined Bomber Offensive, and No. 19, The Combined Bomber Offensive April Through December 1943, and it continues the operational history of the strategic bombing of Europe to 6 June 1944. Later studies will deal with the period between the Normandy D-day and V-E Day.

During the months between 1 January and 6 June 1944, the period treated in this monograph, the Combined Bomber Offensive concerned itself to a great extent with defeating the German Air Force and with securing Allied air supremacy over Europe in preparation for the invasion of the Continent. Emphasis in the present study has therefore been placed upon operations under POINTBLANK. Related subjects, such as planning, training, problems of administration and supply, and tactical operations in support of ground troops, have been discussed only insofar as they are necessary for an understanding of the strategic bombing operations themselves. There has also been no attempt here to give the full story of the part played by the Royal Air Force, although that organization was an important component in the Allied air war against Germany.

The study is subject to revision, and additional information or suggested corrections will be welcomed.

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THE COMBINED BOMBER OFFENSIVE

1 January to 6 June 1944

(Short Title: AAFRH-22)

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The Combined Bomber Offensive

1 January to 6 June 1944

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Chapter I

INTRODUCTION

One of the principles involved in strategic bombing--the destruction of the enemy's ability to wage war by attacking his home front--is not a new one. Before the advent of the airplane, attempts to accomplish this purpose were usually in the form of sabotage, fomentation of strikes and general unrest, blockade, and certain military operations. The Northern blockade of Southern ports in our own Civil War, Sherman's march to the sea, and Sheridan's devastation of the rich Shenandoah Valley had as their ultimate goal, at least in part, the denial to the Confederate government of the ability to maintain an efficient army in the field. In World War I the beginnings of strategic bombardment were made, but results were inconclusive and possibilities limited by the still crude development of the airplane; and the combatants continued to depend upon sabotage, blockade, and ground operations in their attack on the enemy's war potential.

In the years intervening between the two world Wars the idea of strategic bombing grew in spite of opposition. There were two schools of thought as to how the air arm should be employed. One was that the air forces should serve as a support for ground armies--in other words, act as a purely tactical organization. The other school believed not only that the air forces had value from a tactical standpoint but that they could also function as strategic forces, hitting far beyond the immediate battle

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lines and strangling those elements which made it possible for a ground army to fight successfully. The Luftwaffe was primarily designed as a supporting unit and even the Russians seemed to place their faith more in massed troops and artillery than in the heavy bomber.¹ In the United States and England, on the other hand, the possibilities of strategic bombardment were kept alive by determined airmen, although not without creating some bitterness and unpleasant situations.

There were numerous and difficult problems to be solved if strategic bombardment was to be successful. There were problems of plane design, types and fuzing of bomb loads, protection of bombers against enemy action, supply and maintenance, training, target system and weather intelligence, and numerous other questions. Very few, if any, were completely solved before 1959, and even until the progress of the war constant experimentation resulted in changes of plans, ideas, and programs. There were also differences in opinion among exponents of strategic bombardment, and numerous were the arguments, pro and con, on the relative merits of methods and target systems. For example, the British held to night area bombing while the United States advocated daylight precision operations. There were disputes over target priorities, a case in point being the relative value of political or morale targets over industrial ones, or of transportation over oil. Fortunately, these divergencies of opinion were ironed out and satisfactory compromises reached.

Even after the acceptance of the principle of strategic bombing by the military leaders in the United States and England it was necessary to

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educate the public to it. It was hard for the people at home to realize that the war was being won when the communiqués told only of air attacks on this or that city. The average individual was accustomed to measuring the success of his country's arms in terms of territorial advances. As long as troops were massed and held in England he wondered if after all we were not just playing soldier. It was hard to understand that a thousand-plane strategic attack could have more significance than a ground battle involving a whole division of infantry and artillery. It was equally hard to realize that the aerial destruction of an industry might have the same results as capture by ground forces. Concern for the education of the public was evidenced by the American air staff in its attempts to get the proper perspective before the people. General Arnold felt, for example, that a better presentation of the effectiveness of our air war would result from publishing low-altitude oblique photographs of destroyed objectives.² These would thus give the American people a clear, graphic picture of the damage inflicted. At other times war correspondents were directed to explain more fully in their dispatches the importance of targets attacked. Failure to understand the necessity of hitting German installations wherever they might be often led to protests by certain specialized groups. People of foreign extraction, for example, often felt that attacks on their homeland, although it might be German-occupied, was in effect an attack against their nation. To counteract this impression war correspondents were again advised to high-light these operations as being directed only against the Germans and their military installations.³

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Despite all the problems inherent in strategic bombing and those which arose during the course of the program, the United States and England launched a combined air offensive in 1942 and ruthlessly continued it to the end of the war. After the failure of the Luftwaffe to win the Battle of Britain in 1940-41, Hitler gave up the idea of immediate invasion and conquest of England and turned his attention eastward toward Russia. He planned to keep England isolated by a submarine blockade and wait a more opportune time to bring the English people to their knees. At this time England, unable to stage an invasion of the Continent, was left with no alternative except to continue the war with her sea and air forces. The only ground fighting was in North Africa. Except for cooperating with the Royal Navy in the war against the U-boats at sea, the RAF operating out of the United Kingdom was left only with strategic targets. These it struck on a loose priority system, putting most of its weight of bombs on submarine construction and repair and other coastal targets.

Early plans of the United States envisaged a strategic bombing force stationed in England and cooperating with the RAF in the event that this country became involved in war. These plans were activated by the organization of the Eighth Air Force and its arrival in England in June 1942.⁴ The first bombing directives under which it operated were issued by the Commanding General of the U. S. Army in European Theater of Operations and in accordance with a bombing policy established by the British Air Ministry. The objectives were transportation, German Air Force (G.F) installations,⁵ and other military targets in the occupied countries of western Europe.

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This arrangement was not too satisfactory, however, because under it there was no clear-cut definition of the duties of the Eighth Bomber Command, and there developed a movement to have the heavy bombers join with the RAF in night bombing. If this should occur the American bombers would be diverted from their original purpose--that of daylight precision bombing. It was evident to the United States, therefore, that a more definite plan for strategic bombardment would have to be developed in order to utilize the full capabilities of the USAF and the RAF. This problem was debated at the Casablanca Conference, and after full consideration there was issued on 21 January 1943, the so-called "Casablanca Directive" of the Combined Chiefs of Staff (CCS) which was to govern the operations of the Eighth and RAF Bomber Commands. The primary object to be accomplished by these two forces was "the progressive destruction and dislocation of the German military, industrial and economic system, and the undermining of the morale of the German people to a point where their capacity for armed resistance is fatally weakened."⁶

In December 1942, prior to the Casablanca Conference, Arnold, who was anxious to have a precise plan and program of action for strategic bombing, directed that the group of operations analysts under JC/AS, Management Control prepare for him a study on the "rate of progressive deterioration that should be anticipated in the German war effort as a result of the increasing air operations" and give as accurate an estimate as possible as to the date when this deterioration would have progressed to a point permitting a successful invasion of western Europe.⁷

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In compliance with this directive, the Committee of Operations Analysts submitted on 8 March 1943 a comprehensive report on Axis industry. No attempt was made to give priority ratings to the targets, but the committee did conclude that it was better to bring about a high degree of destruction in a few really essential industries than to dissipate bombing efforts over a large number of targets which would result only in small damage to many industries. In the selection of target priorities, the committee recommended the following factors for consideration: (1) essentialness of the product to German war economy; (2) current and capacity production and stocks on hand; (3) enemy requirements for various degrees of activity; (4) possible substitutes; (5) recuperative powers of the industry; (6) time lag until destruction of the industry would be felt. ⁸ Information concerning the above factors could, of course, be obtained only through careful intelligence. It was also impossible for the committee to prophesy when enemy strength would be so reduced through aerial bombardment that an invasion of the Continent could be successfully undertaken. ⁹

Nineteen vital industries were selected, however, which if destroyed would, in the opinion of the analysts, stagnate the German war machine. These industries and the number of targets involved in each were:

<u>Industry</u>	<u>No. of Targets</u>
Single-engine fighter aircraft	22
Ball bearings	10
Petroleum products	39
Grinding wheels and crude abrasives	10
Nonferrous metals	13
Synthetic rubber and rubber tires	12
Submarine construction plants and bases	27
Military transport vehicles	7
Transportation	No specific number
Coking plants	189

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<u>Industry</u>	<u>No. of Targets</u>
Iron and steel works	14
Machine tools	12
Electric power	55
Electrical equipment	16
Optical precision instruments	3
Chemicals	Not vulnerable to air attack
Food	21
Nitrogen	21
AA and antitank artillery	Not vulnerable to air attack

The effects of destruction would vary, of course, and in some cases the total number of targets indicated would not have to be destroyed in order to disable the enemy. The destruction of the 22 single-engine fighter aircraft factories would, it was estimated, virtually eliminate single-engine fighter operations after three months, and recuperation would be slow. Effective attacks on only three of the 10 ball-bearing plants, those at Schweinfurt, would reduce Axis production 42 per cent with a time lag of only one month before affecting the war effort. Likewise, the destruction of 13 hydrogenation plants would eliminate the most vital 25 per cent of German petroleum resources, and with the knocking out of 12 Floesti refineries this figure would be raised to 90 per cent. The effect would be felt within three to four months.

It must be remembered that the importance of the afore-mentioned targets and the estimated effects of bombardment were based on conjectures and that later developments proved some of them ill-founded. It is interesting to note that twin-engine fighters and bombers were not included in the list, although before D-day arrived it was found necessary to attack these industries as well as the single-engine ones. Nor were aero-engines included

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(although they were later added to the target lists) and recent surveys show that heavy attacks on these plants might have been highly profitable. It was also discovered that destruction of more than 50 per cent of ball-bearing production did not produce the air results expected. A similar discovery was made regarding the attacks on submarine bases. For a variety of reasons the campaign against U-boats was more successful at sea than at their pens. Damage to machine tools was later found to be negligible. The statement that the chemical industry was not vulnerable to air bombardment because of its dispersal was also proved false, and the U. S. Strategic Bombing Survey has indicated that more thorough bombing of such plants would have paid dividends. In general, the committee misjudged German ability to recuperate, and it did not take into consideration the possible development of plant dispersal or the strategy of moving plants underground. Nevertheless, at the time the report was made the findings were probably based on the best information available, and very few men are blessed with the ability to foresee the future accurately.

Regardless of its faults this report formed the basis for selecting target systems in the first part of the war. In May 1942, the Combined Chiefs of Staff (CCS) selected target systems with a total of 70 precision targets from those proposed by the Committee of Operations Analysts. The air target systems were: (1) submarine construction yards and bases; (2) aircraft industry; (3) ball bearings; (4) oil; (5) synthetic rubber; and (6) military transport vehicles. ¹¹ With the acceptance of these systems there was also an attempt to integrate the efforts of the U. S. Army Air

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Forces (USAF) and the Royal Air Force (RAF). The striking power of the latter was designed to destroy material facilities and at the same time undermine the German working man's morale through area bombing. The American air forces were intended for destruction of specific targets essential to maintaining the war economy. The two programs were complementary and the best effective results could be obtained by coordinating their efforts. The method to be employed was simply to follow up USAF daylight precision bombing with RAF night area attacks on cities associated with these targets. This amounted to a round-the-clock bombing program. It required practically no change in RAF plans, since the American targets were located in most cases in regions already marked for mass bombing by the English. So, in general, the directives for the Combined Bomber Offensive (CBO) assigned specific key industries to the USAF and the task of destroying German cities, dispossessing the working population, and breaking morale to the RAF.

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Chapter II

COMBINED BOMBER OFFENSIVE PLANS, MAY-JUNE 1944

The pre-invasion operation for the strategic air forces under the Combined Bomber Offensive was given the code name of POINTBLANK, and it was intended to prepare the way for OVERLORD, code name for the cross-Channel invasion of France. In order to assure the success of OVERLORD it was first necessary to eliminate the threat offered by the GAF. The Germans, realizing at the outset of the ^{Allied bombing offensive} that their entire war economy was threatened, began an expanded fighter-production program in 1942 to ward off the Allied bombers and protect their industries. They had succeeded so well by the spring of 1943 that the CCS was led to state in May that "if the growth of the German fighter strength is not arrested quickly, it may become literally impossible to carry out the destruction planned and thus to create the conditions necessary for ultimate decisive action by our combined forces on the Continent." Thus it became necessary to revise the target priorities and make the destruction of the GAF the first, or intermediate, objective of the CBO. The counter-air program of the Allies mounted in fury in the last half of 1943 and ended in a blaze of glory in February in what was known as the "Big Week." Thereafter the campaign tapered off and became largely a policing job which left the strategic forces ^{free} to turn their attention to other POINTBLANK target systems.

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There was, however, no specific definition of subsequent operations after this primary objective had been attained, and therefore Gen. Carl Spaatz, Commanding General of the United States Strategic Air Forces in Europe (USSTAF), felt that further planning was necessary. Accordingly, on 12 February 1944, Maj. Gen. F. L. Anderson, Deputy Commander for Operations, USSTAF, appointed a Special Planning Committee composed of Cols. C. G. Williamson, R. D. Hughes, C. P. Cabell, and J. J. Nazarro and Lt. Cols. F. P. Bender and W. J. Wrigglesworth "to prepare plans and supporting studies for operations to follow after accomplishment of the primary objective of the Combined Bomber Offensive . . . and for operations of the strategic air forces in the direct support of OVERLORD." The final report, due Headquarters, USSTAF on 1 March 1944, was to include the following subjects: (1) summary of the status of the CBO; (2) possible target systems and operational policies; (3) possibilities of heavy-bomber participation in direct support of OVERLORD; and (4) plans supplementing the CBO plan.

The report, entitled "Plan for the Completion of the Combined Bomber Offensive," agreed that the GAF fighter production and ball-bearing industries had been reduced to a satisfactory degree and that subsequent attacks on them could be ancillary to other operations. It would not be necessary, therefore, to give these industries the same high priority as before. The only factors then remaining which could prevent the successful accomplishment of the CBO were adverse weather, misapplication of effort by selecting unprofitable target systems, or the continuance of

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attacks on targets beyond the point where the law of diminishing returns might set in.⁴ Even adverse weather could be, and was in time, circumvented by development of blind bombing and improved navigational aids.

In the light of the new conditions the committee recommended five target systems for future attack. In order of priority they were:

1. Petroleum industry, with special emphasis on gasoline production
2. Fighter aircraft and ball-bearing industries
3. Rubber production
4. Bomber production
5. Transportation centers in Germany as [substitute] targets when weather prohibited precision attacks on the first four priorities

This program, which would remain in effect until OVERLORD, would give maximum support to the invasion by: (1) assuring air supremacy on D-day; (2) confronting the German Army with a growing scarcity of fuel on all fronts and thus affecting adversely the redistribution of strategic ground reserves at the time of the invasion and afterwards; (3) further restricting essential military production; and (4) providing required direct support.⁵

To determine these suggested target priorities, the committee had studied the essentiality of each industry to the over-all enemy war economy and the specific effect its destruction would have on German armed might. Bombing for morale purposes in order to bring about a collapse on the home front was not considered profitable for the American air forces. "Neither fear, war weariness, nor the prospect of impoverishment," said the committee, "is likely to be sufficient to enable impotent political and social groups to overthrow the efficient, terroristic Nazi social controls and bring

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about Balkans.⁶

This view was shared not only by the top men in USSTAF but also by high Army planners on this side of the Atlantic. Maj. Gen. F. S. Fairchild, of the office of the CCB, told Gen. Anderson that the war must be won in the minds of the German high Command and not in the minds of the German people, since the latter could not take effective action. The objective, said General Fairchild, still must be to deny the enemy armed forces the means to fight.⁷ For this reason, therefore, the committee concluded that the "morale" bombing of German towns by daylight should be resorted to only when prolonged periods of bad weather prohibited precision attacks on objectives of direct military importance. When such conditions did occur, industrial cities were to be preferred, and when possible the manufacturing areas of such places should be considered as more advantageous targets than residential zones. Likewise, it was not believed that administrative or commercial sections of cities like Berlin, Munich, or Vienna should be treated as exceptions to this principle.⁸

In addition to the target priorities, a geographical division of effort for the Eighth and Fifteenth Air Forces was suggested. Areas marked for attack by the Eighth Air Force consisted of most of Germany, while the Fifteenth was assigned southern Germany along a line from Munich to Vienna, the remainder of Austria, Czechoslovakia, Hungary, and the Balkans.⁹

According to the committee the target system which would offer the most effective and immediate results was oil, with emphasis on gasoline. The supremacy over the G.F. which the Allied air arm had secured by 1 March 1944

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would now allow profitable attacks on this industry and both the military effort and morale of the German High Command could be critically influenced. "No other target system," read the report, "holds such great promise for hastening German defeat."¹⁰ It was estimated that 90 per cent of the Axis synthetic and refinery output was accounted for by 23 synthetic plants and 31 refineries, with a total production of approximately 7,000,000 tons annually. The complete destruction of these plants would reduce supply to near zero within six months after 1 March 1944. Eighty per cent of synthetic production and over 60 per cent of readily usable refining capacity was located in 14 synthetic plants and 13 refineries. These installations also supplied about 90 per cent of Axis fuel. The loss of this much motor fuel would have dire effects on the mobility of the German Army on the Western, Russian, Italian, Balkan, and Norwegian Fronts, and air opposition of the Luftwaffe to the USSR and RAF would cease when the already small stocks were used up. The will to resist on the part of the German High Command, the Wehrmacht, and political and industrial leaders also would be weakened, although the effect on the German people themselves would be less serious. Nevertheless, the denial of oil for things other than battle-front purposes, such as industry and agriculture, would have additional value by imposing severe restriction on the general economy.¹¹

In order to accomplish these results it would be necessary, of course, to destroy the unused excess capacity of the refineries as well as the capacity in operation. By and large the potential capacity of the 31 major refineries was about one and one-half times as large as their current output.

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In case of extreme necessity, the Germans could resort to the additional capacity of plants in France, Holland, and Italy, although these were inconveniently located and many of them were coastal refineries and within easy reach of Allied bombers. In addition, there were also numerous refineries in the Balkans, Poland, Austria, and Germany. After considerable study the committee recommended immediate attack on the 23 plants producing 90 per cent of the synthetic output and 13 of the 31 crude oil refineries.¹²

In second priority were placed the fighter aircraft and ball-bearing industries, although there were some men who believed these should have been retained in first place. It was believed in USSTAF, however, that by continuing attacks on fighter factories on the same scale as previously there was danger of wasted efforts since the point of diminishing returns had been reached. It was possible now to maintain air supremacy by a policy of policing, and for the most part future attacks on the fighter plants could be incidental to attacks on other systems of German industry which permitted the enemy to wage war.¹³ The attrition of the remaining GAF could be accomplished by attacking such vital targets that the Germans would be forced to protect them with every flyable airplane.¹⁴

The remaining targets for the aircraft industry consisted of 19 fighter and seven bomber factories. For the fighter aircraft they were divided into three categories: (1) prime targets, as yet undamaged; (2) secondary targets, as yet undamaged; and (3) prime targets, partially or wholly out of action but in need of policing. The first category was selected for early attack and comprised the Focke-Wulf factories at Krzesinki,

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Table 1
SYNTHETIC OIL PLANTS SELECTED FOR ATTACK**

Plant	Annual Output (In thousands of tons)	% of Total Synthetic Output	% of Total Synthetic and Refining Output
*Duis	450	10	5
*Leuna	320	9	2
*Pöhlitz	310	9	1
*Eichehammer South	320	8	1
*Gelsenkirchen Nordstern	250	7	3
*Scholven-1 uer	350	6	3
*Schwarzeiche	350	5	2
*Pöhlitz West	240	5	2
*Böhlen Pöhlitz	280	5	2
*Mgdeburg	300	5	2
*Eichehammer North	270	4	2
*Weseling	220	3	1
*Lerberg	190	3	1
*Castrop-Rauxel	150	2	1
Lützkendorf	150	2	1
Lützkendorf Süd	150	2	1
Holton	150	2	1
Krupp (Hans Michel)	150	2	1
Wellein Bottrop	120	2	1
Beschowitz	110	2	1
Wesener Verein	100	2	1
Weserau	90	1	1
Mühlau (Barnes)	50	1	-
Unknown plants	200	5	1
Total	6,200	100	45

*Selected for immediate attack.

**Plan for the completion of the Combined Border Offensive, 5 Apr. 44,
Sup. No. 10 and 11.

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Table 2

CRUDE OIL REFINERIES SELECTED AS PRIMARY TARGETS**

Refinery	Annual Capacity (In thousands of tons)	Activity	% of Total Usable Capacity Suitably Located
*Litra Romana, Floesti	1750	capacity operation	14
*Concordia Vega, Floesti	1300	major portion in use	10
*Romana Americana, Floesti	1100	capacity operation	9
*Phoenix Unirea, Floesti	800	major portion in use	6
*Harburg, Germany	550	capacity operation	4
*Petrol Slock, Floesti	550	major portion in use	4
*Lobau, Austria	350	capacity operation	3
*Hannover, Germany (Lisburg)	300	capacity operation	2
*Snell, Budapest, Hungary	220	capacity operation	2
*Dacia Romana, Rumania	220	major portion in use	2
*Prahova Petrolul, Bucharest	200	major portion in use	2
Perdubice, Czechoslovakia	180	capacity operation	1
Almasfuzito, Hungary	170	capacity operation	1
*Bratislava	150	capacity operation	1
Columbia Aquila, Floesti	135	capacity operation	1
Floridsdorf, Austria	100	capacity operation	1
Bremen Oslebshausen, Germany	100	capacity operation	1
Caprag, Yugoslavia	120	major portion in use	1
Merkwiller, Pechelbronn, France	130	major portion in use	1
Drohobycz (Polmin), Poland	120	major portion in use	1
Magyar, Budapest, Hungary	90	capacity operation	1
Drohobycz, Galicia, Poland	90	major portion in use	1
Trzebinja, Poland	90	major portion in use	1
Czechowice (Dziedzice), Poland	90	major portion in use	1
Kolin	80	capacity operation for lubricating oil, not crude	1
Kegran, Austria	75	capacity operation	1
Speranta, Floesti	400	unknown	3
*Eurotank, Hamburg, Germany	400	unknown	3
Xenia, Floesti	260	unknown	2
Redeventza, Rumania	230	unknown	2
Lumina Petrolina, Rumania	140	unknown	1
Total	10,490		45

* Selected for immediate attack.

** Plan for the Completion of the Combined Bomber Offensive, 5 Mar 44, Sup. No. 10.

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Posen, Tutow, Marienburg, and Sorau; the Wiener Neustadt complex at Bad Vöslau and Fischamend Markt; and Duna Repulogepgyar at Budapest/Szigetszentmiklós. The second category targets, located at Schkeuditz, Halle, Gyor, and Brasov were to be attacked in the course of missions having other primary objectives. The third consisted of the Focke-Wulf plant at Oschersleben; the Erla at Leipzig/Wöckau and Leipzig/Abtnaundorf; the Junkers at Bernburg and Halberstadt; and the Fieseler at Kassel/Bettenhausen and Kassel/Waldau.¹⁵ Responsibility for the destruction and policing of these targets was divided between the Eighth and Fifteenth Air Forces. The latter was assigned Bad Vöslau, Fischamend, Gyor, and Brasov, and the Eighth took all the remaining places.¹⁶ It was estimated that the successful completion of this program would limit the monthly production of fighters to less than 200 single-engine and 100 twin-engine aircraft, and with this level of production Allied air supremacy would not be challenged. The GAF would be incapable of offering serious opposition to other strategic operations or of giving close support to the German Army from D-day onward.¹⁷

Ball bearings, to which the committee gave equal priority with fighter aircraft, were also divided into three categories. The prime targets (those yet undamaged and selected for early attack) were VKF (Vereinigte Kugellager Fabrik) at Berlin and DMF (Deutsche Kugellager Fabrik) at Leipzig. The undamaged secondary targets were the Jaeger and Muller plants at Wuppertal and Nuremberg. The prime targets which were partially or wholly out of

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action but which needed to be closely watched for resumption of activity were the factories at Schweinfurt, Steyr, and Stuttgart. The first two cities were the responsibility of the Fifteenth Air Force, and all other targets were assigned to the Eighth. It was estimated that this clean-up of the antifriction bearing industry would reduce production to about 35 per cent of the November 1943 level, and this reduction, it was believed, would produce a major crisis in the aircraft and finished armaments industries and in the GAF and ground army maintenance commands.

In the field of rubber, which had third priority, there were five targets (the synthetic plants at Schölpau, Hüls, Ludwigshafen, Leverkusen, and the reclaim plant at Hannover) which were selected for immediate attack. It was believed that within three months after the attacks began the German army would begin to feel the pinch and that a crisis would be reached in six to eight months.

The fourth priority went to bomber aircraft production. There were seven assembly plants which still remained undamaged: Henschel (Ju-88) at Schoenfeld; Fieseler (Ju-88) at Schleuditz; Dornier (Do-217 and He-410) at Oberpfaffenhofen; the Me-177 plants of Heinkel and Arado at Oranienburg and Brandenburg respectively; and Junkers (Ju-290) at Dessau. All of these factories and the associated subfields, however, were considered as secondary targets. Assembly plants were chosen rather than components factories because of the slow turnover of bombers in first-line strength. Checks on components would allow too long a delay between attack and effect on first-

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line strength. The estimated effects of this program would be the reduction of bomber production to less than 150 a month. At this level the German bomber force would be incapable of sustained operations in close support, but it could still carry on sporadic attacks of a limited nature.²⁰

Transportation, which had fifth place, was regarded as a sort of last resort target to be attacked only when it was impossible to hit any plant included in the first four priorities. Certain other industries were left off the list because it was believed they would be affected through the bombing of an allied system. The influence on one phase of manufacture by the destruction of another phase is well illustrated by the committee's suggestions on the value of hitting aero-engine factories. The conclusion reached was that since the attacks on airframes and assemblies had created a surplus of engines the bombing of plants producing the latter was unwarranted. Because of an excess of engines over requirements a disproportionate amount of damage would have to be inflicted before any strategic effect would be gained. This task would be further complicated²¹ by the comparative ease with which engine manufacture could be dispersed. The wisdom of this decision, of course, can be debated, and the U. S. Strategic Bombing Survey itself said that after the war was over it was difficult to decide even then whether attacks on engines would have been more profitable than those against airframes.²²

In his conference with General Anderson early in March 1944, General Fairchild urged that grinding wheels be placed among the top priorities when the aircraft industry was disposed of.²³ The Plan for the Completion

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of the Combined Bomber Offensive noted that a concerted series of attacks on seven grinding wheel factories, although not accorded high priority by the committee, would effect productivity of a wide, but unpredictable, range of armament and engineering industries. The military would probably begin to feel the pinch within five to seven months after completion of the attacks.²⁴

Submarine construction was also discarded as a profitable target. Antisubmarine techniques had proved more effective than attacks on construction yards. As a rule U-boats were built under covered slips which were practically invulnerable to anything but a direct hit. The complete destruction of yard facilities, such as power plants and metal-working shops, had also proved impracticable, and, therefore, further attacks would yield very little strategic benefit.²⁵

Two other industries which if attacked long enough would effect the German war effort were motor vehicle and tank factories, but under the circumstances at that time, the committee felt that the attacks would pay dividends too late to justify the amount of effort that would be expended on them. It would take at least a year for the Wehrmacht to feel the effects of heavy bombing on the motor vehicle industry, and furthermore it was capable of rather rapid recuperation because of the ease of replacement of the conventional machines which were employed.²⁶ In the case of tanks, even if the chief plants of Maybach, Nordbau, and Zahnradfabrik were severely damaged, the stocks of engines and gear boxes were sufficient to prevent a decline in final assembly for two months. In any event attacks

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on the tank industry could not meet early enemy resistance to COMFLOC D. ²⁷

A similar situation existed in the matter of tire, but not necessarily rubber, production. The destruction of tire factories and stocks would not prevent or hinder resistance to invasion. If the six largest manufacturers were successfully attacked, only about one-half of a month's supply would be cut off. The six factories, however, were of value as secondary targets and for filling out missions against more significant systems. ²⁸

The completed plan proposing target systems for the completion of the CBO was forwarded on 5 March to General Eisenhower, Supreme Allied Commander, and to Air Marshal Portal, British Chief of Air Staff, for coordination and final clearance through the CCS. In his letter of transmittal, General Spaatz stated that the "intermediate objectives" of the CBO, that is, the gaining of air superiority, had been achieved, and therefore the target systems of COMFLOC D had been re-examined in the light of that fact and of the necessity for giving maximum support to COMFLOC D. The calculation of possible results to be achieved by the plan were considered conservative, but the plan itself had been "pitched in terms of so lowering the German fighting efficiency on existing fronts that the German ability to safely move strategic reserves will be impaired; and in the months following D-Day, the capacity of the German ground forces effectively to continue resistance must inevitably be reduced." ²⁹

Major General Hapson, Allied Expeditionary Forces (AEAF), however, did not accept the plan submitted by HOLLAND. Another plan, which provided for the direct support of COMFLOC D, was proposed by the Allied Expeditionary Air Force (AEAF). This called for transcription of top priority work

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an origin involved by the staff to bring these two plans together, for the
delay involved in permitting to be done in both the United States and
Europe. It did not see objections, but USIA felt that with D-day draw-
ing nearer every hour, some plan for the continuation of strategic bombing
should be immediately implemented. Arnold agreed to this.

Proposals of both plans were in agreement that the destruction of the
railroad system in potential production was a first requirement in order
to isolate the transportation system of the C.E. USIA maintained that
the power of the C.E. would be broken after the day in Germany and
that the emphasis for completing the CBO not only provided for keeping the
air ³¹
energy/operation in a state of emergency but also for destroying railway
viaducts, according to the German ground forces.

The chief point of difference between the two plans was in the decision
as to whether to include the most important part of the system after the C.E. USIA
had proposed oil; the other proposed transportation. The other plan called
for a prolonged attack on rail transportation starting immediately. The
purpose was to disrupt the railway system, and thereby impede the move-
ment of strategic reserves to the western front and prevent supplies from
reaching the German Army in France after D-day. Spartz pointed out that
in the opinion of the Joint Chiefs of Staff (JCS) that was impossible of
accomplishment since the enemy had a large cushion which could easily care
for essential military traffic. The campaigns in Sicily and Italy, where
less extensive railroad systems existed, should have shown that too early

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an attack on transportation was misdirected effort. Spatz did not mean to imply, however, that properly directed attacks close to D-day would not be important for isolating the battle area, because the USSEAF plan provided for this type of operation.

If that remained of the GAF was to be obliterated and at the same time the other factors which were to hinder the German Army's ability to resist were to be destroyed, then the targets to be selected should be of such importance to the enemy that the GAF would be forced to fight to protect them. Spatz did not believe that such strength would be expended by the Luftwaffe to defend marshalling yards since the Germans had a rail transportation cushion sufficient for military needs. With oil, however, the situation was different. If the enemy were denied this item the capability of his ground armies to wage a successful war could collapse. The target areas of both systems were approximately of equal size and the weight of attack would be about the same. Oil had the advantage, though, in that 80 per cent of the production of synthetic fuel and lubricants was concentrated in 14 plants which could easily be put out of operation for several months. Comparable attacks on the same number of marshalling yards, which would be only a fraction of the German rail potential, would not seriously disrupt enemy military operations, particularly in the light of the fact that rail service could be more quickly and easily repaired than a damaged oil plant. Spatz therefore recommended that the strategic air forces (USAAF and RAF): (1) continue with the destruction of the GAF and aircraft and bullet manufacturing industries; (2) initiate immediate attacks on Axis oil production;

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and (3) join with SHAEF, AEAFF, and the Air Staff in planning for direct tactical support of OVERLORD so as to provide for attacks in great strength upon communications and military installations of all kinds and thus give maximum assistance to the initial phases of OVERLORD.³⁵

By the end of March the two plans had been reconciled and needed only the formal indorsement of Eisenhower and Portal. Under the compromise, USSTAF in the United Kingdom and the PAF Bomber Command would come under Eisenhower's command at a future date and would be on the same level as AEAFF. The top target priorities for POINTBLANK were: (1) destruction of the GAF, its factories and supporting installations, and ball-bearing plants; and (2) destruction of transportation facilities. Spaatz had given in on the substitution of transportation for oil because the Supreme Commander, AEF thought this most necessary for insuring the initial success of OVERLORD. The time had arrived, said the Commanding General of USSTAF, when the most important thing was full coordination of air effort in support of this operation.³⁶ The control of all air operations out of the United Kingdom was transferred to Eisenhower at 1200 hours, 14 April, and Spaatz was directed to look to Air Chief Marshal Tedder, Deputy Supreme Commander, for instructions on all operations concerned with POINTBLANK and OVERLORD. After the latter was firmly established on the Continent, the CCS would review the future employment of the strategic bomber forces and the method of their direction.³⁷

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Chapter III

TARGET SELECTION UNDER PRIORITY SYSTEMS

At the time of the entrance of the United States into the war it was belatedly realized that we were sadly lacking in combat intelligence techniques and requirements. Therefore it was necessary to rely heavily upon the British. Shortly after the arrival of American forces in the United Kingdom a liaison was established with the British Air Ministry, and the American representatives worked with British committees in planning air operations.¹ The Air Ministry set up a policy of bombardment to which all bombing forces were required to adhere,² and the directives under which the Eighth Air Force operated were issued by the Commanding General, European Theater of Operations, United States Army (JTCUSA).³

Until the Casablanca Conference, however, there was no clear-cut directive defining the task of the American bombing force, and considerable pressure was being exerted by the British to work the heavy bombers in with the R.A.F. night bombing program. The Americans were opposed on the ground that this would defeat the purpose for which the Eighth Air Force was developed—daylight precision bombing.⁴ At Casablanca the Combined Chiefs of Staff stated that the primary goal of the British and American bomber commands was "the progressive destruction and dislocation of the German military, industrial and economic system, and the undermining of the morale of the German people to a point where their capacity for armed resistance is fatally weakened," and it also

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set up the primary objective for destruction according to the following priorities: (1) submarine construction yards, (2) aircraft industry, (3) transportation, (4) oil, and (5) other targets in the enemy war industry. These priorities, said the CCS, would probably vary from time to time to meet certain exigencies of the moment. In attacking the above-named objectives, the American and British commanders were directed to conform to such instruction as might be issued through the British Chiefs of Staff.⁵

In the meantime the Committee of Operations analysts completed its report to General Arnold, and after being reviewed by Headquarters, USAF, the Joint Chiefs of Staff (JC), British authorities, and other interested persons, the report formed the basis for the plan for the Combined Bomber Offensive adopted by the CCS in May 1943. This plan was then incorporated in the CCS Directive of 10 June 1943. The determination of detailed targets within this framework was still^{left} up to the British Chief of Air Staff, who was the CCS Deputy in the United Kingdom.

In order to aid the British C/A in determining the weekly targets, provision was made at the time of the 10 June directive for setting up a Combined Operational Planning Committee (COPC), which came to be known as the "Jockey Committee." This was the chief agency for coordinating the efforts of all forces involved, and was composed of representatives of the VIII Bomber and Fighter Commands, the Ninth Air Force^(later in 1943), the RAF Bomber and Fighter Commands. Headquarters was located at the headquarters of the VIII Bomber Command. The COPC not only recommended the specific targets to be hit each week but also studied all intelligence reports and planned

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the operations to meet major objectives. After approval of the plans by all commanders concerned, code names were assigned and the plans filed at all operating headquarters. When the Commanding Officer of the VIII Bomber Command received his weekly priority list, and from this chose a target, the code name was immediately forwarded to all related commanders and the previously prepared operational plan was put into effect.

There was much work to be done by lower echelons and this was performed by the various intelligence sections in squadrons, groups, and wings, each of which relayed the results of studies to the next higher headquarters. Prior to the establishment of the United States Strategic Air Forces in Europe the highest purely American echelon for target study was the 8-5 of the Eighth Air Force. With the coming of USSAF this task was taken over by the target subsection of the Directorate of Intelligence, USSTRAF. It coordinated its effort with other American and British agencies which through joint committees studied target systems and their individual components from the point of view of economic and military effects, and recommended priorities. The chief responsibility of the target section of the Directorate of Intelligence was keeping up to date on the status of targets and estimating how much additional effort should be expended on them.

Once the target had been selected for a mission, there were, however, still some local matters to be determined by lower echelons. Daily operational conferences were held to settle all last-minute problems so that the briefing sessions would be accurate and to the point. In order to achieve as productive results as possible, the Eighth Air Force had established an

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Operational Research Section, composed largely of civilian technical experts, to study past performance and recommend needed changes in future tactics. Late in February 1944, a representative of this body was included in the daily operational conferences to advise the mission planners on a variety of technical points, such as the proper selection of bombs and fuses for particular targets.

In the determination of what targets should be hit first there were a number of questions to be considered. Since the GLO had as its primary goal the weakening of the enemy's ability to fight, one of the most important questions was how soon the bombing of an industry would affect front-line strength. The time lag would depend upon the supplies on hand, rate of expenditure, monthly output, an ability to recuperate, ^{and} also upon how far back from combat use the industry lay. In certain items, artillery for example, the Germans had in late 1943 and early 1944 such large holdings in relation to monthly output, that to destroy artillery production completely would deny them only a relatively small addition to their present stocks. Such bombing efforts, therefore, would not affect the amount of this equipment that could be used against the Allies on D-day and for several weeks thereafter. On the other hand, the current strength of the fighter force and the supply of oil were being expended at a rate which was reducing the enemy to a hand-to-mouth existence in these items.

Except on the Eastern front, vast quantities of army fighting equipment was small, and in most items would be needed until after the Allied ground forces had joined battle with the Germans in France. With the air forces

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it was different, of course, because here the expenditure was considerable, due to the determined policy of the Allies to destroy the GAF wherever it was--on the ground, in the air, or in production.

The lack of expenditure of ground army equipment, the growing wastage of aircraft, and the unexpected ability of the enemy to recuperate through dispersal, underground factories, and reconstruction of damaged facilities made it more profitable to hit those industries closest to the front line. It was estimated that an attack on steel production would not affect the military situation for six months, and the effects of an attack on coal would not be felt for even a longer period of time. Thus with the ability of the industries to recover, the flow would soon be re-established and the final production results would be little affected. Raw aluminum would reach the front lines in a finished aircraft in about four months, and partially fabricated airplane parts would arrive in about two months. Airframe components and final assembly were only one month from the battle front.

It was generally agreed, therefore, that those industries which had the most direct and quickest effect on the German military ability to fight should be disposed of first. Priority was given to final aircraft assembly and airframe components for this reason and also because these factories were frequently in the same target area and a large portion of total production capacity was centered in a relatively few large factories. On the same level of first priority was put the antifriction bearing industry, which also offered a concentrated target. Furthermore, it was believed that the destruction of this industry would cut across all lines and vitally affect the production

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Table 3

TARGETS SELECTED FOR ATTACK BY THE 8TH AND 15TH AIR FORCES**

Aircraft:

<u>Factory</u>	<u>Location</u>	<u>Attacking Force</u>
Erla--Me-109	Leipzig/Heiterblick	8th
Erla--Me-109	Leipzig/Möckau	8th
Messerschmitt--Me-109	Regensburg/Prüfening	8th & 15th
Messerschmitt (Wiener Neustadt)--Me-109	Fischamend	15th
Steyr-Daimler-Puch--Me-109	Steyr	15th
Focke Wulf--FW-190	Poznan (Posen)	8th
Focke Wulf--FW-190	Krzesinki (Kreising)	8th
Focke Wulf--FW-190*	Tutow	8th
Fiesler--FW-190	Kassel/Waldau	8th
Gothaer--Me-110	Gotha	8th
Messerschmitt--Me-110	Brunswick/Wilhelmitor	8th
Messerschmitt--Me-110	Brunswick/Neupetritor	8th
Messerschmitt--Me-410	Augsburg	15th
Manfred Weiss--Me-410	Szigetszentmiklós	15th
Junkers--Ju-88	Bernburg	8th
Junkers--Ju-88	Halberstadt	8th
Junkers--Ju-88	Aschersleben	8th
Siebel--Ju-88	Leipzig/Schkeuditz	8th
Heinkel--He-219	Schwechat	15th

Ball Bearings:

Kugel-Fischer	Schweinfurt	8th & 15th
VKF, Werke I	Schweinfurt	8th & 15th
VKF	Berlin/Erkner	8th
Steyrmaschinen Walzlagerwerke	Steyr	15th
Deutsche K.F.	Leipzig	8th
Norma (VKF)	Stuttgart/Bad Cannstadt	8th or RAF
Jaeger	Wuppertal	8th or RAF

* Listed in original as an Arado plant.

** History of MAAF, 10 Dec 43-1 Sep 44, VIII, ltr, Air Ministry to RAF Bomber Command, USSTAF, MAAF, 28 Jan 44.

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of ground army equipment as well as airplanes. Thus in January 1944, Portal, Harris, Evill, Bottomley, Leigh-Mallory, Spaatz, and Anderson unanimously agreed that for the present the U. S. strategic bombers should concentrate on single- and twin-engine fighter production and the ball-bearing industry, and a list of targets was drawn up for operations out of the United Kingdom ¹² and the Mediterranean. If conditions should arise, however, which would prevent precision attacks, then the Eighth Air Force was to supplement the RAF bombing of Berlin when weather and tactical conditions were suitable. Next to the aircraft industry other POINTBLANK targets took precedence for all precision attacks by the Eighth Air Force, but when these were not feasible, full-scale ¹³ attacks would be made on CROSSBOW (V-1 and V-2 bomb sites) objectives.

In the meantime the RAF was to maintain steady pressure on the denser concentrations of German heavy industry and supplement the daylight bombing of individual factories by night assaults on industrial centers associated with aircraft and ball-bearing manufacture. The same directive which established the January targets for the Eighth Air Force assigned the following cities to the RAF in order of priority: Schweinfurt, Leipzig, Brunswick, Regensburg, Augsburg, and Gotha. In any OBOE or GEE-H (types of blind bombing) attacks the Jaeger ball-bearing factory at Wuppertal was to have priority. As in the case of the Eighth Air Force, the RAF was to attack Berlin when ¹⁴ conditions prohibited raids on the above-mentioned places.

The stepped-up offensive against the GAF continued through January and February with other targets relegated to second place. Air Marshal Portal, as CCS Deputy in the United Kingdom, again in February emphasized the need

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for destroying the GAF, and his orders for that month retained fighter airframe and components factories and ball bearings at the top of the priorities. A secondary priority was accorded to installations supporting the GAF and to aircraft not forming a part of the German fighter force. Other objectives were: continued attacks on CROSSBOW targets in order to neutralize the threats developing under the rocket-bombing project; attacks on Berlin and other industrial areas by both RAF and USSTAF, the latter to hit these places when unable to perform precision bombing and to use bombing-through-overcast (BTO) methods; and lastly, attacks on targets in southeastern Europe, such as cities and transportation. Attacks in the Balkans would be delivered by the Fifteenth Air Force when weather or tactical conditions prevented POINTBLANK operations or support of the Italian land campaign.

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Sufficient progress had been made against enemy aircraft production by March to allow the daylight bombers to turn a greater share of their attention to other POINTBLANK objectives which would impose maximum injury on the German ground forces and pave the way for a successful OVERLORD. The controversy over whether or not transportation would have priority over the oil industry has been discussed in the preceding chapter. Despite the fact that oil did not win out over transportation, its importance was recognized and it was given

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a place on the list. Actual full-fledged bombing of oil installations did not begin until April and May, ^{however,} when the Fifteenth Air Force started a concerted action against the Balkan refining facilities. The Eighth Air Force launched its first attacks against synthetic plants in May, but the peak was not reached

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until several months after D-day.

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When target lists were drawn up, there was also a division of effort between the Eighth and Fifteenth Air Forces and the RAF. In general, the RAF Bomber Command was instructed to conduct area night bombing in support of daylight precision assaults.¹⁸ The Eighth Air Force had as its chief primary targets during the first half of 1944 the fighter aircraft airframe and components and ball-bearing factories. To these were added marshalling yards, airfields, and airdromes as the time for invasion drew nearer. Considerable bomb tonnage also was to be dropped on CROSSBOW and other military installations in the Pas de Calais and Cherbourg Peninsula regions. One month before D-day, the priorities for this air force were set as: (1) POINT-BLANK targets, which had aircraft factories first, and then other industries, such as oil; (2) railroad centers in occupied countries; and (3) airdromes in occupied countries. CROSSBOW also was to have overriding priority in France for one satisfactory mission.¹⁹ Although POINTBLANK carried top priority it can be clearly seen that the requirements for OVERLORD were the main factors²⁰ determining targets for the forces operating out of the United Kingdom.

It was in the Mediterranean Theater of Operations (MTO),* however, that the greatest number of changes in priority occurred. This was due in part to the multitude of tasks allocated to that theater. In addition to the Italian campaign the CCS also assigned to the Commander-in-Chief of the Allied Forces the responsibility for operations in Greece, Albania, Yugoslavia, Bulgaria, Rumania, Hungary, Crete, the Aegean Islands, and Turkey.²¹ This, of course, involved the Fifteenth Air Force as well as other air units in the MTO. In addition to heading the Balkan program, the Allied Commander-in-

* Designation of operations area; does not refer to a command.

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Chief was also allowed to use the strategic air forces under his command (the Fifteenth Air Force and the 205 Group, RAF) for operations not a part of POINTBLANK when a tactical or strategic emergency arose in the Italian campaign. This resulted at times in a confused state of priorities, but the wonder is that under these circumstances the system worked as well as it did.

At the time of the organization of the Mediterranean Allied Air Forces (MAAF) in December 1943 the project which had top priority in the MTO was ANVIL--the landing in southern France to coincide with OVERLORD.²² The uncertainty as to whether ANVIL (later called DRAGOON) would ever be mounted after its downgrading following the Anzio stalemate made air planning in the MTO difficult. By May, however, it had been decided that ANVIL would be staged in the near future, and in preparation for it railroad centers in southern France were given a priority immediately below those for the Italian campaign and POINTBLANK. The disruption of communications in this region was intended not only to prepare for an invasion on the southern coast of France but also to help OVERLORD by making it difficult for the enemy to shift reserves to the Normandy beachhead.²³

Aside from ANVIL other MTO projects which required the aid of the strategic air forces were the Italian land campaign and the bombing of the Balkans for political or tactical reasons. In February, the Italian campaign was given overriding priority for all operations in the MTO and had first call on all land, sea, and air resources in that theater.²⁴ Balkan bombing was given last priority, although in the spring and early summer it was given temporary precedence, from time to time, to meet certain political exigencies

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and to aid the Russian advance. In the month prior to D-day, the priority target systems for the Fifteenth Air Force were, therefore: (1) Support of the Italian campaign; (2) POINTBLANK; (3) railroad centers in southern France in preparation for OVERLORD and DRAGOON; and (4) Balkan targets.

Early in January 1944, the day bomber forces in the Mediterranean were given a five-fold mission: (1) destruction of POINTBLANK targets; (2) support of the Italian land campaign; (3) bombardment of important rail centers outside of Italy; (4) bombardment of special industrial targets of strategic importance; and (5) bombardment of specially named objectives for political reasons. The night bombers were to attack marshalling yards and such targets as the Wiener Neustadt complex and other airframe factories, but only when conditions were such that they could be located and bombed effectively.

At the top of the list for POINTBLANK targets were, of course, the German fighter factories and ball-bearing industries. These remained in first priority, with some specific targets withdrawn and others added as conditions warranted, until after D-day. Targets of secondary importance were used as fillers and included a variety of industries, airdromes, landing grounds, and air parks. Airdromes and similar installations gained in importance, however, as the noose was tightened about the GAF neck and the time for OVERLORD and ANVIL drew nearer. In May oil was given recognition as possessing more than a last-resort or target-of-opportunity status, although it was not yet accorded a top or secondary priority. OVERLORD requirements were still uppermost. On the May list, 18 refineries and storage facilities were recommended as non-POINTBLANK filler targets to be used where tactical considerations required supplementary targets in the same general area as POINTBLANK objectives.

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Table 4

FIRST-PRIORITY POINTBLANK TARGETS AUTHORIZED
FOR JANUARY-FEBRUARY 1944**

Fighter Aircraft:

- | | |
|---|----------------------|
| 1. Messerschmitt-109 assembly plant | Regensburg/Prüfening |
| 2. Messerschmitt-410 assembly plant | Augsburg |
| 3. Steyr-Daimler-Puch Messerschmitt
Components | Steyr |
| 4. Messerschmitt-109 components plant | Fischamend |
| 5. Messerschmitt-410 assembly plant | Szigetszentmiklós |
| 6. Heinkel-219 assembly plant | Schwechat |

Ball Bearings:*

- | | |
|--|-------------------------|
| 1. VKF, Werke I | Schweinfurt |
| 2. Steyr-Daimler-Puch and Walzlagerwerke | Steyr |
| 3. VKF | Stuttgart/Bad Cannstadt |

* The ball-bearing factories were to have equal priority with the aircraft factories.

** History of MAAF, 10 Dec 43-1 Sep 44, VIII, Precis of Present Bombing Directives other than Areas Authorized in Operation Instruction No. 8, 22 Feb 44.

Table 5

MAAF POINTBLANK PRIORITIES FOR APRIL 1944*

First Priority:

1. Wiener Neustadter Werke I (Me-109 components), Wiener Neustadt (Werke II to be attacked also if force permits).
2. Wiener Neustadter Flugzeugwerke (Me-109 components), Fischamend
3. Me-109 Factory Airfield, Bad Vöslau
4. Duna Aircraft Factory (a/c components), Szigetszentmiklós
Duna Factory Airfield (Me-210 assembly), T8k81
5. Messerschmitt Plant (Me-410 assembly), Augsburg
6. Norma Ball-bearing Factory (VKF), Stuttgart/Bad Cannstadt
7. Dornier Factory Airfield (Me-410 and Do-217 assembly), Oberpfaffenhofen
8. Hungarian Wagon Works (Me-109 assembly), Gyor
9. IAR Aircraft Factory (Me-109 assembly), Brasov
10. Heinkel Factory Airfield (He-219 assembly), Schwechat

Secondary Priority (to be attacked when first priority targets weathered out):

1. Macchi Aircraft Factory, Varese
2. Fiat Aeritalia Factory, Turin
3. Breda Works, Bresso Airfield, Milan
4. Wiener Neustadter Flugzeugwerke, Klagenfurt
5. Wiener Neustadter Flugzeugwerke, Zemun
6. Muller Ball-bearing Factory, Nuremberg

Subsidiary Targets not Warranting Individual Attack (to be attacked in connection with above targets when size of force permitted or when grouped together to constitute mission objectives on a secondary priority):

1. Industrial Targets:
 - a. Kammgarnspinnerei, Bad Vöslau
 - b. Enzesfelder Metal Works, Enzesfeld (near Wiener Neustadt)
 - c. Textile Mill, Ebreichsdorf (near Wiener Neustadt)
 - d. Rohrback Spinning Mill (a/c components), Neunkirchen
 - e. Pottendorfer Spinnerei (Me-109 components), Pottendorf
 - f. Aircraft Factory, Neaubing Neaubing? (near Munich)
2. A/C Concentrations on the Ground, A/C Servicing Facilities, Air Parks:
 - a. Wallersdorf A/D, Wiener Neustadt
 - b. Fildex Factory A/D, Budapest/Vecses No. 1
 - c. Erding A/D, Munich
 - d. Gablingen A/D, Augsburg
 - e. Landsberg A/D, Munich
 - f. Leipheim, A/D, Ulm
 - g. Munich/Neubiberg A/D
 - h. Munich/Riem A/D
 - i. Graz/Thalerhof A/D

* History of MAAF, 10 Dec 43-1 Sep 44, VIII, Operations Instructions No. 18, 3 Apr 44.

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Table 6

MAAF POINTBLANK PRIORITIES FOR MAY 1944*

First Priority:

1. Wallersdorf A/D, Wiener Neustadt
2. Amme-Luther-Seck (Me-109 components), Atzgersdorf
3. Dornier (Me-410, Do-217 assembly), Oberpfaffenhofen
4. Munich/Neubiberg A/D
5. Zwölfaxing A/D
6. Budapest/Vecses A/D
7. Munich/Riem Air Park
8. Dornier Factory, Neuaubing
9. Graz/Thalerhof A/D

Secondary Priority (to be attacked when first priority targets weathered out):

1. Erding A/D and Air Stores Park
2. Budaörs A/D
3. Muller Ball-bearing Factory, Nuremberg
4. Wiener Neustadter Flugzeugwerke, Klagenfurt
5. Steyr-Daimler-Puch Factory, Steyr
6. Rohrback Spinning Mill, Neunkirchen
7. Pottendorfer Spinnerei, Pottendorf
8. Textile Mill, Ebreichsdorf
9. Kammgarnspinnerei, Bad Vöslau
10. Steyr-Daimler-Puch, Graz/Neudorf

*History of MAAF, 10 Dec 43-1 Sep 44, VIII, Operations Instructions No. 40, 18 May 44.

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Table 6 (Cont'd)

MAAF POINTBLANK PRIORITIES FOR MAY 1944

Subsidiary Targets not Warranting Individual Attack (to be attacked in connection with above targets when size of force permitted or when grouped together to constitute mission objectives on a secondary priority):

1. Industrial Targets:
 - a. Wiener Neustadter Factory, Neudörfl, Austria
 - b. Duna Factory, Szigetszentmiklós, Hungary
 - c. Siebel Co., Phaleron, Greece
 - d. Enzesfelder Metal Works, Enzesfeld, Austria
2. A/C Concentrations on the Ground, A/C Servicing Facilities, Air Parks:
 - a. Zemun A/D
 - b. Brasov A/D
 - c. Münchenendorf A/D
 - d. Klagenfurt A/D
 - e. Markersdorf A/D
 - f. Tököl A/D and Duna Assembly Plant
 - g. Vienna/Aspern A/D
 - h. Vienna/Tulln A/D
 - i. Hirsching A/D
 - j. Wels A/D
 - k. Neuberg A/D
 - l. Memmingen A/D
 - m. Kalamaki A/D
 - n. Gyor A/D

Non-POINTBLANK Filler Targets (recommended for use where tactical considerations required supplementary targets in same general area as POINTBLANK targets):

1. Refinery and/or Oil Storage Facilities:
 - a. Ploesti Area (including Cămpina), Rumania
 - b. Giurgiu, Rumania
 - c. Bratislava, Czechoslovakia
 - d. Vienna-Floridsdorf, Austria
 - e. Vienna-Kagran, Austria
 - f. Vienna-Korneuburg, Austria
 - g. Vienna-Schwechat, Austria
 - h. Lobau, Austria
 - i. Winterhafen, Austria
 - j. Budapest-Csepel, Hungary
 - k. Almasfuzito, Hungary
 - l. Budapest, Hungary
 - m. Caprag, Yugoslavia
 - n. Brod, Yugoslavia
 - o. Ipil, Yugoslavia
 - p. Porto Marghera, Italy
 - q. Trieste, Italy
 - r. Leghorn, Italy

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The target priorities just discussed were concerned with daylight precision bombing. The 205 Group, RAF in the MTO, like the RAF Bomber Command in England, was primarily interested in night area or semi-area bombing as supplementary to the precision work of the U. S. heavies. With the introduction of bombing-through-overcast techniques for use by the day bombers it became possible for these forces to fly missions hitherto considered impossible or unprofitable. Since this meant that the Fifteenth Air Force would now engage in some daylight area bombing, priorities for this type of operation had to be set up. First priority was given to those cities which complemented first priority POINTBLANK targets, such as Regensburg, Schweinfurt, Steyr, Augsburg, and Stuttgart. Second priority was assigned to cities not necessarily connected with first priority POINTBLANK targets but which if bombed would contribute to the mission of the strategic air forces. These places were in order of precedence: Budapest, Sofia, Bucharest, Vienna. ³¹

Perhaps the most troublesome problem which confronted the planners in the selection of targets within specified systems was that of the Balkans. This region, as such, was not a part of POINTBLANK, but with the assumption of responsibility for operations there by the Allied Commander-in-Chief of MTO, this area fell within the sphere of the strategic air forces in the Mediterranean. It was necessary, therefore, to fit a political and tactical target system into the scheme without interrupting the GBO. The adjustment was made after a fashion, but not without some misgivings on the part of the Americans and some confusion in the bombing schedules.

In February 1944 the CCS notified both General Spaatz and General Wilson that when it was impossible to stage POINTBLANK attacks or support the Italian

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campaign, the Balkan priorities would be first Bulgaria, then Budapest,
³² and lastly Bucharest. The following month the Balkan priorities became:
 (1) Sofia, Varna, and Burgas for political reasons; (2) Bucharest; and (3)
³³ Budapest. The tottering position of Bulgaria made this country seemingly
 ripe for bombing out of the war, and the CCS informed Wilson that there was
 no prohibition against using the Fifteenth Air Force to hit this target when-
 ever such operations might be a prime factor in deciding the course of Bul-
³⁴garian affairs.

The wisdom of trying to take the Balkan satellites out of the war at this
 time and of using the Fifteenth Air Force for this purpose at the expense of
 POINTBLANK was questioned by General Eaker, Commanding General of MAAF. He
 wondered if, rather than aiding OVERLORD, it might not release more German
 divisions to oppose that operation. If the British insisted on using the
 Fifteenth Air Force for political bombing, he told Air Marshal Slessor, it
 was possible that the American Chiefs of Staff might regard this as sabotage
 of POINTBLANK and remove that air force from under his control. If this were
 done the Balkan program would be crippled, whereas if the present arrangements
 and authorizations were not disturbed, bombings could be carried on to the
³⁵ satisfaction of both the GBO and the Balkan situation. In the belief that
 the German allies in southeastern Europe needed only a little prodding to force
 them to lay down their arms, the CCS in late March authorized Portal to instruct
 Spaatz and Wilson to depart from the order of priorities currently in force and
 make one or two heavy attacks on the Balkans whenever important results could
 be expected. The matter of reducing to a minimum the diversion from the Italian
³⁶ campaign and POINTBLANK was left to Portal's discretion. Under this authority

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Portal directed that when favorable opportunities offered themselves, Wilson would order one or more of the following places attacked: Bucharest; Budapest; Sofia and other Bulgarian towns. Wilson was requested to keep Portal informed of his intentions after consulting with either Eaker or Twining, as the case might be, as to possible conflict with coordinated operations of the Eighth and Fifteenth Air Forces. Twining was responsible for keeping USSTAF informed of these Balkan operations, and Spaatz was to issue the necessary orders for the attacks.

Spaatz objected, however, to allowing theater commanders to authorize attacks by strategic air forces against political targets. Such a policy, he felt, would nullify the single control established over POINTBLANK, and it might disrupt attacks on vital war industries at critical times. Furthermore, it would let theater commanders judge according to their own standards the relative merits of precision and area bombing of populations and this might in turn change the whole CBO program. He recommended that the CCS have confidence in precision strategic bombing and that they adopt a firm policy of resisting unnecessary diversions. There would always be time to submit factual data on political bombing to the CCS for their consideration, instead of letting the theater commanders make the decision.

Portal explained that theater commanders had always been empowered to use strategic air forces for nonstrategic operations when in their opinion a tactical emergency required it, and in giving first priority to the Italian campaign in the MTO, the CCS had recognized the necessity of occasional diversion from POINTBLANK. In Portal's opinion, and also in that of the British Chiefs of Staff, the precarious position of

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the Germans in the Balkans constituted an emergency although, to be sure, it was the Germans and not the Allies who were threatened. Any increase in enemy difficulties in that area would "yield incalculable benefit" to the Allied position and to the prospects of OVERLORD. Furthermore, because the weather seldom allowed operations in more than one section at a time, a few heavy attacks on Bucharest and other cities of southeastern Europe would not interfere with POINTBLANK.³⁹

Arnold, on his part, also believed that attacks on certain Balkan targets would aid OVERLORD and do more damage to the Germans than certain other targets on the priority lists, but that such attacks should be tied in with the general bombing program. Complete coordination and a minimum of diversion were necessary to secure maximum effectiveness. Since the USAAF had built an extremely powerful bombing force which must be used efficiently, he requested that Portal coordinate all strategic bombing efforts and keep Spaatz informed at all times of what was expected of his air fleet.⁴⁰ Portal answered that he was in agreement on all points and that he would keep in closest touch with Spaatz. He also assured Arnold that there would be no diversion from POINTBLANK unless really important results could be expected.⁴¹

This, with the exception of some differences of opinion between the United States and Russia over a bomb line (which will be discussed in Chapter VIII), ended the Balkan controversy for the most part. Each week Portal sent through channels the targets to be attacked in southeast Europe. These varied from time to time as the political and military situation changed. At the time of D-day the priorities were: (1) oil refineries at Ploesti, in Hungary, and in Austria; (2) mining of the Danube River, and attacks on Giurgiu and the Iron

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Gate Canal; (3) chrome plants at Radusa and Hanrijevo, and the Tungsram Works at Budapest. Because of the lull in fighting on the Eastern Front and the calls for the strategic bombing force to aid in the Italian battle, Balkan transportation, hitherto holding a high rating, was given a low priority, and it was provided that if attacks were made on railroad centers they should be confined to centers such as Bucharest or Budapest which were the main outlets for the Germans.

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Chapter IV

ORGANIZATION OF UNITED STATES STRATEGIC AIR FORCES IN EUROPE

The means for carrying out the American portion of the Combined Bomber Offensive were the Eighth and Fifteenth Air Forces. Together these formed the bulk of the United States Strategic Air Forces in Europe. ¹

The Eighth had a long and varied career. It had been the first of the American air forces to arrive in Europe and it initiated the United States daylight precision bombing program. Its development had been hindered at times by lack of personnel and supplies, lack of long-range fighter escort, and by the loss of planes and men transferred to form the Twelfth Air Force when TORCH (invasion of North Africa) was mounted. ² Despite all its troubles, however, it continued to be the nucleus of the striking force ^{was to carry out} which/the American policy of strategic bombing.

The Eighth was organized into three bombardment divisions, each composed of four or more combat wings. ³ The latter, however, were purely operational in function, although toward the end of the war they began to assume certain administrative duties. Each combat wing was, in turn, composed of groups and squadrons. In addition to the bombardment divisions the Eighth Air Force also included the VIII Fighter Command, VIII Air Force Service Command, VIII Air Force Composite Command, and the 8th Reconnaissance Wing. ⁴ The bombardment divisions carried out the heavy bombing missions; the Fighter Command furnished escort and executed certain strafing, dive,

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and low-level bombing operations of their own; the Composite Command was charged with training as its chief responsibility; and the Reconnaissance Wing performed the necessary photo work.

After the acquisition of suitable bases in Italy, the Fifteenth Air Force was formed out of the XII Bomber Command of the Twelfth Air Force in late 1943. The Fifteenth was planned to supplement the work of the Eighth by attacking from the Mediterranean those targets beyond the range of the latter air force. The Fifteenth, however, was not organized along lines of bomb divisions and combat wings like the Eighth. Instead, the major subdivisions were the bomb wings, which were both administrative and operational, and each of which was composed of three to six groups. At first the fighter groups were included as a component part of each bomb wing, but ultimately they were withdrawn to make up a separate fighter command, consisting of two wings. Other units composing the Fifteenth Air Force were the XV Air Service Command and a reconnaissance squadron (later a group). Also included in the air force was the 885th Heavy Bombardment Squadron (Sp) (which formerly was the 122d Liaison Squadron and which later with the 859th Heavy Bombardment Squadron made up the 2641st Special Group (Prov). The 885th was engaged in supplying the Balkan Partisans.⁵

A matter which complicated the relations between the Eighth and Fifteenth Air Forces was the fact that they were in different theaters of operation and therefore under separate commanders in chief. The Eighth, operating in the European theater (ETO), was a part not only of USSTAF after that organization was formed but also of ETOUSA, and still later, in April 1944, it came under General Eisenhower and SHAEF (Supreme Headquarters, Allied Expeditionary Forces). There was not too much difficulty in coordinating efforts in the ETO, however, since the POINTBLANK program of the CBO

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Chart I

ORGANIZATION OF THE FIFTEENTH AIR FORCE
DECEMBER 1943 AND JUNE 1944*December 1943:

5th Bomb Wing
 1st Fighter Group (P-39), 27th, 71st, 94th Squadrons
 14th Fighter Group (P-38), 37th, 48th, 49th Squadrons
 325th Fighter Group (P-47), 317th, 318th, 319th Squadrons
 2d Bomb Group (B-17), 20th, 49th, 96th, 429th Squadrons
 97th Bomb Group (B-17), 340th, 341st, 342d, 414th Squadrons
 99th Bomb Group (B-17), 346th, 347th, 348th, 416th Squadrons
 301st Bomb Group (B-17), 32d, 352d, 353d, 419th Squadrons

47th Bomb Wing
 154th Squadron of the 68th TR Gp. (P-39 and F-4A)
 82d Fighter Group (P-38), 95th, 96th, 97th Squadrons
 98th Bomb Group (B-24), 343d, 344th, 345th, 415th Squadrons
 376th Bomb Group (B-24), 512th, 513th, 514th, 515th Squadrons
 449th Bomb Group (B-24), 716th, 717th, 718th, 719th Squadrons
 450th Bomb Group (B-24), 720th, 721st, 722d, 723d Squadrons
 451st Bomb Group (B-24), 724th, 725th, 726th, 727th Squadrons

304th Bomb Wing
 454th Bomb Group (B-24)
 455th Bomb Group (B-24)
 456th Bomb Group (B-24)

XV Air Force Service Command

June 1944:

5th Bomb Wing
 2d Bomb Group (B-17), 20th, 49th, 96th, 429th Squadrons
 97th Bomb Group (B-17), 340th, 341st, 342d, 414th Squadrons
 99th Bomb Group (B-17), 346th, 347th, 348th, 416th Squadrons
 301st Bomb Group (B-17), 32d, 352d, 353d, 419th Squadrons
 463d Bomb Group (B-17), 772d, 773d, 774th, 775th Squadrons
 483d Bomb Group (B-17), 815th, 816th, 817th, 840th Squadrons

47th Bomb Wing
 98th Bomb Group (B-24), 343d, 344th, 345th, 415th Squadrons
 376th Bomb Group (B-24), 512th, 513th, 514th, 515th Squadrons
 449th Bomb Group (B-24), 716th, 717th, 718th, 719th Squadrons
 450th Bomb Group (B-24), 720th, 721st, 722d, 723d Squadrons

* History of MAAF, 10 Dec 43-1 Sep 44, ^{XI} 723d SCORU, Monthly Statistical Summary of Mediterranean Allied Air Forces, No. 2 (Dec 43), No. 8 (Jun 44).

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Chart I (Cont'd)

- 49th Bomb Wing
 - 451st Bomb Group (B-24), 724th, 725th, 726th, 727th Squadrons
 - 461st Bomb Group (B-24), 764th, 765th, 766th, 767th Squadrons
 - 484th Bomb Group (B-24), 824th, 825th, 826th, 827th Squadrons
- 55th Bomb Wing
 - 460th Bomb Group (B-24), 760th, 761st, 762d, 763d Squadrons
 - 464th Bomb Group (B-24), 776th, 777th, 778th, 779th Squadrons
 - 465th Bomb Group (B-24), 780th, 781st, 782d, 783d Squadrons
 - 485th Bomb Group (B-24), 828th, 829th, 830th, 831st Squadrons
- 304th Bomb Wing
 - 454th Bomb Group (B-24), 736th, 737th, 738th, 739th Squadrons
 - 455th Bomb Group (B-24), 740th, 741st, 742d, 743d Squadrons
 - 456th Bomb Group (B-24), 744th, 745th, 746th, 747th Squadrons
 - 459th Bomb Group (B-24), 756th, 757th, 758th, 759th Squadrons
- 306th Fighter Wing
 - 1st Fighter Group (P-38), 27th, 71st, 94th Squadrons
 - 14th Fighter Group (P-38), 37th, 48th, 49th Squadrons
 - 31st Fighter Group (P-51), 307th, 308th, 309th Squadrons
 - 52d Fighter Group (P-51), 2d, 4th, 5th Squadrons
 - 82d Fighter Group (P-38), 95th, 96th, 97th Squadrons
 - 325th Fighter Group (P-51), 317th, 318th, 319th Squadrons
 - 332d Fighter Group (P-47), 99th, 100th, 310th, 302d Squadrons
(Group composed of Negroes)
- XV Air Force Service Command
 - ← 305th Bomb Wing (nonoperational)
 - ← 885th Bomb Squadron (SP) (B-17's and B-24's)
 - ← 154th ^{weather} Reconnaissance Squadron (P-38)

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for the first six months of the year was designed to aid OVERLORD, a theater project. The Fifteenth, however, was involved not only in POINT-BLANK but in MTO programs as well, such as the Italian campaign, Balkan bombings, and ANVIL (later DRAGOON). Its operations, therefore, were subject to numerous influences. ⁶ In late 1943 when the MTO was set up as an ^{Allied theater,} an over-all air command (MAAF) was established and placed under the Allied ⁷ Commander-in-Chief of the theater. Under the Air Commander-in-Chief of MAAF there was an American deputy who had administrative control over the Twelfth and Fifteenth Air Forces. There were likewise a British deputy who had similar jurisdiction over the RAF, and an Air Officer Commander-in-Chief of the Middle East. A combined staff had operational control over ⁸ the strategic, tactical, and coastal air forces.

The strategic air force of MAAF was composed of the Fifteenth Air Force and the 205 Group, RAF. In large part, however, the operations conducted were an American show. The 205 Group at the most consisted of six to eight squadrons, and while their night attacks were valuable they were small in ⁹ comparison with the huge onslaughts of the Fifteenth. The latter organization in turn lacked the polish of the Eighth. It took considerable time, patience, and training to make the Fifteenth as smooth and efficient as its elder brother. In March, General Eaker reported that it was a "pretty disorganized mob," but he had some very good men and they were "perfecting the reorganization and training of their groups pretty rapidly." Nevertheless, both he and Spaatz were discouraged. The problems of inadequate training, lowered morale, lack of airdromes, poor living conditions, and

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general ineffectiveness seemed almost insurmountable obstacles. Furthermore, it had been necessary to build within a few months an air force of more than 20 groups from an original strength of only three.¹⁰

By the next month, however, Eaker was considerably encouraged and reported that the Fifteenth looked like a different organization. The benefit of lessons learned by the Eighth Air Force, insistence on high standards, new and better qualified wing and group commanders, and lack of intense enemy opposition had all played their part in developing the Fifteenth into a good strategic force.¹¹ In this same month of April, General Eaker was able to report that out of over 10,000 heavy-bomber sorties, 72 per cent had been effective and nearly 500 enemy aircraft had been destroyed by the heavies. The fighters flew^{over} 6,000 sorties, of which 77 per cent were effective, and for each fighter lost the enemy had paid with 2.4 of his own aircraft.¹² In May the Fifteenth launched its first 1,000-plane attack.¹³ The Mediterranean strategic air forces had come of age.

In late 1943 it had been realized that if two strategic air forces were to operate from separate theaters in an efficient and economical manner against POINTBLANK targets there must be closer coordination than had previously existed. As early as November 1943, Washington was concerned over this problem. It felt that during this month neither air force had flown successful missions against what Headquarters, AAF considered priority targets of POINTBLANK, and it believed that the Eighth and Fifteenth Air Forces should furnish Washington with their latest plans for strategic bombing so that theater and AAF Headquarters planning would be in consonance.¹⁴

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Not only was there a need for coordination between the Eighth and Fifteenth, but it was also necessary to harmonize the efforts of the British and American heavy-bomber forces which were operating practically independently of each other.¹⁵ As early as September 1943, on the suggestion of Air Marshal W. H. Bottomley, this matter had been discussed among Generals Arnold, Eaker, and Devers, and it had been concluded that the current system of coordination through the British Chief of Air Staff was satisfactory and should be continued. It was felt, however, that there was need of some agency to integrate the efforts of the American forces operating out of the MTO and ETO.¹⁶

The solution as finally reached was the establishment in January 1944 of an over-all coordinating organization for the American side known as the United States Strategic Air Forces in Europe (USSTAF). The purpose was twofold. Not only would this new organization serve as a coordinating agency for the Eighth and Fifteenth but it would offer the GAF the difficult choice either of splitting its air force to meet attacks from two different directions or of concentrating on raids from one direction and letting the others go unresisted.¹⁷

When the first plans for the unified control were submitted to the British Chiefs of Staff for consideration they objected to it on the grounds that such an organization might tend to disrupt coordination between the USAAF and RAF, and that the provision for transfer of aircraft and crews from one theater to another would be a waste of manpower and effort. The United States Joint Chiefs of Staff, however, answered that they felt that the advantages of the proposal far outweighed the disadvantages. Since the

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headquarters of the new organization would remain in the United Kingdom and there would be no alteration in intelligence and other services performed by the British, coordination between the United States strategic air forces and the RAF would be strengthened. Furthermore, the plan would have the advantage of bringing the Fifteenth Air Force into closer control. The JCS did not consider the occasional transfer of aircraft from one theater to another as wastage of manpower or facilities since each AAF group was organized to handle the needs of two groups for brief periods.

After disposing of the British objections the JCS proposed to the CCS that: (1) control of all U. S. strategic air forces in the ETO and MTO be vested in a single command and be employed against POINTBLANK objectives or such others as the CCS might from time to time direct; (2) such over-all command coordinate its operations with the RAF Bomber Command; (3) the commanders of the U. S. Army Forces in both the United Kingdom and Mediterranean retain responsibility for over-all base services and administrative control of the strategic air forces; (4) provision be made to assure adequate support to POINTBLANK as the air operation of first priority; (5) the headquarters of the U. S. strategic air forces be established in the United Kingdom; (6) the Commanding General of the U. S. Army Air Forces have direct channels of approach to the Commanding General of USSTAF.¹⁸

On the basis of the above points the CCS established USSTAF, effective 1 January 1944.¹⁹ Under the terms of the directive USSTAF was to come under the command of the Supreme Allied Commander (SAC) at a later date, and in the meantime the British Chief of Air Staff would continue as deputy for

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the CCS and be responsible for coordinating all POINTBLANK operations. The Commanding General, USSTAF was charged with determining the priorities of POINTBLANK targets to be attacked by the Eighth and Fifteenth and with coordination of the efforts of these two air forces. He was also authorized to move the units of the Eighth and Fifteenth between the ETO and MTO within the limits of base area facilities and available for his forces. USSTAF was also to keep the Allied Commander-in-Chief of MTO fully informed of the general bombing intentions and requirements and to coordinate operations with those of the aforesaid Allied Commander-in-Chief. ^{U.S.} The/Commanding generals in ETO and MTO would continue to be responsible for the administrative control of the AAF in their areas of command, including the base services. Whenever a strategic or tactical emergency arose, however, theater commanders could, at their discretion, employ the strategic air forces based in their theater for purposes other than POINTBLANK, but they must inform the CCS and Commanding General, USSTAF ²⁰ of their action.

Lt. Gen. Carl Spaatz was designated Commanding General of USSTAF and immediately began organizing his new command. The headquarters of the Eighth Air Force became the headquarters of USSTAF under the new setup. The VIII Bomber Command was inactivated and its headquarters became that of the Eighth Air Force. The POINTBLANK operations of the Fifteenth Air Force were controlled by Spaatz's ^{Commanding General} Deputy/for Operations who also coordinated efforts of the Ninth Air Force and the RAF. Personnel and logistic requirements of the Eighth and Ninth Air Forces were coordinated by the ^{Commanding General} Deputy/for Administration, who also had under his jurisdiction the over-all air service ²¹ command.

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On 20 January, Spaatz assumed responsibility for all United States air forces in England; and the old office of Commanding General of USAAF in the United Kingdom, which had been held by Eaker along with his job as Commanding General of the Eighth Air Force, was abolished. The question arose, however, as to the wisdom of this move, and after the return of Maj. Gen. B. M. Giles from a visit to England it was suggested to Arnold that Spaatz be officially given such command as an additional duty. Arnold was cold to this recommendation, although Spaatz was willing to assume the added responsibility. Arnold pointed out that in forming USSTAF he not only had had in mind the unification of the two strategic United States air forces but also the building up of an American air commander to the same level as Harris, the RAF commander, and parallel to General Eisenhower. "If you do not remain in a position parallel with Harris," he wrote Spaatz, "the air war will certainly be won by the RAF if anybody. Already the spectacular effectiveness of their devastation of cities has placed their contribution in the popular mind at so high a plane that I am having the greatest difficulty in keeping your achievement (far less spectacular to the public) in its proper role not only in publications, but unfortunately in military and naval circles and, in fact, with the President himself." Arnold was likewise afraid that Eisenhower would not be SAC after the cross-Channel invasion had been achieved, and therefore if Spaatz were not on an equal basis he would be subordinate to Eisenhower^{who}/as Commanding General of the American Army Forces, would, in turn, be subordinate to SAC. Spaatz then would have limited responsibilities. If a common administrative authority over the USAAF in

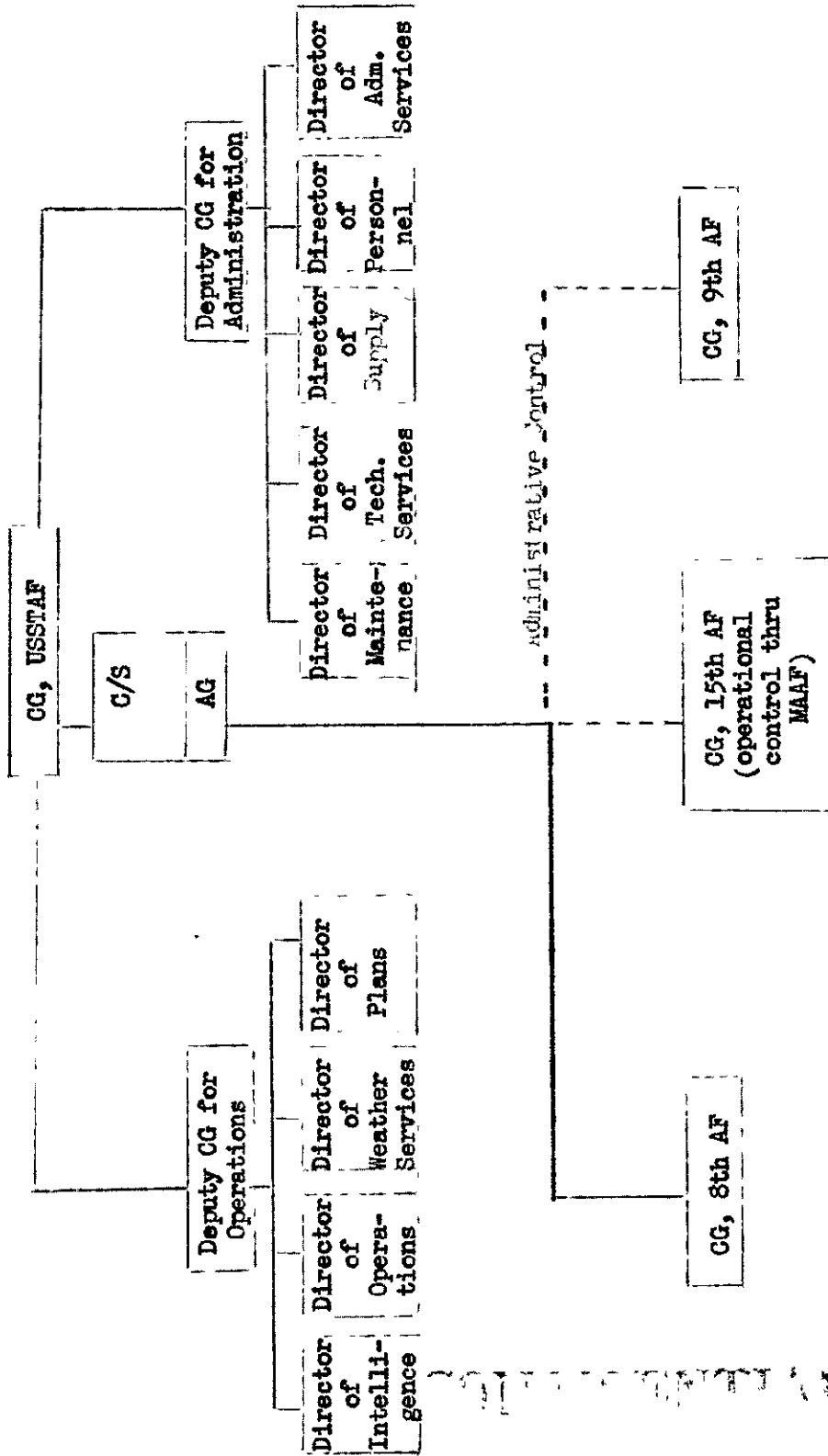
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Chart III

ORGANIZATION OF USSTAF, MAY 1944



NOTE: The Deputy CG for Administration was also CG, Air Service Command, USSTAF.

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England was necessary, he recommended that Spaatz's deputy commander be given the job as additional duty. This would not give Spaatz any lawful authority over administrative matters; but Arnold said he could not imagine one of Spaatz's deputies going contrary to Spaatz's wishes merely because he had the legal right to do so.

Spaatz replied that both the progress of USSTAF in coordinating the efforts of the Eighth and Fifteenth and the accepted channels of communications were satisfactory and should give Arnold no cause for alarm. Eisenhower, he said, planned to make Air Marshal Tedder the SHAEF executive in over-all control of/operations when USSTAF went under control of SAC in accordance with the original directive. Leigh-Mallory would command the Allied Expeditionary Air Forces, which would include only those units assigned to it. There was no danger of USSTAF becoming subordinate to or a part of AEAFF. Harris and Spaatz would be coequal and would receive orders from SAC through Tedder in accordance with a basic plan which would be developed by equal representation from the RAF, AEAFF, and USSTAF. Furthermore, both Tedder and Spaatz were agreed on the vital necessity of POINTBLANK. If Eisenhower's plan of organization was not accepted, however, then Spaatz recommended Arnold's suggestion of appointing the Deputy Commanding General (Administration) of USSTAF as Commanding General of USAAF in England as an additional duty. But until a decision was made on Eisenhower's plan, Spaatz recommended a status quo on the situation.

At this same time the discussion over target priorities for the completion of the CBO was being carried on among the AEAFF, USSTAF, and SHAEF. With the acceptance of the AEAFF proposal that transportation be given priority over oil in preparation for OVERLORD, the CCS passed the responsibility to

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SAC for directing all air operations out of England, including USSTAF and the RAF Bomber Command. This change of responsibility became effective on 14 April, and Spaatz was instructed to look to Tedder for direction on all operations concerned with POINTBLANK and OVERLORD. In regard to the Balkan operations of the Fifteenth Air Force, however, Portal would continue to determine the weekly priorities. Once OVERLORD was established the CCS would review²⁵ the future method of direction and employment of the strategic air forces. This, then, was the situation that existed through D-day.

Although in early March Spaatz had expressed satisfaction with the operational setup, the divided lines of authority and the provision that the theater commanders could declare emergencies and divert the strategic forces from POINTBLANK objectives created at times confusion and misunderstandings. Again it was the Balkans which provoked the most trouble. During the period of debate over the USSTAF and AEAFF plans for the completion of the CBO, Spaatz continued to assign target priorities for his forces under the authority²⁶ granted him by the CCS when USSTAF was established. The USSTAF plan under consideration gave oil the high priority, and Spaatz had placed the Ploesti refineries on the list of primary targets for the Fifteenth Air Force. Portal, after conferring with the CCS and His Majesty's Government, decided against oil and substituted the Ploesti marshalling yards. This he did under his authority to determine Balkan targets for the Fifteenth and under the authority of the Allied Commander-in-Chief, MTO to use the strategic air forces under him for targets other than POINTBLANK when an emergency existed. This decision brought from Spaatz a complaint that too many people were giving orders to the Fifteenth. As he understood it, this organization operated under his instructions

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except when a tactical situation of the ground forces in Italy demanded otherwise, and he declared that if this confused state of affairs continued he could not accept the responsibility for the Fifteenth Air Force. Unless the CCS took definite action on command channels, he said, the power of USSTAF would be emasculated.²⁷ Arnold backed up Spaatz and emphasized the purpose of the Fifteenth in the POINTBLANK program to Portal.²⁸ The latter replied that he regretted the trouble which had arisen and assured Arnold that any by-passing of Spaatz in giving orders to the Fifteenth was wholly unintentional. He did insist, however, that he had the right to divert the strategic air forces in the Mediterranean when a strategic or tactical emergency arose, and because of the political situation and status of the Russian advance he considered that an emergency existed in the MTO.²⁹

Another area where diversion from POINTBLANK targets occurred was the Italian peninsula. This was understandable since the CCS had given highest priority in the MTO to the Italian campaign. It must also be remembered that the Allied Commander-in-Chief, MTO had the authority to requisition the strategic air forces under him whenever he considered a tactical emergency was uppermost in importance. The three Italian campaigns which called for specific aid from the Mediterranean Allied Strategic Air Force (MASAF) were: Anzio (SHINGLE); Cassino break-through; and DIADEM (interdiction of north Italian railroads) which included the final push against Rome. Not all bombing in support of these projects, however, called for diversion, and often support to both the Italian campaign and POINTBLANK could be given simultaneously.³⁰

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Since USSTAF was organized for the purpose of coordinating the efforts of the Eighth and Fifteenth Air Forces and bringing about uniformity in POINTBLANK, the question naturally arises as to how successfully the objective was achieved in actual operations. The numerous changes in command^{that} took place in early 1944 because of the reorganization in the MFO and ETO delayed coordinated action for the Eighth and Fifteenth Air Forces for several weeks. On 3 February General Spaatz issued his first directive outlining the methods by which these attacks would be carried out. There were three possible types of coordination. The first method was coordination initiated by either air force. The commanding generals concerned would notify each other daily of their bombing intentions in order that either one could take advantage of any diversionary effect or give support to the other's mission. Direct communication between the Eighth and Fifteenth Air Forces for this purpose was authorized, but Headquarters, USSTAF and Headquarters, MAAF also had to be notified simultaneously of the daily bombing plans and any changes therein. The second method was coordination by previously prepared plans worked out by the Combined Operational Planning Committee. Either air force could initiate any such already planned operation, with necessary modifications to meet conditions of the moment, upon proper notification to the other headquarters. The third method was coordination by special direction of the Commanding General of USSTAF. This method would be employed when USSTAF decided the necessity for direct execution of a coordinated attack, and it might be ordered on very short notice.

Early difficulties encountered in successfully executing this directive led Spaatz to revise it on 22 February. The three types of coordination

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remained the same but direct communication between the Eighth and Fifteenth Air Forces was prohibited and all notices of bombing intentions or changes would be reported to the other air force by relay through USSTAF and MAAF. If one air force wished to put in operation one of the COPC's previously planned attacks the request would be made through normal channels. In the case of the Fifteenth the request would go through MAAF and, if approved by Eaker, would be forwarded to USSTAF, which would accomplish all necessary coordination. When the third type of coordination was employed there could be no cancellation without authority from the Commanding General of USSTAF. If an emergency which would interfere with the proposed mission existed in the Italian battle, it was left to the discretion of the Commanding General of MAAF as to whether all or a part of the Fifteenth Air Force would be withdrawn. USSTAF, however, was to be promptly notified of any changes in the plans in order that the operations of the Eighth could be amended. Notification also had to be given when weather prohibited participation in a planned mission.³³

In the period covered by this study, however, only three coordinated attacks were completed, but the results of these three fully paid for the effort expended in setting up an over-all control agency. Numerous other benefits also were derived from having USSTAF. It harmonized the work of two air forces operating in different theaters and planned and executed other important operations such as the shuttle bombing to and from Russian bases (FRANTIC) which began in June 1944.³⁴

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Table 7

USSTAF COORDINATED ATTACKS
1 JANUARY-6 JUNE 1944***

Date	Coordinated Attacks		Cancelled or Declined Weather	Other Reasons	Results	
	Proposed	Implied*			Abortive	Completed
9 Feb	8th		15th			
15 Feb	8th		15th			
20 Feb	8th				15th	
21 Feb	8th		15th			
22 Feb	8th					8th/15th
23 Feb	8th		8th			
24 Feb	8th					8th/15th
25 Feb	8th					8th/15th
26 Feb	8th			15th**		
4 Mar	8th				15th	
17 Mar		X	15th			
			8th			
24 Mar	8th				15th	
26 Mar	8th				15th	
29 Mar	8th		8th			
7 Apr	8th		8th			
11 Apr		X	15th			
12 Apr	8th		8th			

* "Coordinated Attack Implied" means that if the intentions of both air forces had been carried out as announced, a coordinated attack would have resulted, though neither had specifically requested the support of the other.

** Planes had been forced by weather to land away from base on previous day's attack.

*** MAAF, Preliminary Study of Coordinated Attacks by USSTAF, Sup. B.

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Chapter V

WEAPONS AND DEFENSE

In addition to operational and administrative planning and organization there were numerous other problems to be solved in order to make the Combined Bomber Offensive a success. Well-trained combat crews were necessary to insure maximum usefulness of the air forces. Adequate supplies had to be available. New and modified weapons needed to be developed to meet ever-changing battle conditions. If the enemy were to be subjected to round-the-clock bombing, techniques for defeating the weather had to be evolved. Self-defense measures and methods of penetrating the enemy defenses had to be worked out.¹

Although the Training Command and the four domestic air forces provided the great bulk of training, supplementary training and indoctrination in combat techniques were necessary in the theaters of operation. After the reorganization of the Eighth Air Force and the establishment of USSTAF in January 1944, this work became the chief function of the Composite Command.² In addition to combat training the Eighth gave instruction in a number of miscellaneous subjects, such as the use of personal equipment and air-sea rescue procedures. Provision was also made for keeping up to date on engineering advancements. A Boeing aircraft school for engineering personnel of B-17 units had to be provided because of the number of modifications made on the Flying Fortress since the first groups had arrived in the theater. The Eighth also made use of schools not under its jurisdiction,

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but to which it sent personnel on temporary duty at various times. Some of these gave instruction in B-17 armament, Cyclone engines, Wasp engines, sheet metal, and Link trainer maintenance.³

In the Mediterranean theater, training was at first under the Training and Equipment Section of MAAF Combat Operations Division, but in April 1944 this was transferred to A-3 of AAF/MEO. The latter was now charged with formulating training policies of all USAAF units in the theater. Although much of the necessary instruction was given by the individual wings and groups in accordance with A-3 directives, arrangements were made with several RAF schools in the Middle East to give specialized training to U. S. personnel. The courses so arranged provided instructions for gunnery leaders, filterers and plotters, pilot gunnery instructors, fighter controllers, and bombing leaders. The best course, however, did not prove satisfactory since the instructors dealt entirely with RAF tactics and equipment which differed considerably from those of the Americans.⁴

One of the biggest problems faced by the air forces was the training of aircrews for combat after arrival in the theaters. It was impractical to dispatch green crews to combat without some training and indoctrination in actual battle conditions as opposed to the theoretical conditions learned in the Zone of the Interior. In the Eighth Air Force this job was undertaken by the Composite Command and new crews were assigned to one of its combat crew replacement centers (CCRC) for the necessary training. When the Composite Command assumed this^{increased} responsibility in early January it was possible to accept only 20 crews at a time, but by the end of this same month the program was revised, and with enlarged accommodations 40 crews

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could be trained in each course. A shortage of B-24 crews in early April led to orders to speed up the program. This was done by assigning new crews to combat units as soon as they finished their ground school, in which case flying training was accomplished at an operational airdrome. Here, by performing practice missions before going into combat, crews did not fly alone or in a lead position until they had the required experience. It was also in April that the Composite Command established its peak record when it graduated 467 heavy bomber crews and 581 fighter pilots from its CCRG's.⁵

The Fifteenth Air Force lacked an organization similar to the Composite Command and its training of combat crews was carried out largely by the groups and squadrons to which they were assigned. The burden on both the MTO and ETO was lightened somewhat in the late spring of 1944 when the four domestic air forces were required to specialize in the type of training they gave. All the heavy bombardment crews of the First, Second, and Third Air Forces were scheduled thereafter to go to the European and Mediterranean theaters, and they were given as much theater indoctrination as time allowed before their departure.⁶

Another plan for combat crew training was evolved in late January 1944. This concerned crews which were already battle-wise, however, and not new replacements. When USSTAF was established, its commanding general was authorized to move units from one theater to another when the occasion demanded; but varying theater conditions did not make this feasible unless the crews were familiar with each other's problems. Therefore a mutual exchange of combat crews between the Eighth and Fifteenth Air Forces was

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contemplated. Eighth Air Force commanders did not look with favor on the scheme. They argued that the crews they would lose would be more experienced in leadership under ETO conditions than the ones they received. Thus, the effectiveness of the operating force would be reduced, at least temporarily.⁷ Headquarters, AAF and the War Department, however, believed the idea an excellent one for equalizing experiences and losses, and Spaatz was authorized to proceed without further authority, but to keep Washington advised as to timing and methods to be employed.⁸ The first exchange of crews took place in February. Eighth Air Force crews to be exchanged were to have completed 12 to 15 missions and those of the Fifteenth 23 to 27 missions. In the new theater the crews from the Eighth would complete 23 to 27 missions and the Fifteenth from 12 to 15, but once rotated the crews would not be again interchanged.⁹

While plans for the interchange of crews were being discussed, an alternative scheme was proposed by Brig. Gen. Robert B. Williams, Commanding General of the 1st Bombardment Division. He suggested sending 15 of his crews and 10 airplanes to North Africa for a short period of training, all to be returned to him upon completion of it. It was decided to study this proposal and if feasible carry it into execution. In April, arrangements were completed for sending 10 airplanes and crews of the 1st Bombardment Division for training at Fifteenth Air Force bases in Italy. Each aircraft was to bring three maintenance men, but all other facilities would be provided by the Fifteenth.¹⁰

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Pilots, as well as crews, needed a certain amount of training during their combat tour of duty. In February, the Eighth Air Force initiated two pilot-training courses. The first course was in the use of SCS-51 blind-landing equipment, which was new and considered superior to all other such equipment. Each bombardment group furnished one pilot to attend this school. Upon completing his training, he returned to instruct the other pilots in his group. The second course taught pilots how to operate airplane engines more efficiently. This instruction had a two-fold purpose: (1) to reduce fuel consumption, particularly on long-range missions; and (2) to reduce general wear and tear on aircraft power units. The curriculum was drawn up by the A-3 Training Section and the Operational Research Section, and instruction was carried out in each group.¹¹

In the Fifteenth Air Force, the inexperience of pilots was a source of concern to Headquarters, AAF as well as to the commanding generals in the MTO. Arnold cabled Eaker that he was aware of the lack of leadership in airplane commanders (not only in the Fifteenth, but in all the air forces) and that an attempt was being made in the Zone of the Interior to improve the quality by placing more emphasis on knowledge of equipment and military discipline for replacements. The training period could not be lengthened, said Arnold, but he would welcome any suggestions from the theater.¹²

Maj. Gen. Nathan F. Twining, Commanding General of the Fifteenth Air Force, recommended, therefore, that during the training period pilots should be drilled in the responsibilities of airplane commanders; personal discipline of all crew members; the preservation of command channels; dangers of undue familiarity between commander and crew members; technical knowledge and responsibility for proper operation of all airplane

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equipment; ability to give orders with assurance; and careful and precise execution of commands.¹³ In the theater, the training was continued by using nonoperational days to keep the men proficient. Long periods of sustained operations had tended to lower efficiency and bring about deterioration in both formation flying and bombing. It was for this reason that nonoperational days were utilized for training. Instruction, though, was carried on in the group and not at a centralized location.¹⁴

Fighter pilots also came in for their share of training. In the Eighth Air Force the VIII Composite Command handled this instruction in the 495th and 496th Fighter Training Groups. Fighter pilots for the Fifteenth Air Force at first received their theater precombat training in the Fighter Training Center of the XII Air Force Training and Replacement Command (Prov.). This training for P-38 pilots was later transferred to the Fifteenth Air Force because of the lack of serviceable planes in the Training Center. P-38 replacements were sent, therefore, directly to that air force's fighter bases and there given the necessary training.¹⁵ In April the same policy was put into effect for P-47 and P-51 replacements.¹⁶ The introduction of the P-51 into the Fifteenth posed a new training problem. With no centralized training center and no experienced P-51 personnel to give instruction, the Fifteenth was obliged to request the Eighth to lend the needed instructors, including at least one squadron or flight leader. This same procedure had also been followed earlier for P-47 training.¹⁷

Since the chief function of heavy bombers was to drop bombs directly on a target considerable attention was given to achieving a high degree of accuracy. In the United States crews and bombardiers had been trained under

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more favorable conditions, and this resulted in the belief that American flyers could hit fish in a pickle barrel. In the theater, however, weather and enemy defenses such as smoke screens, flak, and fighter opposition limited the degree of accuracy obtainable and made necessary many adjustments in technique.¹⁸ Many lessons had to be learned the hard way in actual battle, but it was possible to pass on the experience so gained to green crews before they began to fly combat missions.

Although the VIII Composite Command trained the Eighth Air Force replacements, there was constant need for continuous training within the operational groups. In January, the Eighth Air Force training director urged greater use of synthetic equipment by those groups possessing it, and those without these aids were told to requisition them immediately. The problem was further aggravated by a scarcity of practice bombing ranges, but this situation was considerably alleviated by March.¹⁹ A new problem complicated Eighth Air Force training as the time for the invasion of the Continent drew nearer. It was realized that the heavy bombers would be assigned a number of tactical targets on D-day and in the weeks following, and since this work required different techniques than those employed in strategic bombing, studies of such methods²⁰ were made, and training on the new procedures began in May.

The need for training in the Fifteenth Air Force is illustrated by a complaint of Eaker to Twining in March that studies of accuracy, particularly of B-24's, in attacks on marshalling yards and airdromes were disappointing, and he stressed the necessity for improved accuracy, formation flying, and leadership.²¹ Twining replied that he fully concurred with Eaker and he hoped to show marked improvement in the near future, especially when the Fifteenth

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got back to more frequent strategic bombing and when blisters for navigator and bombardier were installed in the B-24 airplane.²² In order to improve accuracy, Headquarters, Fifteenth Air Force had established a full-time school for bombardiers and by June was turning out approximately 20 potential leaders a week. The Operations Analysis Section made exhaustive studies on bombing problems and errors and in collaboration with the Training Section published a weekly "dope sheet" called "Straight and Level," which listed all bombing results and helped stimulate competition between groups. One practice bombing range for each wing was also provided and it was hoped that by summer two would be available for each. Training was given on these ranges on all nonoperational days and at any time when individual planes were not being used in combat.²³

In general the Eighth showed better results than the Fifteenth, although the latter indicated an improvement of 5 per cent on the basis of Circular Probable Error (CEP) in the first four months of 1944.²⁴ In May the average CEP for Eighth Air Force B-17's at a 15,000-foot altitude was 900 feet and for the B-24's it was 1,100 feet. The CEP in the Fifteenth for B-17's at 15,000 feet was 1,050 feet and for B-24's it was 1,250 feet. At a 20,000-foot altitude the Eighth Air Force CEP was 1,100 and 1,300 feet for B-17's and B-24's respectively; and in the Fifteenth, 1,470 feet for B-17's and 1,600 feet for B-24's.²⁵ It was expected that accuracy of the Eighth would be better than that of the Fifteenth, which was a newer and less well-integrated air force. Despite the striving, a high degree of accuracy was not achieved in this period. A survey of over-all bombing results for the entire war shows that only 20 per cent of bombs aimed at

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precision targets fell within a circle having a radius of 1,000 feet. This low percentage of accuracy made it necessary, of course, to send larger tonnages of bombs against targets than would have been required if accuracy had been greater.²⁶

One of the most persistent training problems in the theaters of operation was that of aerial gunners in heavy bombardment units. A high degree of efficiency was needed even after the increase of long-range fighter escort reduced the danger from the GAF, because there was always a group or two upon which the enemy concentrated with ferocity and determination. The blame for the poor showing of gunners lay in large part in the training they received in the Zone of the Interior. The chief deficiencies complained of in the combat zones were (1) inability of many gunners to perform their basic mission; (2) little or no knowledge of the .50-cal. machine gun; (3) inability to load turrets; (4) lack of information on sighting.²⁷

Table 8

BOMBING ACCURACY OF EIGHTH AIR FORCE, JANUARY-MAY 1944*

Month	Per Cent of Bombs Falling within 1,000 ft. of Pre-assigned Aiming Point	Per Cent of Bombs Falling within 2,000 ft. of Pre-assigned Aiming Point	Total Weight of Bombs in lbs.
January	37	62	8,928,000
February	39	68	14,570,800
March	31	61	16,240,000
April	33	63	32,100,000
May	39	69	43,577,000

* Eighth Air Force, ORS, Reports of Bombing Accuracy, Jan-Jun 44, in ORS Archives. Above table excludes targets of opportunity.

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During January 1944 in conjunction with its combat crew training, the VIII Composite Command established a ground school for aerial gunners at Greencastle, Ireland. The gunnery school at Snettisham was also reorganized to give flexible and turret gunnery instruction to 4,000 men a month, and all gunnery replacements in the ETO were sent here prior to being assigned to a tactical organization. An exchange of Eighth Air Force gunners with instructors from the Zone of the Interior was worked out. Those from the United States were assigned to the three bombardment divisions where they participated in a minimum of three missions, and then were placed in a CGRG or bomb group as gunnery instructors. Training turrets were set up in some groups, and in all, practice missions were flown in which fighters made mock attacks while the gunners practiced tracking and aiming. Training films and pamphlets were widely used and instruction was given in aircraft recognition.

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In the Fifteenth Air Force arrangements were also made with the Zone of the Interior to provide instructor training for flexible gunnery. Devices such as the Peorman trainer and training turrets were employed in the groups, and practice ranges were set up. Fixed gunnery training was carried on in the fighter units in addition to sending two pursuit pilots a month to the RAF school at Ballah, Egypt.

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Supply was another persistent problem of both the strategic air forces. Foremost interest in this matter was, perhaps, in maintaining a constant flow of planes and crews from the United States to the theaters in enough volume to allow both for build-up to authorized strength and for adequate replacements. Next in importance was the problem of keeping the planes on hand operational, because regardless of how much equipment was assigned, it was useless unless it was ready for combat. During the first five months of 1944, the percentage

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of heavy bombers operational in either one of the strategic air forces ranged from 65 per cent to 85 per cent, with the monthly average for both being somewhat over 70 per cent.³¹

One of the chief reasons for the nonoperational state of aircraft was the lack of spare parts for repair. In February, it was stated that 10 per cent of the B-17's in the Eighth Air Force were grounded for this reason. In other cases maintenance men were handicapped by shortages of tools and such raw stock as sheet metal, cable, wire, and hose.³² The Fifteenth Air Force had the same experience. It was estimated that 9 per cent of the nonoperational bombers in that organization in March were grounded because of spare-part shortages. In most cases these were small items which could be brought from Patterson Field to Italy in one transport plane. Maj. Gen. Walter H. Frank, Commanding General of the Air Service Command, recommended that a plane or two be sent to the United States to procure the necessary items and bring them back to the theater. This would be sufficient to put 60 aircraft in commission. Accordingly, Twining was directed to dispatch to Patterson Field one Fortress and one Liberator from his force to pick up the needed supplies. The planes used were to be those leastlikely to be needed for tactical operations, and their crews would be those with great experience and most deserving of a trip home.³³

Another factor in determining the number of planes that could be put into the air at any one time was the number of crews available. The attrition rate rose steadily as the bomber offensive was stepped up. For the first three months of 1944 the Eighth Air Force lost a total of 857 bombers, of which 723 were missing in action. The crew casualties were 430 killed, 656 wounded,

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Table 9

HEAVY BOMBERS ON HAND AND OPERATIONAL
JANUARY-MAY 1944*

<u>Month</u>	<u>Air Force</u>	<u>Type of Plane</u>	<u>No. on Hand</u>	<u>No. Operational</u>	<u>Per Cent Operational</u>
January	8th	B-17	938	657	70
	8th	B-24	244	186	76
	15th	B-17	234	186	80
	15th	B-24	458	300	66
Total			1,874	1,329	71
February	8th	B-17	1,129	786	70
	8th	B-24	352	260	74
	15th	B-17	192	159	83
	15th	B-24	518	341	66
Total			2,191	1,546	71
March	8th	B-17	1,100	792	72
	8th	B-24	399	302	76
	15th	B-17	324	279	86
	15th	B-24	734	570	78
Total			2,557	1,943	76
April	8th	B-17	1,129	908	80
	8th	B-24	485	379	78
	15th	B-17	324	245	76
	15th	B-24	853	607	71
Total			2,791	2,139	77
May	8th	B-17	1,190	949	80
	8th	B-24	836	675	81
	15th	B-17	326	264	81
	15th	B-24	936	605	65
Total			3,288	2,493	76

* Eighth Air Force Statistical Control, Monthly Summary of Operations, Mar-May 44; History of MAAF, 10 Dec 43-1 Sep 44, X, SCORU, Recapitulation of Weekly Report of Status of Aircraft and Combat Crews, Jan-May 44.

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and 7,160 missing; and, with losses due to other causes, the Eighth lost a total of 1,094 combat crews during this same period. More than half this number, or 552 bomber crews, was lost in May alone.³⁴ The Fifteenth lost a total of 229 heavy bombers in the first quarter of 1944, with approximately the same number of crews. In May alone the loss amounted to 168.³⁵ The flow of replacements did not always keep pace with the needs. At one time Eaker complained that although the Fifteenth lost 114 heavy bomber crews in February, he was told to expect only 57 replacements in March and 51 in April.³⁶ Even though the Eighth Air Force fared somewhat better than the Fifteenth, its available crew strength dwindled from a surplus over operational aircraft in January to a reverse situation in May.³⁷ The relationship of operational aircraft to operational combat crews determined the combined effective operational strength of both air forces.³⁸

One of the theories upon which heavy bombers had been developed was that they would be able to furnish their own protection. The practical application of this theory early in the war proved, however, very costly. Numerous modifications in armament and armor were made, mostly in 1943, to correct the faults discovered by actual battle experience. Satisfactory modifications in armament of the B-17 had been completed by late summer of 1943 and it was not until a year later that further major changes were made.³⁹ On the B-24 several gun changes were tried in the early months of 1943. In the fall of that year several more occurred. The waist gun position, for example, was relocated farther outboard to increase the azimuth of fire. A nose turret also superseded the twin .50-cal. nose gun so as to give more frontal protection. The retractable ball turret, installed in production aircraft in the fall of 1943,

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Table 10

HEAVY BOMBER CREWS ASSIGNED AND OPERATIONAL
JANUARY-MAY 1944**

<u>Month</u>	<u>Air Force</u>	<u>Type of Crew</u>	<u>Crews Assigned</u>	<u>Crews Operational</u>	<u>Effective Strength</u>
January	8th	B-17	1,190	805	*
	8th	B-24	454	308	
	15th	B-17	201	172	169
	15th	B-24	583	492	300
Total			2,428	1,777	
February	8th	B-17	1,171	812	*
	8th	B-24	512	343	
	15th	B-17	151	121	121
	15th	B-24	687	497	339
Total			2,521	1,773	
March	8th	B-17	1,091	699	650
	8th	B-24	548	364	292
	15th	B-17	278	223	223
	15th	B-24	883	715	514
Total			2,800	2,001	1,679
April	8th	B-17	1,134	711	694
	8th	B-24	583	393	355
	15th	B-17	312	270	232
	15th	B-24	966	826	604
Total			2,995	2,200	1,885
May	8th	B-17	1,299	848	805
	8th	B-24	807	534	499
	15th	B-17	309	249	241
	15th	B-24	1,008	870	597
Total			3,423	2,501	2,142

* No figures on effective strength for Eighth Air Force given for January and February.

** Eighth Air Force Statistical Control, Monthly Summary of Operations, Jan-May 44; History of MAAF, 10 Dec 43-1 Sep 44, X, MAAF, SCORU, Recapitulation of Weekly Report of Status of Aircraft and Combat Crews, Jan-May 44.

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was removed on some of the Liberators in June 1944. This turret had lost much of its value since the enemy ceased attacking in the field covered by it, and its removal gave increased performance to the airplane. Several changes in armor also were instituted in both the B-17 and B-24. In order to reduce the weight of the aircraft, flak curtains were substituted for armor plate to protect the crew, and the results appeared to be satisfactory. One of the most vital points in an airplane is its engine. The number of planes which were lost when the enemy was successful in hitting the engines led to experimentation in 1944 with heavily armored power units. The changes proved unsuitable in operation, however, because the added weight of the protective equipment reduced the speed of the plane too much. ⁴⁰

Excluding outside help, the best defense for the heavy bombers seemed to be in the type of formation they flew. When the Eighth began to operate in August 1942 it used a squadron formation of six aircraft each, but the squadrons were so widely separated that they were unable to give mutual fire support. This small formation had, however, an advantage in flexibility and permitted greater bombing accuracy. In September, the 18-aircraft group composed of two squadron combat boxes of nine planes each was used. Each squadron, made up of three elements, flew a V formation, and each element was a V of three aircraft. This gave greater compactness to the group at the expense of flexibility. Then came the 36-plane group and the javelin and wedge formations. The increasing enemy opposition and lack of long-range fighters to escort the bombers all the way to the target and back demanded still more fire power and minimum exposure. To provide this the 54-plane group was devised in the spring of 1943, and remained the

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standard formation throughout the rest of the year. Despite its protective advantages, it was unwieldy and inflexible, it failed to take care of stragglers, and pin-point bombing accuracy was reduced. In January 1944 the increase of fighter escort and its longer range allowed the return to a 36-plane formation. The introduction of pathfinder force (PFF) equipment also necessitated a smaller and more compact organization. The effectiveness of the 36-plane type of formation was proven in the attacks of February in which the Luftwaffe suffered its worst setback. This became standard operating procedure until the spring of 1945 when a 27-⁴¹ plane formation was inaugurated.

By the spring of 1944 the danger from the GAF had decreased and danger from flak had increased, so that there was need for a revision in the internal organization of the 36-plane formation. There were more damages than losses from flak, but in both categories there was a constant increase.⁴² In order to offset the hazards of flak, Lt. Gen. James H. Doolittle, Commanding General of the Eighth, requested his division commanders in March to study types of formations best suited for defense against flak. In the coming months increasing attention would be focused on such installations as marshalling yards, roads, railroads, and bridges, all of which would be heavily defended by anti-aircraft fire.⁴³ In May the 12-ship stagger which gave the necessary protection to each group of 36 planes and allowed safe⁴⁴ bomb dropping was perfected.

The best defense against enemy air opposition, however, was in the use of fighter escort. It was realized very early in the war that regardless of the armor and formations of heavy bombers the losses were great

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Table 11

CAUSES OF HEAVY BOMBER DAMAGE IN EIGHTH AIR FORCE
JANUARY-MAY 1944*

<u>Causes of Damage</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>
Flak	1,198	1,933	2,610	3,355	3,468
Rockets, aerial bombs, or shells larger than 20 mm.	5	4	2	2	0
20-mm. shells	86	129	144	174	135
Small caliber	81	90	68	79	36
Total damaged by enemy a/c	172	223	214	255	171
Machine-gun fire (origin unknown)	64	68	58	106	80
Fire from friendly aircraft	2	8	5	3	7
Self-inflicted damage	53	60	40	38	17
Total caused by Allied gunfire	55	68	45	41	24
Empty shell cases or links	115	100	114	108	136
Other sources	22	23	28	17	44
Unknown causes	29	18	17	19	10
Total incidents of damage	1,655	2,433	3,086	3,901	3,933
Total aircraft damaged	1,357	2,163	2,805	3,542	3,667
No. of incidents of damage per a/c damaged	1.22	1.12	1.10	1.10	1.07

* Eighth Air Force Statistical Control, Monthly Summary of Operations, Jan-Apr 44.

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Table 12

CAUSES OF HEAVY BOMBER LOSSES IN EIGHTH AIR FORCE
JANUARY-MAY 1944**

<u>Cause</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>
Flak	8	39	62	105	77
Enemy aircraft	77	125	103	147	6
Flak and enemy aircraft	0	15	6	26	136
Accident	5	0	17	1	15
Unknown causes	85	71	110	82	76
Category E*	36	49	49	43	51

* Category E airplanes were those damaged beyond repair.

** Eighth Air Force Statistical Control, Monthly Summary of Operations, Apr-May 44.

unless they were adequately protected by fighters. In general, therefore, the range of the fighters limited the depth of penetration which could be economically effected by the heavies. This did not mean, however, that the experiment of self-protection ceased. Formations of B-17's and B-24's continued to fly beyond the fighter range, but usually at great cost. This continued until the fall of 1943 when operations were more or less restricted to the fighter ranges. The peak for average monthly losses in the Eighth Air Force was reached in October with 28 bombers lost per mission. Thereafter, when bomber missions were held down to or not far beyond the capabilities of the escort, the average monthly losses were cut to half and less than half.⁴⁵

In May 1943 when P-47's began to join the Spitfires in escort duties their range was only about 175 miles from their base. This meant, of course, that the bombers had the benefit of their protection for only a short distance across the English Channel. In August of that year the addition of a belly tank increased the range to about 375 miles. Two

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108-gallon wing tanks attached in February 1944 extended the P-47's radius another 100 miles. With the wing tanks this airplane could fly still farther when not escorting. In fact, it was possible to reach beyond Berlin on a sweep. The first group of P-38's became operational in October 1943 and was used to provide escort beyond the range of the P-47's. In November, P-38's with two wing tanks of 75 gallons each were able to fly escort for 520 miles. Increasing the size of wing tanks to 108 gallons each in February 1944 extended the range to 585 miles. One of the most satisfactory of the fighters for escort purposes was the P-51. Without any additional fuel tanks this airplane could range as far as the P-47 with its wing tanks. The addition of two 75-gallon wing tanks in March 1944 allowed the P-51 to escort for 650 miles, and with two 108-gallon wing tanks, added the same month, its potential range was 850 miles from base. The high point in escort for this plane was on 29 May 1944 when it furnished escort all the way to and from Poznan (Posen)--a distance of over 700 miles. From that time on fighters escorted the bombers to every target.⁴⁶

The range of the fighters and the number available to accompany the bombers demanded that various methods of escort tactics be developed to meet varying conditions. Three basic types of escort were finally evolved: (1) close or direct support, (2) area support, and (3) combination area and close support. In the first, the fighters flew with the bombers protecting them from the enemy. Since there was considerable weaving back and forth to ward off attacks and cover the slower bombers, the potential range was greatly reduced. In order to overcome this deficiency, a system of relays was worked out, whereby the bombers would be met at various

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rendezvous points by fighters flying directly from their bases to relieve the old escort. The new group would give escort for another specified distance, and then in turn be relieved by another group, and so on until the target was reached. A similar plan was followed on the return.⁴⁷

The second basic type, area support, was used when continuous direct support was too difficult because of the splitting of the bomber stream into small units to attack a number of targets. In this case, fighters would precede the bombers and patrol the area through which they would pass to clear it of enemy planes. This third type was used when there was a deep penetration into enemy territory before division into smaller units. In this case, continuous support was given until time for dividing and area support was given in the target areas. Continuous protection was again resorted to on the return trip after the bombers had re-formed into a single force.⁴⁸

Despite the need for adequate numbers of long-range fighters, it was not until the spring and summer of 1944 that the supply began to meet the demand.⁴⁹ Adding to the difficulty resulting from the shortage was the fact that the planes had to be divided between two strategic air forces, each operating in a separate theater. The Eighth Air Force, being the older and larger of the two and considered the leader in POINTBLANK, naturally had first call on personnel and equipment. General Baker by dint of argument and hard work, however, was able over a period of six months to build up the fighter force of the Fifteenth to its authorized strength. In January he convinced General Spaatz that P-38 groups scheduled for transfer to the ETO should remain in the Mediterranean. At that time Baker's P-38 groups were down to an average of less than 36

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operational planes, and he maintained it would be absurd to take away the only long-distance escort for the heavy bombers at the very time that deep raids into Germany on an extensive scale were in the offing. Again in February the question arose as to the advisability of transferring certain pursuit units to England for the build-up of OVERLORD, and once more it was decided to let the Mediterranean forces alone. The heavy bombers of the Fifteenth were desperately in need of these escorting planes. The P-47's could not range farther than the Alps, and for this reason could be used only to escort bombers to targets in the Po valley and parts of the Balkans. There were only three P-38 groups at half strength, and since they were of the old type their range did not much exceed the Alps. The shortage of planes also prevented the use of relays to and from the target, which meant that the bombers were needlessly exposed to enemy attacks. But as soon as sufficient and properly equipped P-38's and P-51's, able to escort the bombers all the way to and from the target, were available the hazards of POINTBLANK missions would be greatly ^{reduced.} The presence of just one fighter group in the target area, Eaker maintained, would cut bomber losses ⁵¹ 75 per cent.

The build-up in the Fifteenth Air Force continued, however, at a slow pace. Devers explained that the greater losses sustained by the Fifteenth in February than by the Eighth were due to the shortage of long-range escorts. In February and March plans were developed to have three groups of P-38's and four of P-51's eventually assigned to the Fifteenth with one P-47 group being retained until full strength of the P-51's was reached. 52

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Some of the P-47 groups already in the Fifteenth, such as the 325th, would be converted to P-51's to accomplish this. It was also decided to transfer three fighter groups from the Twelfth to the Fifteenth Air Force and equip them with P-51's for long-range escort purposes. The groups selected were the 31st, 52d, and 332d. The first transfer, that of the 31st Fighter Group, became effective on 1 April, and the last, that of the 332d, in late May.⁵³ This latter group, composed of Negroes, presented several problems. Experience, particularly at Anzio, showed this group was more efficient at aerial fighting than in giving ground support. At first it was planned to equip the 332d with P-63's, but since these planes were not yet free of "bugs" the idea was dropped. It was finally decided to put the 332d Fighter Group into P-47's. The equipping and transfer of the group was dependent, however, upon the re-equipping of other P-47 units with P-51's. The transition was finally accomplished, and on 31 May the 332d Group was transferred to the Fifteenth Air Force for duty.⁵⁴

Slowly but steadily the work of equipping and transitioning proceeded. In the latter part of March Eaker informed Arnold that he could cease worrying about the Fifteenth since there was now "the means and the will to bring it to a high level of efficiency."⁵⁵ The 31st Fighter Group, the first P-51 unit of the Fifteenth, was fully equipped and started operations in April. For the first time the Italy-based strategic bombers had full support to and from targets beyond the Alps. By June, the long-range fighter program was practically complete and it was possible to provide increased protection to the 21 heavy bomber groups in the Fifteenth Air Force.⁵⁶

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Although the Eighth Air Force did not have so much trouble as the Fifteenth in regard to long-range escorts, it was faced with similar problems. When it was decided in January not to transfer the pursuit units from MTO to VIII Fighter Command, plans were formulated to bring a P-38 squadron from Iceland to the Eighth to help meet the requirements of that air force.⁵⁷

In spite of shortages, however, the Eighth was able to reach a new high in the use of fighter escort in January when full support was given on all major attacks except two. Work had also been started on equipping all fighters with extra fuel tanks and/or bomb shackles. Though the VIII Air Force Service Command did not hold out much hope that these installations could be fully completed before 1 September, by pushing the job practically all the aircraft in the VIII Fighter Command were equipped with the additional tanks by the end of April.⁵⁸

The Eighth like the Fifteenth used the same process of converting and transferring in order to get an adequate number of groups capable of long-distance escort. In February the 358th Group, equipped with P-47's, was transferred to the Ninth Air Force for a P-51 Group. In the following months several P-47 groups were converted to P-51's, and by 31 May seven such groups were operational. By this time the Eighth Air Force had 522 P-51's on hand of which 383 were fully operational, 634 crews assigned with 459 available, and an effective strength of 382. This meant that practically 100 per cent of the serviceable P-51's could be flown at any time. In addition to the P-51's the Eighth also had four groups of P-47's and four of P-38's by the end of May. Altogether there were 870 fully operational fighter aircraft, 1,039 available crews, and the effective strength was 856.⁵⁹

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In general the P-51 was the preferred plane for long-range escort, and during the transition period these airplanes and their pilots were borrowed from the Ninth to participate in critical missions. The P-47 was considered very dependable, but its usefulness was limited by its range. Cold cockpits, low carburetor air temperatures, and poor functioning of the turbo-regulator affected the efficiency of the P-38. New flying suits, electric gloves and spats, however, solved the cold problem, and a modification program of Lockheed promised to remedy the mechanical defects. Brig. Gen. Francis H. Griswold, Chief of Staff of the VIII Fighter Command, believed that despite these corrections the P-38 had reached its zenith of potentialities for escort at high altitudes, but he also believed that it would be extremely valuable in other operations at lower altitudes.⁶⁰

The effectiveness of the fighters in reducing bomber losses was cited by Spaatz in April while the fighter program was still incomplete. On 17 April 1943, 115 bombers were dispatched without escort to attack the Focke-Wulf plant at Bremen. They flew 400 miles over the sea in order to lessen the danger from enemy attack, but 16 bombers were lost that day. On 18 April 1944, nearly 1,000 bombers took off to attack several targets in the Berlin area. Protected by almost 700 fighters they flew straight through enemy territory in broad daylight with a resulting loss of only 19 bombers and 6 fighters. The Germans were hoarding their fighter force by this time, however, and despite efforts to provoke the GAF to combat only one of the three bomb divisions encountered formidable opposition. One of the most telling arguments for strong long-range fighter escort was given by the German Reichsmarshal himself. When he was asked at the close of the war

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why the Luftwaffe failed to prevent the aerial invasion of Germany, Goering replied: "I most firmly believe that the reason was the success of the American Air Force in putting out a long-range escort airplane, which enabled the bombers to penetrate deep into the Reich territory and still have a constant and strong fighter cover. Without this escort, the air offensive would never have succeeded. Nobody thought such long-range fighter escort was possible." He had at first refused to believe, he said, that American fighters could fly escort even to Liège. It was still more incredible when they went as far as Hannover, but when they appeared over Berlin with the bombers he knew the results would be tragic.

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Even if the GAF had been completely driven out of the sky there would have been yet another enemy for the bombers to battle. That was Nature, and she frequently played a deciding part in the success of a mission. Oftentimes weather determined the target to be attacked, routes to be followed, altitudes to be flown, and numerous other factors necessary in planning a raid. As a rule, weather in England and western Europe seemed to conspire against the Allies. Throughout the year there was a procession of storms, fog, and cloud banks, and during the winter there was a severe storm on an average of once every three days in the region between London and Berlin. Even in the summer months cloud cover over Germany averaged 50 to 80 per cent. The AAF weather experts estimated early in the war that the maximum number of days per month that visual daylight bombing operations could be carried out would be 10, and the average that could be expected was six.

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Nor was weather in the MTO any better. In the five weeks following the Big Week in February the weather was so consistently bad that it was difficult to capitalize on the gains made in that week. It was not uncommon,

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therefore, in either theater for operational summaries to read: "Weather conditions over the continent were very poor and visual bombing of all primaries was impossible," "Solid cloud rising to as high as 24,000 feet prevented six combat wings from completing assembly," "Several attempts made to get through but overcast up to 25,000 feet forced all aircraft to return to base," or "All bomber operations cancelled due to weather at base and en route."⁶⁴

Even in April, which was considered a good month, 65 per cent of the bombers in the Eighth which failed to make sortie or attack were prevented from doing so by weather. This was 16 per cent of the total number of bombers airborne that month.⁶⁵

Various techniques were developed and employed to circumvent the weather. One was improved weather forecasting. Regional weather offices were established to furnish the necessary data for the various operating units. In order to get as perfect forecasts as possible weather information was exchanged between theaters, between air forces in the same theater, and between the AAF and RAF. Some data also came from Russia and the Balkans.⁶⁶ The available weather facts often had limited value, however, since they were gathered for the most part on the fringes of Axis Europe and accurate up-to-date meteorological information from enemy-held territory was lacking.

To remedy this defect weather reconnaissance was flown regularly by both air forces, P-38's usually being used for this purpose.⁶⁷ In the spring of 1944 additional intelligence was acquired by the Eighth Air Force by briefing fighter pilots on combat missions to report weather conditions they encountered over enemy territory immediately upon return to their station. In this way bomber formations getting ready to take off had the benefit of the

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latest weather news. In May, this was improved upon by dispatching one Mosquito to each division area just prior to a heavy-bombardment mission. The commanding generals of the divisions were authorized to use these aircraft in any way they thought best to obtain up-to-the-minute weather data. ⁶⁸

Techniques were also developed to allow missions to be carried out on days ordinarily considered nonoperational. There were various navigational and blind-bombing aids. ⁶⁹ While there were many of these, one of the most important was H2X. This equipment could be used for both navigational and bombing purposes. Its chief advantage over OBOE, GEE-H, and SHORAN was that it was not tied to any ground station, and therefore its range was limited only to the range of the aircraft carrying it. Actually H2X was a radar bomb sight which transmitted high-frequency electrical impulses downward through a revolving antenna. The objects on the earth reflected these impulses back to the plane where they were converted into light patterns. ⁷⁰

H2X was first introduced in May 1943 and by the next month 12 handmade sets had been installed in B-17's of the Eighth Air Force and were used as navigational aids. The first use of it for bombing was in the fall. In November, Brig. Gen. F. L. Anderson, Commanding General of the VIII Bomber Command, reported that his bombers had been experimenting with it for bombing through overcast ^(BTO) of Wilhelmshaven, Bremen, and Ruhr targets. From this time on there was constant effort to improve on its use, train competent operators, ⁷¹ and build up an adequate PFF in both theaters.

In general, the results obtained from H2X paid for the time, effort, and cost expended in developing it. A very large percentage of total sorties flown with such equipment was effective, and it also allowed the heavy bombers to operate on days when visual bombing was impossible. In January

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Table 13

EFFECTIVE H2X SORTIES FLOWN BY EIGHTH AIR FORCE
FEBRUARY-JUNE 1944*

<u>Month</u>	<u>Total H2X Sorties</u>	<u>Effective Sorties</u>	<u>Per Cent</u>
February	53	53	100
March	191	181	95
April	124	116	94
May	274	260	95
June	554	526	95
Total	1,196	1,136	95

* Eighth Air Force, Tactical Development, August 1942-May 1945, 69.

1944, daylight missions were conducted on 11 days by the Eighth Air Force, and on seven of these and part of the eighth bombing was conducted by H2X methods. At least seven more full days were available for striking the enemy than there would have otherwise been. In February there were 18 daylight operations, and on seven days and part of three others the missions were BTO. The next month on 13 out of 23 days blind bombing missions occurred. In April there were 6 out of 21, and in May 10 out of 25.

One chief advantage which visual aiming had over H2X, however, was accuracy. Although there were constant efforts to improve the accuracy of blind bombing, visual bombing, if properly done, still remained the better method. There were, of course, instances when BTO missions were almost perfect and outdid those where the optical bomb sight was used exclusively. In March the Eighth flew a mission against the marshalling yards of Munich and the aircraft industry at Friedrichshafen; visual sighting was used at the former place and hits were scored on the post office, central revenue office, town hall, King

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Edward School, municipal hospital, a small factory, residential areas of the old town section, and royal palace and botanical gardens. At Friedrichshafen PFF aid was given at the target and results showed that the Dornier factory, railroad yards, a seaplane hangar and ramps, Lowenthal assembly plant, Manzell Do-217 seaplane base, Maybach Motorenbau factory, Zahnradfabrik plant, and some of the residential section all suffered bomb damage.⁷³ In April an experiment was conducted in the Fifteenth Air Force to determine the practical value of H2X bombing. Bucharest was selected as the best site, and 14 groups were dispatched against it in daylight under good weather conditions. Six of the groups had their bomb sights disconnected, and all bombing was conducted by H2X methods with the operators sealed in without any outside vision. The other eight groups followed the conventional methods. A study of the strike photos showed that all bombs dropped by H2X fell within the city, their pattern was more compact, and the accuracy was better than for those bombs dropped by the eight groups using visual sighting.⁷⁴

These instances of accuracy, however, were rather the exception than the rule. H2X could rarely be depended upon for pin-point bombing of a particular factory or other single objective, but occasionally on the radar scope a large industrial plant would make a "blip" of its own which could be distinguished from the picture made by the whole city. A test conducted by the Eighth Air Force in May and June showed greater H2X accuracy against small coastal targets than against large cities. There were several reasons for this. First, although the H2X equipment did not show up the specific coastal target, it did show up the beaches sharply and clearly and these

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served as excellent check points. The edges of the cities, on the other hand, were fuzzy and indistinct and it was difficult to locate exact points in the city. Furthermore, crews over cities were not so concerned about dropping all bombs precisely on the aiming point, and this resulted in greater dispersion. A second reason was that bombing altitudes were lower for coastal targets, and accuracy varied inversely with the altitude. Thirdly, the size of the attacking force and bombing unit was always greater against cities, and the smaller the force and unit the greater the accuracy.⁷⁵

The question naturally arises as to what extent improved weather forecasting and blind bombing methods aided the prosecution of the CBO. It has already been shown that H2X increased the number of days on which the enemy could be profitably bombed. Better forecasting permitted improved advanced planning which enabled the Allies to step up the tempo and subject the enemy to an almost continuous pounding. He was not allowed to rest and gather strength with which to launch a counterblow.⁷⁶

Matters of defense and offense resolved themselves into a circle. Whenever the American air forces devised a new technique the Germans promptly set to work on an offsetting one, or when the enemy developed a new weapon the Allies instituted countermeasures. Each in turn spurred the other side to circumvent the new danger. The most effective defense the Germans had was their fighter force, and it was for this reason that the British and Americans finally turned their full attention to the job of destroying the Luftwaffe. It has already been pointed out that when long-range escort was limited, the USAAF had experimented with heavy-bomber formations designed to cut down losses from fighters. The German employed every means he could devise to

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Table 14

ACTUAL DAYS OF OPERATION IN THE EIGHTH AIR FORCE
JANUARY-JUNE 1943 and 1944*

<u>Month</u>	<u>1943</u>	<u>1944</u>
January	4	11
February	5	18
March	9	23
April	4	21
May	9	25
June	7	28

Table 15

MISSION FAILURES IN THE EIGHTH AIR FORCE
JANUARY-JUNE 1944**

<u>Month</u>	<u>No. of Attacks</u>	<u>Mission Failures</u>	<u>Per Cent</u>
January	154	29	19
February	261	71	27
March	232	51	22
April	529	53	10
May	639	93	15
June	832	111	13

* Eighth Air Force, Tactical Development, August 1942-May 1945, 86.

** Eighth Air Force, ORS, Bombing Accuracy of the Eighth Air Force Bombardment Divisions, Combat Wings and Groups, in ORS Archives.

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break or open up the formations so that he could attack the individual aircraft. Some of the methods used were aerial- and ground-fired rockets, cable bombs, parachute bombs, and glide bombs. The firing of rockets from planes had been started in 1943. The technique was to stand out of range of the bombers' guns, 1,200 to 600 yards away, and lob the missiles into the formation. Then when the formation was disrupted the fighters would close in and use their machine guns or 20-mm. cannon for the kill. Another method was to hide in the condensation trails left by the bombers and when within range of the formation let go the rockets before the tail gunners could see them distinctly. Although aerial-fired rockets took their toll, the danger from them was never so great as from the 13-mm. or 20-mm. cannon of the fighters.⁷⁷

Ground-fired rockets were reported in use in the early spring of 1944. Each rocket upon exploding released five parachute incendiary bombs which burned for about a minute. By May the use of these was quite frequent but their accuracy or intensity was never great enough to be a serious threat to the safety of the American bombers.⁷⁸ Cable bombs also were employed to some extent. Their use, however, was not new as they had been tried in World War I. The Germans revived the idea. In November and December 1943 American crewmen saw what they believed to be bombs towed by a cable, but it was not until January that there was complete confirmation. The difficulties of pulling the bomb through a formation, however, made this type of bombing ineffective.⁷⁹

The greatest danger to the American bombers came from the fighters. Prior to the lengthening of American fighter range, the German single-engine fighters were deployed along a thin line extending from Denmark to Bordeaux.

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This force could effect interception for a distance of from 175 miles to 200 miles inland from the coast, beyond the limits of the American escorts. When the range of the USAAF fighters was increased so that they could give long protection, the Germans were forced to redeploy their forces. They had to have depth as well as length, and in order to achieve this it was necessary to transfer fighters from the Russian and Italian fronts, where the pressure was less, to Western Europe where it was greatest. Twin-engine night fighters were also converted to day use, and it was from the twin-engines that most of the rockets were launched. As the Americans increased their range by use of auxiliary tanks, so did the Germans. New tactics were also evolved by the Germans. The bomber formations were attacked at the coast line and in the ensuing engagements the U. S. fighters were forced to use up their surplus gasoline and return to base, thus leaving the bombers with little or no escort. Then German fighters equipped with extra tanks could pursue the bombers unmolested. Until sufficient fighters were available for both escort and free lance fighting, the Americans ceased chasing the enemy and made him come to them if he wanted to fight. By spring sufficient fighters were available to allow some to go off seeking out the GAF and still leave sufficient force to protect the bombers.

As the GAF began to feel the effects of the CBO it tried new tactics and tricks. Aircraft were sometimes painted to resemble P-51's or other American fighters. These would simulate escort tactics and then at opportune times attack the bombers. In general, however, the new tactics evolved from the need for caution and conservation. The enemy was unable to afford much wastage by the spring of 1944. Fighters hung around the edges of a formation

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waiting to pounce like wolves upon stragglers or cripples. Many times they showed great reluctance to engage in battle with the American escort. When the weather was bad they often refused to come up through the overcast, depending upon ground defense to protect the target. At other times only one target would be strongly protected or en route only one combat wing would be aggressively attacked. Also the GAF by late spring ceased protecting certain areas and over these the dominance of the USAAF was practically uncontested. French targets were almost never defended by April, and attacks in Italy and Yugoslavia were virtually unopposed. Raids into Germany, Austria, and regions east of Yugoslavia, however, were vigorously opposed. When there was concentrated opposition it was usually aggressive. German fighters were not cowardly and at times were daring to the point of being foolhardy. Their reluctance to fight was born of the necessity for conserving air strength and not from fear.

The Germans were also led to develop new types of aircraft to counter the constant improvement of American planes. But this came too late to ward off the aerial invasion of Germany and save the Luftwaffe from destruction. As early as 1936 experiments on jet-propelled aircraft were begun by Heinkel, and in 1938-39 a jet-propelled ^{aircraft} program was initiated by the Air Ministry. The progress was slow, however, and it was not until 1944 when the shortage of high-octane fuel became serious that production was stimulated. By this time, though, the shortage of trained pilots and the intensity of Allied bombardment along with the failure to iron out mechanical troubles prevented jet-propelled aircraft from being a serious threat. The most successful of these planes was the Me-262, but its production was delayed by engine troubles and by Hitler's insistence that it be made into a fighter bomber, which kept

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it out of combat use for a number of months. The first models of this airplane had been accepted in March 1944 and by 8 May 1945 about 1,400 had been received by the GAF. Only a few of them^{ever} became operational, however, and their value was decreased by poorly trained pilots.⁸²

As the ability of the GAF to protect vital targets waned, more and more reliance was placed on ground defenses. Of these flak was the most efficient and was a constant threat to the Allied bombers throughout the war. After the fall of 1943, Hitler was convinced that the best defense against the increasing intensity of aerial attacks was not his fighter force but more and more flak, and by March 1944, because of the flak encountered, pilots no longer considered the hop to Calais a milk run. About 30 per cent of the total German output of guns in 1944 consisted of flak guns, and about 20 per cent of the ammunition of calibres from 7 cm. upwards was AA shells. In the latter case the shortage of aluminum raised the question of whether this metal should be allocated to flak ammunition or to fighter aircraft. In the end a compromise was reached, but flak received preference. By D-day the flak personnel in Germany and occupied countries numbered 1,000,000, with half of it in Germany proper. In spite of this imposing flak defense, Germany still did not have enough equipment to protect everything and many routes had to be left unguarded. Moreover, the strength and quality of AA units declined as the Allies advanced both on the ground and in the air. While bomber losses attributable to flak alone were usually not so great as those caused by enemy aircraft, the amount of damage inflicted was much more than that resulting from fighter attacks. For the first 10 months of 1944 about 25 per cent of a bomber force could be expected to be hit by flak, but fortunately such damage

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was usually repairable in a short period of time. With better protection against flak the per cent of damage and losses was cut considerably by the end of the war. From July 1943 to October 1944 in the Eighth Air Force, one bomber was lost for every 13 damaged, and by the end of the war the ratio stood one lost for every 22 damaged.⁸³ The Germans also made use of considerable numbers of barrage balloons in conjunction with flak units. At the beginning of 1944 the heaviest concentrations were found around important industries, ports, and industrial cities. Synthetic oil and rubber plants were most heavily protected, with ports second, and then dams, bridges, and canals. By the end of April, however, a reversal of policy in their use was noted. The big barrages around places like Wilhelmshaven, Emden, Hamburg, and Bremen were materially reduced, and the barrages protecting the Ruhr cities of Homberg, Sterkrade, Essen, Gelsenkirchen, Hils, and Kamen were discontinued. The enemy also discontinued or reduced the size of the barrages at synthetic oil plants. The emphasis was now placed on protecting the road and railway bridges and lock gates of inland waterways in Germany; and in France, where several new barrages appeared, they were concentrated around power and transformer stations.⁸⁴

Another type of ground defense more or less successfully employed by the Germans was to obscure the bombardier's vision by a smoke screen. Smoke was commonly used to hide mouths of tunnels and other communication targets, such as marshalling yards, bridges, and junction points. It was also used to protect plants and cities, such as the Villar-Perosa ball-bearing factory at Turin, oil installations at Floesti, or industrial centers like Friedrichshafen. At first these smoke screens seriously affected bombing accuracy,

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but in time it was possible to reduce their effectiveness by such methods as H2X and offset bombing.⁸⁵

Despite all German attempts to develop counterweapons and defense, the Allies were able to keep one or several jumps ahead. When the Germans began to use radar to warn them of the approach of American bombers or to determine the altitude and location of the formations for accurate sighting of the AA guns, the Allies jammed the enemy radar with WINDOW or CHAFF (strips of metal foil) or with CARPET or MANDREL (noise). Attacks were made on radar stations, and often fighters flew under the radar curtain to surprise and beat up an airfield prior to the arrival of the bomber formation. By this means the heavies were assured of negligible interference en route to their target.⁸⁶ Larger and larger air armadas continued to fly against strategic targets and gradually the German ability to fight was ground down. When D-day arrived and the invasion of the Continent got underway, the Army Ground Forces found their task made easier by the success of the CBO.

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Chapter VI

ATTACK ON AIRFRAMES, AERO-ENGINES, AND AIRFIELDS

The success of the CBO was dependent upon the ability of the heavy bombers to penetrate the enemy defenses and destroy those industries whose existence was vitally necessary to the German war machine. The chief protector of these industries was the enemy's air force, and therefore the destruction of the GAF, in being and in production, became an intermediate primary objective of the CBO. The attack on the aircraft industry was divided into two main phases. The first was the high-priority campaign from the middle of 1943 to the late spring of 1944, and the second was a low-priority campaign from D-day to April 1945. The period of high priority was further divided into four phases: (1) April-October 1943, (2) November 1943-January 1944, (3) February 1944, and (4) March-May 1944. During the first two of these periods the bombing of aircraft targets was slight because of need for equipment and personnel, particularly fighters to give adequate escort protection. Nevertheless, 58 aircraft factories were hit with varying degrees of damage in 1943. By February 1944, both the Eighth and Fifteenth Air Forces were able to operate with great effectiveness against German strategic targets. The total weight of bombs dropped on the aircraft industry in this third phase of the high-priority campaign totaled just a little less than that dropped on the industry to that date. It was during this same period, too, that USSTAF met its most vigorous opposition, but the blow delivered against the GAF was such that it was never able to recover its

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strength. From March to May 1944, it was possible, because of the waning GAF, to give the German aircraft industry its heaviest bombing, and by late April attention began to turn from these factories to other strategic targets such as oil and transportation.¹

The main attack was carried out against the single-engine fighter factories, chiefly those producing Me-109's and FW-190's. These attacks included all phases of manufacture, but emphasized airframes and final assembly. By the end of September 1944 all known single-engine airplane plants had been attacked from one to seven times. In January 1944 twin-engine fighter factories were added to the list, and in the first nine months of 1944, 16 of these had been bombed from one to five times each. Long-range and dive bombers, transport, and jet-propelled aircraft factories were also made primary targets during the early months of 1944, and by D-day practically every type of German aircraft manufacture had felt the weight of Allied bombs.²

The Germans had early recognized the threat of strategic bombing and had started to expand their production of combat planes. The program as worked out by April 1943 provided for an increase of fighters to reach 2,230 per month by December of that year. By July, production had reached about 1,740 planes monthly, of which 910 were single-engine. Even the comparatively small-scale operations of USAAF, however, emphasized the need of accelerating and expanding the output to offset the rapidly growing Allied air forces. A stepped-up plan was initiated in August and further revised in October when the goal was set at a minimum monthly production of 4,150 single- and twin-engine fighters a month by December 1944. In December

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1943, however, Hitler was tired of being kept on the defensive and wanted to be able to retaliate by again bombing England. Accordingly, he ordered a reduction in the schedule for single-engine fighters to 3,000 a month and an increase in production of the four-engine heavy bomber--the He-177. The German expansion program, however, did not reckon on the success of American precision bombing, and by March 1944 production fell to a low of 1,320 airplanes of all types. From this time on, however, production rose steadily to 1,950 in September, of which 1,400 were single-engine. Altogether the GAF in 1944 accepted 39,807 aircraft, about 26,000 being single-engine fighters, but the expansion program came too late to save German industry from aerial destruction. More and more the GAF was forced into a policy of conservation, and this gave greater freedom to the Allies to attack oil and other war industries. As the effects of the raids on oil began to be felt, the effectiveness of the Luftwaffe was further reduced because regardless of how many planes were produced they were useless if there was no fuel to fly them.³

The rise in aircraft production after March 1944 was due in large part to the reorganization of the industry. This involved several factors, one of which was dispersal of component manufacturing to many small plants including unused textile factories. A study of dispersal problems had been made in 1942 and the Air Ministry recommended the principle, but little was done along these lines until the latter part of 1943. The government itself did not institute a compulsory program of dispersal until after the disastrous February assaults. Dispersal on a small scale had started, however, after the 1943 attacks on the Focke-Wulf and Heinkel plants at

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Bremen and Rostock. Although these raids resulted in little or no loss of production, the enemy was smart enough to read the signs, and he began to move the Focke-Wulf factory to East Prussia and Poland. These areas were chosen because it was believed they were beyond range of effective Allied bombing and because there were facilities and^{an}adequate labor supply for converting existing plants to aircraft production. Another example of dispersion was the Messerschmitt complex at Regensburg/Prüfening which, after suffering heavy damage in 1943, was moved in part to Regensburg/Obertraubling, and its component plants to Köttern, Kempten, and Dingolfing. The Wiener Neustadt Me-109 complex was originally centered in Werke I and II at this Vienna suburb with components coming from Kischamend, Belgrade/Zemun, Klagenfurt, Neudorf, and Obergrafendorf and with repair work carried on at Atzgersdorf. The heavy attacks on these places in early 1944 led to partial dispersal of assembly from Wiener Neustadt to Bad Vöslau, Zwölfaxing, and Markersdorf. Several textile factories at Ebreichsdorf, Pottendorf, and Neunkirchen were converted to manufacturing airframe components to take the place of bombed-out factories of the original complex, and the Enzesfeld light-metal plant was retooled for making wings.⁴

Other forms of dispersal, such as converting GAF airfields into assembly points and moving factories to underground locations, were also resorted to. When the official order for dispersal was given in February 1944, a government agency was established to locate suitable underground sites and prepare them for industrial use. The first of the manufacturing processes to go underground was that of the V-weapons. Then jet aircraft, especially the Me-262 engine plants, were moved to caves, tunnels, and other similar

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shelters, and they were followed by the conventional fighter-engine factories. In the spring of 1944, Daimler-Benz transferred parts of its Genshagen plant to a gypsum mine at Neckarelz near Heidelberg. In Czechoslovakia, Skoda moved part of its engine production into a granite quarry at Kobanya near Budapest, and in June 1944, the Bayerische Motoren Werke⁵ began its move to a railroad tunnel at Markirch near Strasbourg.

The effects of dispersal were both good and bad. The moving of factories to forest sites afforded good camouflage. The breakup of manufacturing processes into small plants easily protected by bunkers lessened bomb damage. Underground factories were, of course, out of sight and hard to hit. The multiplicity of plants made it difficult for Allied intelligence to seek them out and their very number made it almost impossible to reduce production capacity to any great extent. On the other hand, the policy had serious disadvantages for the enemy. Supervisory management was spread thin and there was a resulting loss in efficiency and quality. Hermann Goering pointed out after his capture that fittings from dispersed plants were not always accurate enough for proper assembly or that unmatching parts, such as two different landing wheels, would be received. Dr. Karl Frydag, chief of the airframe industry, gave similar testimony. Dispersal also placed an additional burden on the transportation system in bringing parts together for assembly. When concentrated attacks began on transportation, final assembly plants often found themselves without the necessary subassemblies, and although transportation was never completely disrupted, the delay involved worked to the disadvantage of the Nazis. In the end there was a reversal of policy, and concentration of industry, particularly in underground locations, was

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once more undertaken.

Another phase of reorganization of the aircraft industry was the transfer of the duties of the Director of Aircraft Procurement to Albert Speer's Ministry for Armaments and Munitions. At the very time when aircraft manufacturing was being dispersed, direction of the industry was centralized. Field Marshal Milch had taken over the office of Director of Aircraft Procurement under the Air Ministry in 1941 after the suicide of General Udet. In February 1944, the functions of the director were transferred to the Jaegerstab which operated under the Speer Ministry, and Sauer superseded Milch as Speer's representative. In June the final dissolution of the office of Director of Aircraft Procurement took place. From this time forward the Speer Ministry had full responsibility for airplane procurement, and by clever utilization of capacity, use of specialists to supervise the complexes, exchange of workers and material, and concentration on a few fighter types, acceptance figures tripled within seven months. Speer, however, liked big figures as proof of his efficiency, and a goodly portion of the planes listed as new production were probably repaired or rebuilt aircraft.

The attacks against the aircraft industry in January 1944 were very light in comparison with those delivered in the succeeding months. The Eighth Air Force made five attacks on airframe factories. The first of these was an attack on the FW-189 assembly and FW-200 repair plant at Bordeaux/Merignac on 5 January. The 112 B-17's making the attack were escorted by 76 P-47's as far as La Pallice, the extent of the fighter range. The bombers met with strong opposition, 50 to 75 Me-109's and FW-190's, and 11 B-17's were lost. Claims against the enemy were 24 destroyed, 5

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probably destroyed, and 6 damaged. Despite almost 10 per cent loss of the attacking force, the GAF installations suffered extensive damage. The second was a triple attack on 11 January against the FW-190 assembly and components factory at Oschersleben, the Me-110 assembly at Brunswick/Waggum, and the Ju-88 wing plant at Halberstadt. Weather was bad en route, but over the targets it was clear and severe damage was inflicted on the factories in spite of strong enemy fighter opposition. On 30 January, 778 bombers were dispatched against the Me-110 components factory at Brunswick/Wilhelmiter. Again the weather was bad and with a 10/10 cloud over the entire Continent it was necessary to use PFF equipment. One combat wing lost contact with the other formations and bombed Hannover instead. Opposition was heavy and the enemy employed rockets fired from both single-⁸ and twin-engine planes. Cable, parachute, and aerial bombs were also used.

The Fifteenth made two major attacks against airframe factories in January. The first was on 8 January when 109 B-17's dropped 324 tons of bombs on the Reggiane fighter (Re-2005) and SM-79 assembly plant at Reggio Emilia. It was estimated that the damage inflicted would substantially reduce production for the next six to eight months. The second attack was against the Me-109 components factory at Klagenfurt--part of the Wiener Neustadt complex--on 16 January. Sixty^{-one} B-17's dropped 201 tons of bombs inflicting moderate to severe damage on the factory, warehouses and railroad tracks. These attacks of the Fifteenth appeared puny in comparison with those of the Eighth, but the former air force was still in process of being built up and its strategic efforts were dissipated to some extent by the exigencies of the Italian campaign.⁹

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The RAF was also busy supplementing the destruction brought about by USSTAF. Most RAF attacks were area ones, but the target list complemented that of USSTAF. For example, the RAF Bomber Command followed up the Eighth Air Force attack of 11 January on Brunswick with a fire and high-explosive raid of its own on 14/15 January. On 2/3 January, the RAF attacked Berlin in an area raid seriously damaging the Henschel Hs-126 assembly plant at Johannisthal. Other January attacks hit the FV-200 components factory, the Flettner plant engaged in assembly and repair of trainers and gliders, and the aircraft research establishment of the Deutsche Versuchen Anstalt, all at Berlin/Treptow. In the Mediterranean the 205 Group, RAF preceded the American attack on the Reggiane factory on 8 January with a raid on Reggio Emilia on 7/8 January.¹⁰

February started out inauspiciously enough, but hopes were high. Maj. Gen. F. L. Anderson wrote Lt. Gen. Ira C. Eaker that the future looked bright in the Eighth Air Force if the weather would just clear up. The results of combat crew training given in November and December had begun to show, and the advent of the P-51 had extended the bomber capabilities tremendously. Before the end of the month it was contemplated the Eighth could put 1,000 bombers in the air for a single operation and most missions would average about 900 bombers. A few clear days, plus good bombing and a willingness to take some extra losses, would enable the air forces to finish off the German fighter factories.¹¹

The bad weather of January carried over into February, and for nearly three-quarters of the month operations against the aircraft industry were at a minimum. On 5 February, 113 B-17's escorted by P-47's made a successful attack on the SMO Ju-52 assembly and FV-190 repair base

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at Villacoublay, without American losses. Sighting was by both PFF and visual methods and 380 tons of general purpose (GP) and incendiary bombs (IB) were dropped with excellent results.¹² On 14 February, the Fifteenth Air Force made a small attack with five B-17's against the Piaggio Pi-108 and G-55 assembly factory at Pontedera, and in spite of the small size of the force serious damage was inflicted.¹³

These attacks by USSIAF were secondary in nature, however, and the factories bombed were of minor importance. The RAF Bomber Command in its night area raids was able to damage more important aircraft industries during this period of inclement weather. On 15/16 February it attacked Berlin, damaging the Fw-200 components plant and the Flettner factory at Berlin/Treptow, and the Hs-126 assembly plant at Berlin/Johannisthal. In the 19/20 February attack on Leipzig the Erla Me-109 components factories were heavily hit.¹⁴

Toward the end of the month weather forecasts indicated a few days of good weather, and Spaatz set about to cram as much bombing as possible into these few days. Several coordinated attacks by the Eighth and Fifteenth Air Forces were planned, but only three were carried out (see Table 7, page 62). Despite this, for six days, 20 to 25 February (the Big Week), the enemy aircraft industry received the worst pounding of its life, one from which it never fully recovered. The success of the Big Week assured Allied air superiority for the rest of the war. A coordinated attack had been planned to take place on the next day of good weather in the ETO, but on that day, 20 February, the bombers from the Fifteenth Air Force failed to reach their target of Regensburg because of icing conditions over the Alps. The Eighth Air Force, however, dispatched 1,003 four-engine bombers against aircraft production

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plants in Germany. The targets hit, many through 10/10 overcast, were the He-109 assembly and fuselage and the MAG Ju-88 and Ju-52 assembly factories at Leipzig/Östlich and Leipzig/Westerblick; the IAG He-110 components and tank plants at Brunswick/Leupetrator and Brunswick/Wilhelmstr.; the He-110 assembly and components at Oschersleben; the Junkers Ju-88, Ju-188, Ju-82 assembly at Bernburg; the Gothaer He-110 and Do-242 assembly at Gotha; the Focke-He-111 and He-219 assembly and components at Rostock/Warthe and Rostock/Warndorf; and the Arado FW-190 assembly at Luton.

The attacks continued on the next day with the Eighth striking the He-110 factories at Brunswick once more. On 22 February it was out again in force against the Junkers assembly at Bernburg, and Junkers components at Halberstadt and Oschersleben. This day was also the first successful coordinated attack of USAAF. While the Eighth was hitting the above-mentioned places the Fifteenth struck the He-109 components factories at Merseburg/Prüfening and Wernau/Obertraubling. With simultaneous attacks from the west and the south the GLE was hard put to protect all the targets. About 200 enemy aircraft were encountered by the Eighth and 120 by the Fifteenth. The former air force lost 38 out of 289 bombers and eleven of its fighters, but it claimed 91-25-43 enemy planes. The Fifteenth lost 19 out of an attacking force of 233 bombers and 2 fighters and made claims of 30-18-5 against the enemy.

The following day weather forced the Eighth Air Force to cancel its part of a coordinated attack, but the Fifteenth was able to dispatch 108 B-24's against the He-109 components factory of Daimler-Benz at Steyr. The bombers met with intense flak over the target but dropped 214 tons of bombs with good results. About 120 enemy fighters plagued the formation

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until the P-38 escort met it at the Alps on withdrawal. Sixteen bombers were lost, but bombers and escort claimed a total of 33-10-13 of the enemy.

On 24 February USSTAF staged another successful coordinated attack. The Eighth returned to Gotha to finish the job begun on 20 February. The Fifteenth Air Force struck the Daimler-Puch factory at Steyr again. That night, 24/25 February, the 205 Group, RAF, hit the same plant. The next day brought the Big Week to a close, and it also marked the last of USSTAF's successfully completed coordinated attacks until July. That day also was notable because it marked the first time when both air forces were over the same target on the same day. The Fifteenth dispatched a force of 149 heavy bombers (111 succeeded in reaching the target) to bomb the Regensburg factories at Prüfening and Obertraubling. Several hours later, 268 heavies of the Eighth arrived over the same targets and proceeded to complete the destruction. The total tonnage delivered on these places that day was 948 tons of GP, IB, and fragmentation bombs. The Fifteenth met with heavy and aggressive opposition, encountering about 200 enemy fighters, and lost 39 bombers and 4 fighters against claims of 93-17-15. The Eighth Air Force found the stinger pulled when it arrived, since it encountered only 35 to 50 enemy aircraft. It lost only two B-17's and made claims of only 13-1-7. While part of the Eighth was attacking Regensburg, other formations attacked the Bachmann Me-110 components factory at Fürth and the Messerschmitt Me-410 assembly at Augsburg. The RAF Bomber Command followed up with a raid on the latter place that night, 25/26 February.

The Big Week was now concluded. Weather closed in and operations against the aircraft industry were curtailed. It was not until the last

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day of the month that it was again possible to attack the airframe industry. On 29 February, 226 B-17's were dispatched to attack the Me-110 components factories at Brunswick. A 10/10 cloud made it necessary to use PFF techniques and results were unobserved. A significant feature of this raid, however, was that no enemy fighters attacked the bomber formations, and in fact escort pilots reported seeing only 13 German planes, which would not do battle. One bomber was lost to flak, and four fighter pilots were lost to causes other than enemy action.¹⁶

The attacks during the Big Week were not confined solely to airframes. Aero-engines, ball bearings, airdromes, transportation, and other industries were also hit. RAF bombing was area in nature and its effects extended to residential as well as industrial sections of a city. But all in all airframe assembly and components factories were given the heaviest dosages of bombs. In the 10 days from 15/16 February to 25/26 February, 41 attacks were made on the aircraft industry, 26 of which were by the Eighth, 6 by the Fifteenth, and 9 by the RAF. The total number of tons dropped in these 41 attacks amounted to nearly 16,000. The Eighth Air Force delivered almost 5,240 tons, the Fifteenth about 1,168 tons, and the RAF in its area attacks approximately 9,500 tons. The total tonnage for the whole month of February delivered against all targets by the entire Eighth Air Force was 18,436 tons; for the Fifteenth it was 5,901 tons; and for the RAF (both the Bomber Command and the 205 Group) it was 15,319 tons.¹⁷

The success of the Big Week was not obtained, however, without cost. Out of 8,572 bomber sorties in February by the Eighth, 299 bombers were lost. Of these, 156 were lost during the six days of 20/25 February. In the Fifteenth Air Force there were 3,981 bomber sorties and 115 bombers

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were lost, 95 of these during the period of the Big Week. These losses were not uncompensated, however, for in addition to the destruction of aircraft production the GAF suffered crippling losses in its operating strength. The combined bomber and fighter claims of the Eighth and Fifteenth Air Forces for February were 992 enemy aircraft destroyed, 224 probably destroyed, and 468 damaged, and of these 641-177-264 were claimed for 20/25 February.¹⁸

The February attacks, despite heavy Allied bomber losses, paid high dividends in the long run. Production was slowed down at the moment. It was estimated that effective production at Bernburg was lost for 10 weeks, at Aschersleben for six weeks, at Regensburg/Obertraubling for four months, at Fürth for two months, and at Augsburg for three weeks. It was also estimated that over-all productive capacity was cut from 900 airplanes per month on 1 February to 450 per month after the Big Week. In spite of future increases in production and acceptances, the first line of operational strength was never able to grow at a rate sufficient to offset the growing intensity of Allied bombing. Operational strength of the GAF on all fronts was cut from 2,638 planes on 28 January to 2,607 on 25 February. By the end of March this had risen to 2,613 in April to 2,646, and by 1 June to 2,721. In order to combat the threat to her war industries from USSTAF and the RAF it was necessary for Germany to keep from 60 to 70 per cent of her fighters on the western and south German fronts, thus leaving her armies in Italy and those facing the Russians with only token air support.¹⁹

Although the reduction in production capacity had a hindering effect on the GAF, it was not so serious in the long run as the corresponding loss

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Table 16

GAF SINGLE-ENGINE FIGHTER ACCEPTANCES
JANUARY-DECEMBER 1944*

<u>Month</u>	<u>Acceptances</u>
January	1,315
February	1,016
March	1,377
April	1,696
May	1,907
June	2,177
July	2,627
August	2,779
September	3,031
October	2,735
November	2,776
December	<u>2,124</u>
Total	25,860

* U. S. Strategic Bombing Survey, Over-all Report (European War),
September 30, 1945, 18.

of trained pilots. Planes could be produced faster than competent flyers. In order to meet the ever-increasing shortage of fighter pilots, training time in 1944 was cut to almost half of what it had been in 1942 and to about 25 hours less than in 1943. Bomber and staff pilots and instructors were also converted into fighter pilots in a space of 30 days. These efforts succeeded in maintaining a balance between the number of aircraft and pilots, but the quality of the pilots, like that of the airplanes, grew progressively worse. The peak of the GAF strength and efficiency had passed.

The heavy February attacks and succeeding bad weather left slim pickings in airframe production for both the Eighth and Fifteenth Air Forces in March. There was little reason to repeat the bombing of most factories until sufficient recovery had taken place to warrant a return engagement. The

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Eighth, nevertheless, attacked airframes on six days. The first of these was on 15 March when 344 heavies were dispatched against aircraft factories at Brunswick--328 actually making the attack. A 9/10 to 10/10 cloud cover obscured the targets, however, and the bombers bombed the city instead, dropping approximately 740 tons of mixed bombs by aid of PFF equipment. Some damage was inflicted on the MIAG Me-110 components factory at Wilhelmitor. The city was revisited on 23 and 29 March with dense clouds again hiding the targets, but later reconnaissance showed that the Me-110 factories at both Wilhelmitor and Neupetritor suffered additional damage.²¹ On 16 March, 195 B-24's dropped nearly 500 tons of GP and IB bombs on Friedrichshafen by PFF means through 4/10 to 10/10 cloud and heavy smoke screen. The Dornier FW-190 components factory and the Zahnradfabrik at Manzell received some damage. Two days later 189 B-24's returned to drop another 487 tons of bombs on the city, hitting again the same installations at Manzell and slightly damaging the Do-217 assembly and FW-190 tool factory at Lowenthal. On this same day, 18 March, 136 B-17's dropped slightly more than 300 tons of bombs²² on the Dornier Me-410 and Do-217 assembly plant at Oberpfaffenhofen. On 27 March the Eighth dispatched 707 heavy bombers to attack a number of German and French targets. Included in the list were the SNCA FW-189 assembly and FW-200 repair base at Bordeaux/Merignac and the Liotard FW repair plant at Tours/Usine. At the former place, 124 bombers dropped almost 210 tons of GP bombs and 84 tons of fragmentation clusters. Although the assembly plant was hit, the hangars, barracks, airfield, and parked airplanes received the brunt of the attack. Thirty-five B-17's attacked the Liotard installation at Tours with 107 tons of GP bombs, inflicting moderate damage.²³

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In March the main emphasis of the Fifteenth was placed on airdromes and marshalling yards, although several successful attempts were directed against aircraft factories. On 17 March, a large force of B-17's and B-24's was dispatched to the Wiener Neustadt Me-109 complex plants at Fischamend and Schwechat. None of the 125 B-17's were able to reach their targets because of weather. A force of 192 B-24's reached the vicinity only to find everything hidden by dense clouds, so they dropped 379 tons of mixed bombs on the city of Vienna by estimated-time-of-arrival technique. Twenty-six other B-24's dropped 64 tons of bombs on scattered targets of opportunity with unobserved results. Two days later weather prevented an attack of the Daimler-Puch factory at Steyr, and a second mission on 23 March was recalled for the same reason. A third operation against Steyr on 26 March was turned back over Yugoslavia because of deteriorating weather, and the bombers attacked instead the port of Fiume, Rimini marshalling yards, and Udine airdrome, all with poor results. The 205 Group, RAF was able to inflict some damage on the Cant aircraft factory, however, in connection with its raid on the submarine base at Monfalcone on the night of 19/20 March.²⁴

In April improved weather conditions and partial recuperation of the German aircraft industry through reorganization and dispersal allowed USSTAF to intensify again its attacks against airframe production. Single-engine fighter factories were still the main focal point of attack, with the Eighth emphasizing destruction of FW-190 factories and the Fifteenth trying to clean up the remaining Me-109 plants in south Germany and the Balkans. Attacks against twin-engine fighters were continued and long-range heavy bombers were added to the list. Both air forces were able to operate on nine days

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against airframe factories. The Eighth made 29 attacks against 27 targets,
 and the Fifteenth launched 21 attacks against 14 targets.²⁵

On 8 April the Eighth dispatched over 600 bombers to attack GAF installations and factories in the Brunswick and Oldenburg areas. At the former place 192 B-24's dropped 476 tons of bombs on the Me-110 components factories in Wilhelmitor and Waggum with excellent results. The next day 542 planes flew against the FW-190 components plants at Tutow, Marienburg, Posen, Warnemünde, and the FW-190 assembly and repair factory at Gdynia/Rahmel. A total of 958 tons of bombs was dropped on these places with generally good results. The bombers were attacked, however, by 225 to 300 enemy fighters which in many instances were vicious and persistent and a total of 31 bombers was lost. On the other hand, the fighter escort found the enemy unwilling to engage in combat with it, and so after completing their escort duties the pilots attacked various ground targets. From these operations they claimed 8-0-4 locomotives, one freight train, 11 factories, several antiaircraft installations, and 15-0-5 aircraft on the ground, against a loss of 10 fighters. The combined bomber and fighter claims of German airplanes destroyed in the air was 65-9-20. On 10 April the Eighth paid some attention to minor factories in France and Belgium. On that day 153 planes dropped 466 tons of mixed bombs on the SNCA Se-204 assembly and repair plant at Bourges, France, and 122 bombers left 296 tons of bombs on the Evere He-111 repair factory at Brussels. No aircraft were lost and severe damage resulted at both places.²⁶

Another big day for the Eighth was 11 April when 917 four-engine bombers out of an available force of 1,077 were dispatched against six assembly and components factories in eastern and central Germany. The airframe targets hit were the FW-190 assembly plants at Sorau, Cottbus, Oschersleben, the Ju-88,

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Ju-188, and Ju-52 assembly at Bernburg, the Ju-86 components at Halberstadt, and the He-111 components plant at Rostock. Adverse weather, however, necessitated some PFW bombing, and some of the results were not so good, especially at Sorau and Bernburg. In general, results were fair to good. On this mission the bombers met with severe and well-coordinated attack by the J-8F, although fighter escort reported that the enemy avoided combat with it when possible. Antiaircraft fire over the target areas was also intense and accurate. A total of 64 of the bombers was lost, 24 of which went down over Rostock and 8 at Oschersleben, the two cities hardest hit. Bomber crews claimed 73-24-03 and fighters claimed 51-4-25 in aerial combat. Once again when their escort duties were finished the fighters descended to attack ground targets and claimed 64-7-63 planes on the ground, 18 locomotives and 8 trains, 2 hangars, 2 factories, flak towers, a radar station, barracks, and gun emplacements damaged.

On 16 April the He-410 assembly plant at Augsburg was attacked by 230 heavies which dropped 232 tons of bombs with good results although 18 bombers were lost. A part of the force^{also} inflicted severe damage on the Lechfeld airbase, a Messerschmitt training and jet experiment field just south of Augsburg. A small force of 60 aircraft dropped 149 tons of mixed bombs on the Dornier He-410 and Do-217 assembly plant at Oberpfleffenhofen with but fair results and the loss of six of the bombers.

On 18 April a force of 768 bombers flew against numerous targets in the Berlin area. The airframe objectives were the He-111 and He-177 assembly plant at Oranienburg/Anahof, the He-177 assembly at Oranienburg/German-dorf, the Arado He-177 assembly at Brandenburg, and the Arado Fu-190 components at Arthenow. A total of 1,091 tons of bombs was dropped on these

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places. The next day 209 aircraft dropped 481 tons of high explosive and incendiary bombs on the Fieseler Fu-190/plant at Kassel/Bettenhausen and Fu-190 assembly at Kassel/.aldau, resulting in an estimated loss of three months' production. The Do-217 assembly and Fu-190 components factory at Friedrichshafen/Menzell and the Do-217 assembly and Fu-190 tool plant at Friedrichshafen/Lowenthal were bombed by 211 planes on 24 April. A total of 494 tons of bombs was dropped, but results were disappointing. The Menzell targets were not hit, although extensive damage was inflicted on the Lahmrodfabrik gear factory. At Lowenthal results were only fair. On this same day, 34 bombers paid a return visit to Oberpfaffenhofen, dropping 192 tons of bombs with accuracy. Also, 95 aircraft dropped 248 tons of bombs on the Leipzig airfield where Messerschmitt had a jet-aircraft assembly plant. The last attack against airframes by the Eighth in April was on the 29th when 10 B-17's out of a much larger force headed for Berlin returned to Brandenburg to lay 12 tons of bombs on the Arado He-177 assembly plant.

The RAF Bomber Command also sided in the destruction with its night raids. On 5/6 April, 141 British bombers attacked Toulouse with 673 tons of bombs and heavily damaged the Ateliers de L'Air Industriel (AIA) Weibel repair plant, the Dewoitine trainer factory of SACA, and the S.A. Ateliers D'Aviation Louis Grognet, which manufactured the Latécoere-298 and experimented with jet aircraft. On 22/23 April, 237 aircraft bombed the city of Brunswick with 729 tons of bombs, adding fresh damage to the aircraft factories there. The Bomber Command also hit the Kjeller Messerschmitt airframe and Daimler-Benz engine repair factory at Oslo with 50 airplanes and 210 tons of bombs on 28/29 April. The next night 53 bombers

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put 217 tons of bombs on the Aulnat factory airfield at Clermont-Ferrand
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which was engaged in repair work.

The April campaign against airframes in the Mediterranean began on the night of 1/2 April when 55 bombers of the 205 Group, RAF attacked the Macchi Me-200 assembly plant at Varese, Italy with 92 tons of bombs. As a part of a wide-spread attack on Budapest by the Fifteenth Air Force on 3 April, 111 B-17's dropped 352 tons of bombs on the Duna Repulogepgyar aircraft factory located on Csepel Island near the town of Szigetszentmiklós and on the edge of the Tököl airfield. Enemy opposition was weak, and although there was intensely heavy flak over Budapest only three B-17's were lost against total bomber and fighter claims of 24-4-10. Ten days later the Duna factory was again bombed, with 93 B-24's dropping 215 tons on the components plants scattered in the woods and 125 bombing the assembly plant on the edge of the Tokol airdrome with 200 tons. Another 125 B-24's also attacked the Budapest/Veeres airdrome with 186 tons of fragmentation bombs. This installation was used as a storage field and repair base. It was also capable of performing final assembly, and it was supposed to be partially engaged in Ju-52 assembly. While these installations were being attacked, 163 B-17's raided the Hungarian Wagon Works at Győr where Me-109 components were made. Severe damage was inflicted by 381 tons of bombs
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which were dropped on the factory and adjacent airfields.

Two nights before, on 11/12 April, the 205 Group, RAF hit the Macchi factory at Varese again. It was a very light attack, only three tons being dropped through a 10/10 cloud cover which forced most of the aircraft to seek targets of opportunity. The following day the Fifteenth turned its attention to the great Wiener Neustadt Me-109 complex at Wiener Neustadt, Bad Vöslau, and Fischamend Markt, 134 B-24's hitting Werke I (assembly) and Werke II (components) at Wiener Neustadt with 280 tons. Damage to

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Werke II was so extensive that it was unnecessary to return to it before 10 May. The assembly plant, however, was not so heavily hit. A formation of 172 B-17's dropped 465 tons of bombs on the Fischamend components factory, covering the target so well that it was unnecessary to bomb it again. At Bad Vöslau 140 B-24's put 259 tons on the assembly plant, severely damaging the important installations chosen for attack.

In the middle of the month the Fifteenth extended its operations against aircraft production in the Balkans. On 16 April, the Rogozarski Me-109 assembly plant at Belgrade was attacked by 116 B-17's and 28 B-24's which dropped 397 tons of bombs on it. The same day the IAR Me-109 assembly and aero-engine factory at Brasov was severely damaged in an attack on that city's marshalling yards. On 17 April, the Fifteenth returned to Belgrade and dropped another 81 tons on the Rogozarski factory and 74 tons on the Ikarus Me-109 assembly plant. The latter was paid a return visit on 24 April, when 19 B-17's laid on it another 56 tons of 500-pounders.

Another strike against Werke I at Wiener Neustadt and the Bad Vöslau factory was made on 23 April. Werke I had escaped for all practical purposes in the bombing of 12 April, and although Bad Vöslau suffered heavy damage on this same attack, portions still remained which needed further working over. These plants were the two most important airframe production centers left within the range of the Mediterranean forces. A total of 171 airplanes of the Fifteenth Air Force attacked Werke I with 513 tons of well-aimed bombs. Only 30 to 45 enemy fighters were encountered and only 2 B-17's were lost. Claims against the enemy were 0-1-0. At Bad Vöslau 170 B-24's dropped 125 tons of "frags" and 262 tons of 500-pound GP bombs with excellent results. Five of the attacking Liberators were lost, but

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the RAF suffered losses of 16-8-8. Thirty-three B-24's also bombed the Wiener Neustadt north airbase with 36 tons of frags, but no fresh damage was inflicted on the installations there. Another force of 143 B-24's attacked the Meinkel factory at Schwechat, and 348 tons of 500-pounders were dropped with good concentration on the target. This plant was of importance because it was the only one producing the He-219, and it was also engaged in work on jet-propelled aircraft. Enemy opposition was very light; only three fighters were encountered, but four B-24's were lost, one of them crash-landing at the base.³⁴

On 25 April the Fifteenth again turned its attention to the Italian factories, and 118 B-24's attacked the Aeritalia assembly plant at Turin with 291 tons of bombs. Numerous workshops and hangars were hit and a number of planes were destroyed on the ground. The Aeritalia factory was a Fiat subsidiary and was one of the most important aircraft production centers in Italy in which the Germans were interested. Enemy opposition was not very strong, however, only 41 fighters, 16 of which were over the target, being encountered; but flak at the factory was moderate, accurate, and heavy. The claims against the enemy were 8-2-2, but American losses were seven bombers and one P-47. The last attack against airframes in April was on the 30th and again it was directed against Italian factories. Fifty-three B-17's dropped 153 tons on the Breda factory at Milan/Bresso, and 67 Fortresses delivered 201 tons to the Macchi factory at Varese. In these two operations four bombers were missing, but claims against the enemy of 18-1-1 were made. The April attacks by both the Fifteenth and 205 Group, RAF "wrote off" practically all Italian aircraft production and left very little construction to be accomplished in the following months.³⁵

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May was the windup month before OVERLORD. The Eighth Air Force was preeminently occupied with this operation, and the Fifteenth, in addition to its strategic bombing operations, had additional assignments in the campaign to take Rome. Yet, in order to cinch the gain in air superiority, attacks against aircraft production continued. Some factories had recovered, in part at least, from previous bombings, and these played host again to returning bombers. New sites to which production had been dispersed were discovered and added to the target lists. By D-day, 6 June, every known major components and assembly plant had been hit and in most cases severely damaged during the first half of 1944.

The majority of the attacks against airframes in May came in the last half of the month. Each air force made three attacks prior to 15 May. On 6 May, the fifteenth dispatched 161 B-17's against the IAR Me-109 components factory at Brasov, Rumania. Of that number, 154 bombers succeeded in reaching the target and dropping 369 tons of bombs in a well-concentrated pattern on the objectives.³⁶ In the Eighth Air Force raid on Berlin on 8 May, 10 B-17's dropped 25 tons of 500-pound GP bombs on the Arado Me-177 assembly plant at Brandenburg as a target of opportunity. Two days later Wiener Neustadt was again the target for the Fifteenth Air Force. A force of 174 B-17's and 126 B-24's dropped 795 tons of bombs on Werke I and Werke II, with more damage resulting to the latter than to Werke I. Another 102 Liberators hit Wiener Neustadt north airdrome with 212 tons of frags with fair results. Altogether about 150 German fighters were encountered over the target areas and flak was intense and heavy. Twenty-eight of the bombers and three of the escort fighters were lost, and claims against the enemy were 50-22-23. On 12 May, 58 B-17's from the eighth put 142 tons on the G. Brasser FW-190

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repair factory at Zwickau, damaging all buildings except one. The same day, the Fifteenth flew against the city of Merina di Pisa and in the course of the attack moderate damage was inflicted on the Fiat airframe factory. On 13 May, 220 heavies from the Eighth, using PFF equipment, struck at the Tutor factory airfield with 559 tons of high explosive and incendiary bombs, further damaging the already partially destroyed Fw-190 assembly plant.

No further raids against airframe production were made by either air force until the 19th. On that day 272 planes of the Eighth attacked the Me-110 components factory of HMG at Brunswick/Wilhelmshof. A total of nearly 803 tons of mixed bombs, including 64 tons of MDX and 522 tons of IE, were dropped, adding fresh damage to this already well-bombed plant. The following day, 73 bombers struck the Ju-52 assembly and Fw-190 repair base in the Paris suburb of Villecoubly with 193 tons of bombs. This MOA installation had not been attacked since 8 February and such new damage resulted. On 23 May, the Eighth again bombed the Se-204 assembly and components plant at Bourges with 84 planes and 250 tons of bombs.

The next day the Fifteenth attacked the Arne-Lutner-Loek Me-109 components factory at Itzgersdorf, a suburb of Vienna, with 128 E-17's. Poor weather, however, made it necessary to drop the 384 tons of bombs by PFF methods, and results were unobserved. In the 25 May raid by 61 B-24's on the Ronfalcone harbor, on which 149 tons were dropped, the Cant E-1007 assembly plant was severely damaged.

The Eighth resumed its attacks against airframes on 29 May when 15 bombers paid a return visit to the S. Messer plant at Zwickau and 48 attacked the Ju-52 and Ju-58 assembly factory at Dessau. The former place, a secondary target for a main attack on the oil installations at Ruhland,

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Zolitz, and Wersburg, received 26 tons of bombs. Dessau, which was a primary target on the same mission, was hit with 102 tons.

The month ended in a blaze of glory, when in two days, 29th and 30th, a total of 2,025 bombers from both air forces dropped 4,000 tons of bombs on 18 airframe targets. This tonnage represented 70 per cent of that dropped on this type of objective during the last half of May, and 6 per cent of the total tonnage dropped on all targets in the whole month by the Eighth and Fifteenth Air Forces. The Eighth started off these two days by dropping 379 tons on the Erla Le-109 assembly and ^{JU-52 and} AAG/JU-88 assembly plants at Leipzig/Bekau and about 112 tons on the Erla Le-109 fuselage factory at Leipzig-Weiterblick. A force of 138 heavies made the raid on the Ju-190 assembly and components plants at Luton, Gersau, Arzozinski, Posen, and Cottbus were attacked by 455 bombers which dropped 382 tons of bombs on these places, creating much war and havoc. The Fifteenth hit Werke I at Wacker Neustadt with 104 heavies and 220 tons of bombs. At Wersdorf was paid a return visit by 123 bombers which dropped 252 tons of bombs, ⁴² destroying the Hans-Luther-werk factory and marshalling yards.

On 30 May, the Eighth struck the Ju-190 plant at Gochersleben with B1 plants and 110 tons of B1 and B5 bombs, and the Junker factories at Halberstadt and Dessau with 350 tons. The latter plant received 170 of these tons delivered by 63 bombers. Thirty-six heavies also laid 103 tons on the stores depot at Diepholz. The Fifteenth sent 101 B-24's with 226 tons of bombs against the aircraft factory at Jels. The preceding night, in preparation for this and other day attacks on the 30th, the 205 Group, 13 bombers the fighter base at Luersbrunn ^{airfield}, about 30 miles northwest

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of Vienna, with 45 tons of bombs carried by 36 Wellingtons. The Ebreichsdorf carpet factory, converted into an Me-109 components factory when the Wiener Neustadt complex was dispersed, also was struck by the Fifteenth on 30 May. Sixty-seven B-24's dropped about 112 tons of bombs on this place, but no particular damage was done to the factory itself. At Neudorf, a suburb of Wiener Neustadt, there were as another Me-109 components plant, 37 B-24's dropped 74 tons with good concentration on the target. The Rohrbach Spinnmühl, converted to Me-109 components, at Leunkirchen was hit by 40 B-24's and 50 tons of GP bombs. The Lottendorfer Spinnerei, also converted to Me-109 components, was attacked by 50 B-24's which dropped 132 tons of bombs.⁴³

In these May attacks, particularly those of the 29th and 30th, the German aircraft industry received a very serious setback. The emphasis put on the destruction of component factories assured a much slower recuperation than in the past, when final assembly plants had been the priority targets. Improvisation which would allow work to continue in the latter was much more simple than it was in the parts factories.⁴⁴

During the first part of June the major portion of the Eighth's efforts was devoted to the support of landing operations and ground activity in Normandy. Its strategic work was confined chiefly to hitting airfields to prevent the Luftwaffe from interfering with the invasion, and between 1 June and D-day eight of these, chiefly in the Paris area, were attacked. One airframe factory was struck, however, during this period. On 4 June, 23 bombers revisited the SICA Se-204 plant at Bourges with 28 tons of fragmentation clusters. Some new damage resulted. The Fifteenth Air Force was chiefly engaged in hitting important railroad junctions and bridges in

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support of the Italian campaign and the Russian advance in the Balkans. Its first attack on aircraft production after 30 May was on 9 June when 30 bombers struck the Dornier factory at Munich/Leuauwing with 57 tons of bombs. By D-day, however, German aircraft production had been reduced to such a low level that the task of the air forces became one of policing to see that this level was maintained and primary attention was turned to other target systems.

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As a corollary to aircraft, aero-engines were seriously attacked in 1944. They became priority targets early in the year and by the end of September, 21 of the 22 major factories producing Bayerische Motoren Werke (B.M.W.), Daimler-Benz, and Junko engines had been damaged. The end result was to limit both replacements and installations in new aircraft. At the beginning of 1944, the RAF had a surplus of 10,000 engines and an increasing monthly production which reached a peak of 6,000 in April. This provided for a balance between production and requirements until May, when requirements began to exceed production. In October production had been reduced to 2,700 a month and the surplus had fallen to less than 1,000. There was some recovery from this time on, due in part to removal of factories to dispersed and underground sites, until about 4,200 engines a month were being produced by the end of the year. While this helped, it was not enough to meet the requirements.

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The concentrated attack on aero-engines did not take place until the latter half of 1944. From January through May there was a total of 42 strikes, 10 by the Eighth Air Force, 5 by the Fifteenth, and 21 by the RAF. Many of the factories bombed in this period received their damage from area rather than precision raids. This was particularly true in the

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case of the Hilt missions. The Eighth was also able to hit some engine plants by IFF bombing, although the particular factory involved was not pin-pointed. The damage inflicted on the Fischer A. G. Juno carburetor plant at Frankfurt was an example of this. In some instances an engine factory, such as the Meyerische Motoren Werke at Eisenach which was raided by the Eighth on 24 February, was attacked as a part of a raid on an airframe establishment--in this case the Me-110 assembly at Gotha. The Fifteenth's attack on the Daimler-Benz (DB) engine components at Steyr was in connection with the raids on the ball-bearing industry.

Not all precision attacks were successful. On 21 February the Heider-sachsische Motoren Werke at Brunswick/Querum was the target, but the bombs fell wide of the mark and practically no damage resulted to the primary objective. Although only 86 per cent of the total tonnage of 5,534 tons dropped by the Eighth specifically on aero-engines was dropped prior to June 1944 (937 tons from April to December 1943, and 1,028 tons from January to May 1944), these attacks hastened the dispersal of the factories with the resulting loss of quality and quantity and added to the problems of the already ⁴⁷harassed GAF.

Allied with the campaign against aircraft production was the destruction of the enemy's airfields. Not only were these installations fighter bases from which the GAF could dispatch planes to intercept the bomber formations but they also served numerous other purposes. The Zemun airdrome at Belgrade, for example, was an important stop-over point for German transports flying supplies to the Russian front from northern Italy, Yugoslavia, and Greece. Some fields, such as those at Aviano, Villaorba, and Piacenza

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served as ferry bases for aircraft flying from the production lines to the Italian battle areas.

Other airfields were used as repair bases, and practically every final assembly plant had an adjacent airfield for testing and storage. For example, the Sondorf airrome not only was a long-range bomber base but also was equipped with extensive repair and conversion facilities. The Udine and Aviano fields in Italy were among the best in that theater for repair of battle-damaged planes. The Flersfurt airfield adjoining the Messerschmitt components plant was not only a point in the first line of defense of southern Germany, but also a storage depot and repair base. As the destruction of Luftwaffe production increased in intensity the airbases having repair facilities increased in importance. It became necessary to recondition and return to service many airplanes which normally would have remained grounded. An example of this was the Möllersdorf airfield at Wiener Neustadt. This installation had always been the chief GAF air stores park in Southeastern Europe for supplying Italy and the Balkans, but after the severe damage inflicted on Werke I and Werke II Messerschmitt factories at Wiener Neustadt, its importance as a repair base grew rapidly.

Attacks on many airfields were tactical in nature rather than strategic. The Eighth Air Force sorties against many of the French, Belgian, and Dutch installations, such as Chateaudun, Caen/Carpignat, Romilly, and Biarritz in France, Ostend, Brussels/Le Culot, and Brussels/Melsbroek in Belgium, and Gilze-Rijen and Lindhoven in Holland were designed not only to render them unserviceable as bases from which to fly against the heavy bombers but also to prevent their use for repelling the cross-Channel invasion when it got under way. In the Mediterranean where a land battle

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was already in progress, the Italian and southern French airfields had a particular tactical significance. Gradually the German fighter operational fields were pushed further and farther back from the front lines as both the Fifteenth and Eighth Air Forces poured tons of bombs on the fields. By the middle of February, the IAF could use the bases in the Rome area, such as Viterbo, Tarquinia, and Orvieto, only as advanced landing grounds. The airfields in southern France, such as Montpellier/Frejorgues, Istres Le Tube, and Salon de Provence, served as long-range bomber bases from which the IAF operated against Mediterranean shipping and the Anzio beachhead, and it was necessary for the Fifteenth to neutralize them not only to protect shipping and Anzio but also to assure the success of ANVIL.

Not only were the airfields attacked by the four-engine bombers of VIII AF, but as the strength of the Luftwaffe waned and the number of American fighters increased, the fighter escort, freed from close watch over the formations, often descended to shoot up fields either as primaries or as targets of opportunity. By the end of April, it was common procedure for fighters to strafe any fields they could find when relieved of escort duties. The effectiveness of these bomber and fighter strikes is attested to by the great number of fugitive sorties flown by the Germans on the approach of Allied formations. The attacks, in addition to destroying and damaging aircraft on the ground, facilities, and supplies, also furnished the IAF with a varied assortment of transportation, repair, and morale headaches. Problems of personnel evacuation, conscription and transportation of sufficient labor for repair work, and maintenance of discipline caused trouble long after the bombs had fallen. After the 5 February attack on the Châteauroux/Martinari airfield by the Eighth, the Germans requisitioned

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several hundred workers from the usual sources to assist with the repairs. Unable to get more than a fraction of the man power needed, however, the Germans drafted laborers from factories in the vicinity. The difficulties were not lightened by the fact that a week after the attack 40 to 50 unexploded bombs were still on the airfield. Altogether in the first nine months of 1944, assaults on airfields accounted for 76,700 tons of Allied bombs, with the USAAF and the RAF making 531 attacks on 257 targets--135 in France and the Low Countries, 75 in Germany and Austria, and 47 in Italy and the Balkans.

The Luftwaffe did not take these attacks lying down, but as its strength declined it had to develop techniques for conserving its operational aircraft. As early as January the Germans resorted to a new dispersal policy on airfields in occupied countries, placing dispersal areas as far as a mile and a half from the main field. This made it more difficult to destroy or damage planes on the ground and divided the Allies' efforts. Another trick was to plot the approaching fighters and order all aircraft on the field to go up and hover over a near-by woods where their color blended with that of the forest. Often the American fighters would not see these so-called planes in the air and would pass them by, and so on; no aircraft on the ground would do little or no strafing. If one of these hiding formations was spotted, however, the Americans descended on them like wolves on a herd of sheep.

The USAAF also developed tactics of its own to secure the most efficient results from attacks on enemy airfields. In order to prevent the AF from rising against bombers on their way to targets, a number of fighters would precede the bomber formation by about 15 minutes. They

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would fly low enough to come under the enemy's radar curtain, and arrive at the field undetected in time to catch the German fighters getting ready to take off to intercept the heavies still miles away. Another tactic developed was for the escort to slide to one side of the bombers when the latter prepared to drop their bombs on an airfield. Then as soon as the bombs had exploded and before the flak guns could be fully manned, the fighters would sweep in and shoot up the rest of the field. By this technique it was possible to stay over the field for about five to 10 minutes before it was necessary to pull out.⁵¹

The results of the attacks on aircraft production are confusing and paradoxical. In spite of the damage inflicted (146 assembly, component, repair, and aero-engine plants were damaged in the first nine months of 1944) production rose sharply after March, and during the whole year 39,807 aircraft of all types, of which 25,530 were single-engine fighters, were accepted by the GAF. It must be remembered, however, that an increased production had been planned and provided for in 1943, and only a guess can be made as to how much greater the output would have been if the Allies had not given the aircraft industry the high priority it held. Reichsmarshal Goering explained that increased total numbers meant little unless the types were also considered. The change from bomber to fighter planes^{alone} allowed for greater numbers. Four fighters, he said, could be built out of what it took to construct one He-177. Goering also stated that after the War Ministry took over procurement more raw material was available, and this coupled with large-scale dispersal naturally permitted increased production. The effects of bombing were, as Goering said, partially offset by dispersal and concealment of factories in underground sites. Yet in conjunction with the later attacks on oil and transportation the aircraft target program reduced the GAF to the vanishing point.⁵²

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After eliminating other factors which contributed to reducing production, responsible German officers agreed to the effectiveness of the Allied bombing policy in general. Field Marshal Milch claimed the attacks had a noticeably crippling effect as early as July 1943. An operations officer in Italy estimated that 18 per cent of the aircraft industry failed. "We were confronted," he said, "with insurmountable difficulties—moving the industry underground, using every available workshop, no matter how small, every garage to produce parts. Replacement of workers, moving and housing workers, difficulties with our foreign laborers, the transportation difficulties and securing the alloys and other materials which go into an aircraft were but a few of our Gargantuan tasks. In this respect your strategic bombing program was of course successful, you forced us to the limits of our endurance, ability and energies, and had it not been that we were fighting a desperate, fanatically defensive war, our aircraft industry could never have overcome your bombings." Another staff officer admitted that the industry was badly damaged and that it was a tremendous task to assemble the parts from widely dispersed locations where they were being made, but said he, "somehow we managed."⁵³

A very important effect of the war against the aircraft industry was to deny organizations enough new planes to keep them up to the authorized operational strength. The Jagdgeschwader 7 (fighter wing) which was to be re-equipped with the famous jet-propelled Me-262 was forced to twiddle its thumbs because of a lack of planes. Deliveries were delayed for a long time because an important tool supply, necessary in construction, had been destroyed in the Regensburg raids. Since the Jagdgeschwader had already

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relinquished its old planes to other units, the training and transition to the Me-262 was considerably slowed down, and many pilots and ground crews were forced into idleness. ^{conventional} Some groups, in addition to lacking new planes, also suffered from a shortage of replacement parts, such as propellers⁵⁴ after the bombing of the Vereinigte Deutsche Metallwerke at Frankfurt.

The Germans themselves should be given some credit for their reduced production. Hitler, stubbornly refusing to recognize that the Luftwaffe was no longer an offensive but a defensive organization, insisted that the Me-262 be converted to a fighter-bomber, and on his personal orders production on this plane was held up at a time when the Germans needed every fighter they could get. He likewise ordered a cut in the fighter production program in order to make materials available for an increased four-engine bomber program. There was also friction within the German organization and too much red tape in matters of materials, tools, and manpower. Apparently there was no effective priority system, although captured responsible officials did not agree on this. Dr. Karl Fryden, who was chief of the airplane industry in the Speer Ministry, claimed that aircraft always had first or second priority. Fryden, however, was also a director in both the Heinkel and Messerschel companies. Directors in other companies having to compete with other industries for materials insisted that aircraft was often in fifth, sixth, or seventh place. From this it would appear that priority positions depended upon the personal whims and influence of governmental officials instead of on objective ratings.⁵⁵

The Americans themselves were guilty of mistakes which lessened the effectiveness of the bombing of the aircraft industry. One was in the

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choice of bombs used. The attacks on aircraft factories often resulted in more structural damage to buildings than destruction of essential machinery. Certain precautions taken by the Germans, such as leaving windows open during a raid to reduce the force of the blast and removing undamaged or slightly damaged machinery immediately to a rapidly improvised workshop such as a hangar, allowed production to go on. Some 70 per cent of the bombs used were 500-pound G's, about 25 per cent were IP's, and 2 per cent were fragmentation. It had been supposed that aircraft factories were not particularly vulnerable to fire, but postwar surveys show that a high degree of vital damage resulted from incendiaries. The chief objection to the 500-pound G's was that they were too light to wreck important structures completely and they were badly fused. They dug craters in the floor but did little damage to the machinery. Technicians agreed that maximum damage was caused when the bomb exploded just beneath the roof, but proper fuses for this type of detonation were not available even in limited quantities until the last half of 1944.

Fire protection, too, was at fault. Lindbergh indicated that attacks on a paper in the industry would have paid greater dividends. The emphasis placed on final assembly at first was intended to prevent finished aircraft from reaching the front lines, but the excess capacity and ease of repair or improvisation kept this part of the industry going and necessitated many return attacks. Goering and Milch were generally agreed that earlier attacks on aero-engines and components would have affected final assembly more disastrously than the destruction of final assembly facilities themselves.

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The attacks on airfields were generally effective, but in the opinion of Goering they were not a major factor in the destruction of the Luftwaffe. Repair facilities were, of course, damaged, but these could be more or less easily put into operation again. This the Germans called "the race between the shovel and the bomb." A large number of grounded planes at these places was destroyed also, and although the bombing of these airfields might not have been a major factor in Germany's defeat, it certainly was a contributing one.

Regardless of the faults inherent in the bombardment policy of the German aircraft industry, it did accomplish in the end certain important results. First, it forced the Luftwaffe to change from an offensive to a defensive organization, and the RAF was not adequately prepared for an effective quick readjustment. The famous bomber force was obliged to build up the fighter arm. It also necessitated the redistributing of forces so that the heaviest disposition was in Western Europe and Germany, thus leaving the ground forces in Italy and on the Russian front with diminished air protection. A captured officer exclaimed: "Why don't we see any of our planes? Because we don't have any! If you're in Russia you're told that the Air Force is in Italy; if you're in Italy, then you're told it is in the West; and if you're in the West, then you're told that it is in Russia. I saw something of the situation. At Bologna there were exactly 16 planes! It made my hair stand on end!"

Another important effect was to eliminate serious air opposition to OVERLORD. The extent to which the RAF was knocked out is illustrated by the lament of General Dorch, commander of the fighter defenses in the French

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invasion area. He stated, and his statement was corroborated by Goering, that on D-day he had only 160 aircraft, 80 of which were operational, to oppose the invasion, and in the ensuing month he was given reinforcements of only 600. During the first five days of June 1944, 3,300 bomber crews and 2,312 fighter pilots of the Eighth Air Force reported that scarcely an enemy plane was seen. The total GAF reaction to nearly 2,000 sorties was an attack by 10 He-100's on the straggling B-24's on 4 June over Melun, but even these fled from the P-51 escort.

A third result of the air attack on GAF production was to force the Germans into a retreating policy of plane conservation and to hit more vulnerable other portions of the enemy's war industry. This lack of air opposition in turn considerably reduced the costs during the latter months of the GIC and allowed an economical destruction of oil, transportation, and other vital targets.

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Chapter VII

ATTACK ON BALL-BEARING INDUSTRY

Allied with the bombing of aircraft factories were the attacks on the antifriction-bearing industry. In these days of mechanized warfare and high-speed moving machine parts the ball and other types of bearings play an important role. Thus it was hoped that the destruction of the sources of supply for these critical items would effect the production not only of airplanes but also of motor vehicles, tanks, machinery, and other war equipments. The RAF had opened the campaign against antifriction bearings with a night raid on the Vereinigte Kugellager Fabrik (VKF) at Stuttgart on 14 April 1943. The Eighth Air Force inaugurated its daylight offensive against ball bearings when it attacked the Schweinfurt plants on 17 August of that year. Its next attack was a month later, 15 September, when the SKF factory at Paris/Lois Colombes was bombed. On 14 October Schweinfurt was again raided by the Eighth and before the end of the year the bearing factories at Aurin and Villar-Cerose were attacked by the Fifteenth and Jersey had been hit by the RAF Bomber Command.

By the middle of January 1944 it was estimated that ball-bearing production in Germany had been cut somewhat over 20 per cent, and General Arnold was anxious that the complete destruction be accomplished as soon as possible. He estimated that the effects would be seriously felt within a month after production ceased. Schweinfurt still remained the chief producer even after the two heavy bombings in 1943, and in the ensuing

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Table 17

WARTIME USES OF ANTI-FRICTION BEARINGS
DECEMBER 1943*

<u>Industry</u>	<u>Consumption</u>	<u>% of Total Production</u>
Aircraft	31.4	
Tanks	4.0	
Motor vehicles	4.1	
Weapons and naval guns	3.5	
General equipment	49.1	
(Electrical		19.7)
Mechanical		16.5)
Precision tool and optical		1.4)
Other		11.5)
Export	7.9	
TOTAL	<u>100.0</u>	

*U.S. Strategic Bombing Survey, The German Anti-Friction Bearings Industry, Nov 45, p. 7

months it received the most attention. The three plants (Kugelfischer, VKF, and Fichtel and Sachs) located there still produced a little over 38 per cent of the bearings. Outside of Germany, the biggest manufacturer was the Steyr-waffen Walzlagerwerke, a Daimler-Puch factory, which had produced nearly 10 per cent of the pre-attack supply. With the elimination of other sources of supply this was stepped up to about 14 per cent by the end of the first quarter of 1944.³

The Fifteenth Air Force began the 1944 campaign against the bearing industry with an attack by 53 B-17's on the RIV factory at Villar-Perosa on 3 January. A total of 171 tons of bombs cascaded down on this plant which had supplied 1.4 per cent of Germany's normal supply. The importance of Villar-Perosa had been considerably increased after the destructive 1943 raids on

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Schneidmuller and Hurin, and this attack prevented the possible shipment of precision machinery to the German ball-bearing factories in Germany. The only other attack on anti-friction bearings in January took place on the night of 20/21 when nine B-24's attacked the Wuppertal works at Elberfeld with nine tons of high-explosive bombs. The Eighth Air Force had attempted a raid against Elberfeld on 5 January, but visibility in the target area was so poor that five targets of opportunity were attacked instead.

However, which had held down attacks against aircraft production during the first half of January, also inhibited the campaign on ball bearings. Except for a series of light strikes by the Eighth Air Force against the Wuppertal plant at Elberfeld, it was not until the 20th that the anti-friction-bearing industry received attention. Between 20 and 26 February, however, seven large-scale strikes were launched, three by the Eighth Air Force, one by the Fifteenth, and three by the Second Bomber Command. The first of these was a large-scale attack on the aircraft manufacturer's aircraft production at Leipzig on 20 February. As this time a little damage was done to the aircraft manufacturer's plant (LW). That night, 20/21 February, 424 B-24's, 103 B-29's, and 10 B-52's dropped 1,170 tons of high-explosive and 1,080 tons of incendiary bombs on Stuttgart, damaging the plant in the suburb of Neuhausen. This plant, which was estimated to be producing about 7.75 per cent of the total German supply of anti-friction bearings, was again bombed on 25 February, when Eighth Air Force B-17's dropped approximately 100 tons of ball-bomb loads on it. On 23 February a force of 109 B-24's from the Fifteenth dropped 514 tons of 500-pound bombs on the factories and aircraft engine shops at Augsburg, inflicting serious damage

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on the Steyr-Waffen-Werke.

Schweinfurt, of course, was center which still received the main attention of the air forces. This city, however, because of the policy of factory dispersal, did not reach 30 percent of the target it had been in August 1944. Nevertheless, on 24 February, 385 B-17's of the 8th AF attacked the plants with 17.5 tons of high-explosive and nearly 171 tons of fire bombs. One of the plants, the Reichsaufbaufabrik, was the hardest hit. The factory, which had been partially reconstructed, escaped. The Luftwaffe received only a fair amount of damage. The Deutsche Flugzeugwerke, which had been completely reconstructed, escaped. The Luftwaffe received only a fair amount of damage. The Deutsche Flugzeugwerke, which had been completely reconstructed, escaped.

German reconnaissance had been considerably more the time of the 1944 raids, and only 11 B-17's, 1 B-24's, and 2 B-29's were lost. The combined claims of the bomber command for aircraft destroyed, probably destroyed, and lost were 11 B-17's, 1 B-24's, and 2 B-29's were lost. The combined claims of the bomber command for aircraft destroyed, probably destroyed, and lost were 11 B-17's, 1 B-24's, and 2 B-29's were lost.

This success was followed by a night area raid on 24/25 February by 400 bombers, 11 B-17's, and 10 Mosquitos of the bomber command, which covered the target area with 1,328 tons of fuel and 1,061 tons of incendiaries. The next night, 25/26 February, five Mosquitos returned to Schweinfurt with little or no loss of fuel loads. It was estimated that in these attacks on the chief ball-bearing centers, Schweinfurt and Stuttgart, during the big week 34.76 per cent of Germany's mid-January capacity had been hit. The other, about 71 per cent of the enemy's mid-1944 capacity had been attacked since the opening of the campaign in the previous month.

In March only five effective attacks were made on ball bearings, two each by the 8th Air Force and the 15th Air Force and one by the Fifteenth Air Force. On two occasions, 1/2 March and 15/16 March, the 8th AF made area

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raids on Stuttgart, but reconnaissance showed no further change to the ball-bearing factories. The most successful of the first anti-friction bearing factories on 2 March on 470 bearings of the Light project or 90 tons on the Berlin suburb of Ormer, was an important plant located.

Another excellent and the target received a severe plastering from nearly 600 hits. This, however, was not so well taken care of as this time that it was unable to return to its air. On 13/11 March the 13th sent 13 bombers with 77 tons of mixed bombs to the needle-bearing factory at Leicovario. A fair amount of damage was inflicted. Schweinfurt was a major target for two attacks. On 24 March, the Eighth dispatched 280 B-17's against this city, but a 10/10 cloud forced most of them to fly to Frankfurt, which was bombed on pathfinder flares. Fifty-six of the bombers, however, dropped about 117 tons of bombs by 11 on Schweinfurt. The second attack was by one B-24 and six bombers of the 12th on 30/31 March. About 12 tons of G and 14 tons of H were unloaded on the target. Later intelligence indicated that while 29,155 square feet of buildings were destroyed and an additional 462,272 square feet were damaged in these two raids, there was no destruction of or damage to machinery and only 2.3 percent of the finished stock was damaged. The fifteenth's one attack was on 29 March. The primary target was the shell line yards at Turin, but some bombs spilled over on the TV plant. This factory, however, had ceased to be of any importance as a source of supply for ball bearings.

In April, only two ball-bearing centers were attacked in three raids. The first of these was on 2 April by the Fifteenth against Steyr, where 257 B-17's and B-24's dropped 540 tons of G and 206 tons of H on the ball-bearing works in conjunction with an attack against the aircraft factories

located there. This was, perhaps, the most destructive raid against anti-friction bearings carried out by this air force. Ten per cent of the machinery was destroyed and 40 per cent was damaged, and at least 50 per cent of the bearings in production was destroyed. The RAF made a valiant effort to protect the target and 20 bombers were lost in this operation. Claims against the enemy were, however, 110-40-15. Despite the losses, this raid was highly successful in that it disposed of this top priority target and brought to a close the first phase of USAAF's campaign against the bearing industry. From now on it was merely a question of policing.

On 15 April the Eighth Air Force returned to Schweinfurt and dropped about 545 tons of mixed bombs on the Kuefelfischer, IAG, and Fichtel and Wechs installations with excellent results. Building damage amounted to 490,730 square feet, with an additional 347,420 square feet destroyed. Almost 1 per cent of the machinery in these plants was destroyed and 25 per cent was damaged. The RAF hit the same targets with about 100 Mosquitos and 187 Lancasters on 26/27 April in what was a largely a fire raid: A total of 146 tons of high-explosive bombs and 1,061.7 tons of IR were dropped. Although there was no destruction or damage to machinery and no loss of finished stocks, 339,073 square feet of buildings were damaged and 22,170 square feet destroyed. With these attacks, there came a lull in the campaign against ball bearings. In May, there was only one attack on the industry. The J. Schmidt-Rost (SRO) plant at Amnevy, France was hit by the RAF with nearly 114 tons of bombs. About 85 per cent of the total floor space was destroyed and 700 tons of finished stocks were lost. This plant, which had furnished 1.7 per cent of the Axis pre-raid supply of bearings, was completely written off by this raid.

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The Allied campaign against the antifriction-bearing industry continued right to the end of the war. No attacks were made in June, but eight were launched in July. Then there was another lull until October, when the last attack came on 23 February 1945 when 12 B-17's dropped about 30 tons on Schweinfurt in an area raid. ¹¹ During the main period of the attacks, 17 August 1943-30 September 1944, USAAF made 26 attacks on 14 factories producing about 84 per cent of the Axis supply of bearings. The tons dropped on these plants represented 1.2 per cent of the total effort of the U. S. Strategic Air Forces in these 14 months. In the first half of the period, August 1943-February 1944, it was estimated that these attacks, along with the loss of imports, caused a 20 per cent reduction in the German pre-raid supply. In the next seven months the reduction amounted to 30 per cent. ¹²

In spite of the high hopes entertained in the beginning that disastrous effects would be achieved by the attacks on ball bearings, the results were not so fruitful as desired. Experience showed that it is very difficult to put factories out of operation. Even the destruction of a vital process did not stop production, since the organization of the plants into departments along one complete phase of manufacture allowed continuation of work in other departments when one was bombed out. This, along with the failure to destroy or disable machinery and the inability to harness raw materials or finished and semifinished stocks, permitted a certain supply to keep flowing to users. The greatest damage was to buildings. Almost half of the pre-raid floor space was destroyed and another half was heavily damaged. Machine tools suffered considerably less, only about 12 per cent being destroyed and 30 per cent damaged. Although some plants such as D.C.

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at Würzburg and Fulda (Fulda) were completely knocked out and other major cities such as Stuttgart, Mannheim, and Frankfurt were out of operation for considerable periods of time, other factories such as those at Schweinfurt had production only partially disrupted. At no time, therefore, were the Germans so pressed that they could not meet at least half of their requirements. In the first phase of the campaign, August 1943-February 1944, they succeeded in filling 60 per cent of their needs with a 20 per cent reduction in supply. Even in April 1944, when supply fell to 47 per cent of pre-attack levels, 59 per cent of the requirements were met. The average supply for the first six months of 1944 was 58 per cent of pre-attack days, and this was sufficient for 70 per cent of the needs.

German leaders themselves did not believe that the Allied campaign against ball bearings was too effective. Goering explained that this was because of dispersal, underground factories, and use of substitutes.

Table 18

ALLIED BOMBING OF BALL BEARINGS
JULY-JUNE 1944*

Month	Supply as Per Cent of Pre-attack Level	Supply as Per Cent of Requirements
January	74	87
February	71	84
March	58	73
April	47	59
May	47	64
June	49	67
Average	58	70

* OS/10 Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 85a.41--Bombing, Talk (Classified Files).

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which have approximately the same relations plus the fact that Germany had hoarded bearings for a considerable length of time, which made it possible to keep a pipe line open to the users and avoid the stop in production. Cooper's basic one corroborated that of Orrin and Jlich. Yes, it stands to reason that there were some effects of a disastrous nature. Jlich stated that the bombing forced the Germans into a policy of dispersal which caused at least a temporary shrinkage in production. Also a mistake was made in the technique of dispersion, he said, by building the new plants above ground, leaving them still vulnerable to continued bombing. This defect was remedied, however, by moving to several other subterranean places.

Along with dispersal was a reorganization of the industry similar to that in aircraft production. In the fall of 1942, the Cooper industry took control of a main bearing factory at a point to be given full authority to requisition from other industries all tools and machinery, buildings, raw materials, personnel, and services necessary to maintain production. Another reason for the ability of the aircraft industry to hold its head above water was that with the plan for increased aircraft production in 1943 had been one for anti-friction bearings. Although many of the projected new plants did not go into production, the machinery made for them was used to take the place of that damaged or destroyed in existing factories.

A quite successful method of keeping supply and requirements somewhat in balance was 50 to 60 per cent out in the use of ball bearings. About the time of the 1943 reorganization the Air Ministry ordered a redesigning of plants to effect a change in bearings. Although most of the aeronautical engineers objected, Mr. Jackson of the Westinghouse company succeeded in

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collapsing some aircraft engines to reduce the number of bearings by 10 per cent. This device has been adopted by a number of other manufacturers when the short supply of bearings is acute. It is claimed that about 30 per cent of the ball bearings used in aircraft engines are unnecessary luxuries that could be eliminated. The ball-bearing manufacturers are not even allowed to experiment in producing and selling designs of the idea of a ring which would serve as a substitute for a ball bearing, such as a sleeve or roller bearing, alleviating the problems involved in the loss of ball bearings. This bearing will not prove satisfactory, however, and their chief producer, Chrysler, is to offer a claim for a "market" with the Government. In connection with releasing the use of substitutes, it should also be mentioned that all effects of production losses were cushioned to some extent by a reduction in requirements resulting from the aerial production of aircraft factories, reduced allocations to civilian industrial users, and strict control of stocks.

Still another effect has been the increase to augment their supply of bearings for the planes that they have been shot down. A memorandum concerned on 20 April 1945 from the United States and Great Britain to British suppliers of bearings "billions of dollars for ball bearings through the collection of the free aircraft brought about by the war effort. The so-called 'war effort' explained that a major source of collection had been instituted by the Government. How much of this was due to a real need for bearings and how much was a propaganda to impress the American people with the efficiency of defense measures it is hard to tell, but it deserves some attention.

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In order further to reduce the supply of bearings, Gidley reports all air attacks reported to the Allies. After the 1943 Schweinfurt raid, the lack of ball bearings created a serious bottleneck, and the German Government endeavored to supplement its supply by importing from Sweden. Although that country's production capacity was only about 14 per cent of that of Germany, France, and Italy, Swedish shipments could do much to alleviate the shortage caused by Berlin. The Allies, realizing this, proceeded to contract for the many Swedish ball bearings as it could not limit by treaty Sweden's shipments to Germany. Furthermore, the Nazi ability to purchase the bearings by Sweden's refusal to grant credit and insistence on cash payments or immediate exchange of goods on a barter basis. Despite these limitations, the Germans were able to procure more bearings from Sweden than the Allies had anticipated. When the British learned of a shipment of 75 tons of ball bearings to Germany in November 1943, it protested vigorously. The air force had already lost nearly three groups in two missions against Schweinfurt, and if these sacrifices were not to be in vain, then all holes must be plugged. Brig. Gen. H. A. Craig, Acting Deputy Chief of Air Staff, recommended that the Secretary of State do what he could to remedy this situation. Spetz was also concerned over the looseness of the Allied trade agreement with Sweden, and said that loopholes allowed that country to ship enough ball bearings to Germany in January 1944 to fill 70 per cent of airframe requirements. He requested that the State Department apply pressure on Sweden to halt these shipments. By force, however, it was conceded that Swedish ball bearings were critical only so long as German production continued at its present level, and if production were broken out, the value of the imports would be very small. It was agreed, therefore, to continue both the

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bombing and the application of diplomatic pressure.¹⁶

Despite the fact that the campaign against ball bearings did not bring the full amount of desired results, the theory behind the decision to strike at this industry was sound. It was in part unforeseen developments, such as Swedish supply of bearings, lack of intelligence on the full condition of the industry, and some tactical errors on our part which prevented the end results from being completely successful. Albert Speer testified that the effect on armaments production would have been disastrous and the entire armaments industry would have been brought to a complete standstill if: (1) all ball-bearing plants had been attacked simultaneously; (2) repeat attacks had been staged at short intervals, about every 14 days, until production stopped; and (3) each attempt at reconstruction had been attacked every two weeks for six months.¹⁷

Whether Speer's advice could have been followed is a question for tacticians. It was an accepted fact among Allied airmen that repeat bombings at regular intervals were usually necessary to knock out a large target completely, but incidents of weather, shortage of equipment, availability of personnel, incorrect interpretation of previous damage, and other human failings often interposed to alter a line of action. It is easier to see mistakes after they are committed.

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Chapter VIII

ATTACK ON TRANSPORTATION

Next to aircraft production transportation held highest priority, and when the success of the counter-air program was assured in the spring of 1944, transportation succeeded to first place. The reason for placing it at the head of the list of target systems at this time was to give as much direct support as possible to the forthcoming invasion of the Continent. The campaign against the transportation systems, however, can be placed into three distinct areas of operation: (1) the Italian peninsula; (2) western Europe; and (3) southeastern Europe and the Balkans. In each of these there was a specific purpose to be accomplished, and for this reason the attack on transportation lacked the singleness of purpose which characterized the fight to gain air superiority. Furthermore, transportation included more than railroads, although these were the targets most frequently attacked. The other transportation features also covered were harbors (largely the responsibility of the Coastal Command in the AOC and the AFM to the Command in the AIO), bridges, viaducts, and canals, while rivers and coastal areas were mined. For this target system the responsibility solely of the strategic air forces. The tactical air forces, such as the Ninth and Fifteenth and the Second Tactical of the AFM, used their share of bombing yards, bridges, tunnels, and viaducts which were located within their range, and in the Mediterranean theater the Coastal Command was engaged in striking at shipping both in harbors and at sea.

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Unlike other target systems, transportation is one where it is difficult to draw a clear line of distinction between strategic and tactical attacks. This was particularly true of the Fifteenth Air Force, which during the period covered by this study was actively engaged in supporting the land battle raging in the Italian peninsula and the advance of the Russian armies in Southeastern Europe. The same was true of the Eighth Air Force after the invasion of Normandy. Generally speaking, however, strategic attacks were those designed to strike at facilities well behind the enemy's forward lines and were not intended to isolate specific units engaged in battle, and they might have an adverse effect on industry as well as a long-range tactical benefit.²

In the Italian theater the line of demarcation between strategic and tactical operations was roughly that of Rimini-Pisa. The Fifteenth Air Force, as discussed in Chapter IV, was often called upon, however, to fly missions south of this line. The general plan for the strategic disruption of rail communications in Italy by MASAFA at the beginning of 1944 was two-fold: (1) to strike at the northern marshalling yards, and (2) to interdict lines in the La Spezia-Rimini area. With the marshalling yards knocked out the movement of goods and personnel into and out of Italy, would be eliminated or at least greatly hindered, and the cutting of the lines from the marshalling yards to the forces in central Italy would prevent the enemy's troops in battle areas from receiving equipment and reinforcements already gathered at distribution points.

In the interdiction program six specific areas were chosen for attack. One was the Genoa-La Spezia railroad, particularly the Recco viaduct which was the longest of four such structures on this line. The task of knocking

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this out was given primarily to the Coastal Command and the Navy, although the strategic forces also worked on it. In the Rimini-Ancona sector the work of destroying the bridges at Fano and Falconara and the Cesano River bridge was assigned to the fighters and fighter-bombers. The other four areas, Parma-Aulla, Bologna-Pistoia, Bologna-Prato, and Faenza-Borgo San Lorenzo, were assigned to MASAF. On each of these lines there were important bridges, viaducts, and transformer stations, and it was hoped that successful attacks on these targets would create a serious bottleneck. All of them were in difficult terrain and far away from railway repair centers. Furthermore their distance from combat zones would not make transshipment by motor transport feasible. Goods would then tend to pile up at marshalling yards and thus create a still larger traffic jam and offer spectacular targets.³

During the month of January the total tonnage of bombs dropped on railroads and marshalling yards by MASAF was 4,325. The Fifteenth Air Force was responsible for 3,904 tons and the 205 Group, R.F. for 421 tons. This represented 39.8 per cent of MASAF's total bombing effort in January. Most of the transportation targets hit were within a radius of 200-300 miles of Foggia, with the marshalling yards in the Florence area, such as Prato, Certaldo, Poggibonsi, Pontassieve, and Pistoia, receiving the heaviest blows. Although the line for separating the activities of the strategic and tactical air forces was roughly Pisa-Rimini, MASAF struck a number of railroad targets and marshalling yards, such as Arezzo, Siena, Orvieto, Perugia, Iesi, Terni, and Porto Civitanova, which were considerably south of this border. Above the line the important marshalling yards hit were

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Pisa, Ferrara, Pontedera, Verona, Bologna, Turin, and Rimini. Several of the targets were attacked more than once, and not all were primary targets but were raided as secondary or targets of opportunity when weather conditions obscured the primaries.⁴

In February, the bulk of the bombing effort against rail transportation was expended in approximately the same area as in January--between Ancona-Civitavecchia and Pisa-Ferrara. Tonnage was reduced, however, to less than half (2,087 tons--1,994 tons by the Fifteenth and 93 tons by the 205 Group, RAF) of the January total, but it represented 30 per cent of all of MASAF's bombing. A good many of the raids could be called tactical since they had as their primary purpose the giving of direct aid to the ground forces. For example, on 16 February the Fifteenth dropped approximately 358 tons of 500-pound GP on the rail lines, bridges, and marshalling yards of Prato, Pontassieve, Certaldo, Poggibonsi, Rieti, Siena, and Cecina, and on 20 February it let loose 182 tons on the road and rail communications in the Sante Marie/Tagliacozzo area. In the first half of the month, however, MASAF did bomb a number of the more important yards and rail communications in the north, such as Padua, Verona, Ferrara, Mantua, Vicenza, and Modena. These were key points in routing traffic into Italy and southward to the battle zone.

The Fifteenth also struck several railroad targets outside of Italy, but these were in conjunction with attacks on other objectives. On 4 February, as a part of the Toulon Harbor raid, 87 tons of bombs were aimed at the Antheor viaduct, just east of the harbor, but with no success. On 22 February, 42 tons of bombs were dropped by 21 B-17's on the Petershausen marshalling yards, which were a secondary target on the Regensburg/Prüfening mission of that date. Three days later on another attack against

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Regensburg, 16 B-24's hit the yards at Zell-am-See, 100 miles northwest of Klagenfurt, as a target of opportunity. The same day, another 16 B-24's dropped 37 tons on the Fiume marshalling yards and docks as a secondary target.

About the middle of the month it was definitely stated, however, that the second priority for MASAF (counter-air program of POINTBLANK being first) would be the disruption of Italian rail communications, including repair shops and other services as well as marshalling yards, at the following points, listed in order of priority: Padua, Verona, Bolzano, Turin, Genoa, and Milan. When visibility did not permit attacks on these places, alternate targets would be: Treviso, Mestre, Vicenza, and Alessandria. If weather was such that none of the 10 targets could be attacked, other communication centers north of the Pisa-Florence-Rimini line would have priority in accordance with the size of their marshalling yards and repair facilities.⁵

This new directive meant that generally speaking the Fifteenth Air Force and the 205 Group, RAF henceforth would devote their main attention in matters of rail transportation to integrated systems rather than to individual engineering structures involved in interdiction and that the attacks would be less immediately associated with the front lines. Although the plans for March were to concentrate on the northern yards as supplementary to the attacks of the Twelfth Air Force closer to the battle areas, MASAF continued occasionally to bomb single targets, such as bridges or marshalling yards in the area south of Pisa-Rimini. For example, on the night of 2/3 March Wellingtons of the 205 Group, RAF struck at the Orbetello marshalling yards and railroad targets in the vicinity of Montalto di Castro.

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The Fifteenth sent a number of its heavies on 3 March against the Rome/Littorio and Rome/Tiburtina marshalling yards with fair results. Later in the month, on 28 March, the Fifteenth bombed the bridges at Fano and Cessno. The major transportation attacks of MASAF were directed, however, against such places as Padua, Genoa, Verona, Bologna, Rimini, Milan/Lambrate, Turin, and Bolzano. The biggest day for the Fifteenth Air Force was on 28 March, when 1,061 tons of bombs were dropped on communication targets in Italy. This was the first "1000 ton day" for this organization. Altogether the Mediterranean strategic air forces dropped nearly 6,000 tons of bombs on railroads and marshalling yards (4,939 tons by the Fifteenth and 1,000 tons by the 205 Group, RAF) in March. This was 55 per cent of all MASAF tonnage that month.

In April, MASAF's total tonnage delivered against all targets almost doubled (from 10,767 tons in March to 21,348 tons in April), but the amount dropped on rail transportation targets was down to 46 per cent. These 9,882 tons, however, represented more than half of the total tonnage (17,062 tons) dropped by all components of MAAF on railroads and marshalling yards. The bombing pattern was pretty much the same as it had been in March, with the northern transportation centers receiving the most attention. The 205 Group, RAF hit such railroad centers as Vicenza, Genoa, La Spezia, Alessandria, and Piacenza. The Fifteenth Air Force bombed, mostly with good results, the marshalling yards at Treviso and Mestre in the Venice area, Ferrara, Bologna, Parma, Milan, Alessandria, Vicenza, Padua, and Trieste/Opicina. Some of these targets were struck several times, demolishing repairs as soon as they were made and thus allowing only a small amount of traffic to trickle southward to the Florence area. Below Florence the tactical air forces had cut practically every line to Rome and the battle front, but MASAF continued

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to bomb individual engineering structures and targets south of Pisa-Rimini. These were for the most part, however, either secondary targets or targets of opportunity. For example, on 20 April, some of the forces from the Fifteenth, finding their primary targets cloud-obscured, dropped their bombs on Ancona and Fano marshalling yards as secondaries, and hit the railroad bridge over the Tagliamento River at Casarsa as a target of opportunity.⁷

During April the Fifteenth introduced a new type of bomb to the European theater. This was the Azon which consisted of a special radio tail attachment for 1,000-pound bombs and a radio transmitter in the airplane, by means of which the bombardier could control the azimuth movement of the bomb. As early as February, Headquarters, AAF had decided to use at least 100 of these bombs against special targets in the ETO, and plans were made to ship necessary equipment and personnel to the Eighth Air Force by 1 March. Experiments at Eglin Field had led the planners to believe, however, that this weapon was not a suitable one against the selected objectives on the French invasion coast. Since they were controllable only in azimuth, they could be used more efficiently against long targets, such as bridges, docks, and marshalling yards, where range was not particularly important. For this reason it was recommended that the project be transferred to the Fifteenth Air Force, which was doing considerable bombing of transportation targets. The recommendation was accepted, and a six-plane, 200-bomb, Azon project was scheduled to leave the United States for the MTO by 15 March.⁸

The first shipment did not leave until early April, but by 19 April everything was in readiness in the theater to start operations at an early date. The first mission took place on the 24th when five Azon-equipped B-17's attacked the Ancona-Rimini railroad with eight tons of bombs. The bombers met

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with no opposition, there were no losses, and the results were considered good since hits were scored on the tracks and on the approaches to a bridge. The next mission was on 29 April. Again five B-17's participated, dropping 12.5 tons of 1,000-pound RDX Azon bombs on the same railroad. There was a direct hit on the bridge at Senigallia, a cut in the line, and numerous near misses. The average deflection error was estimated to be 150 feet and for range about 500 feet and it was hoped that further experiment would decrease the number of misses.

On 13 May, four B-17's, Azon-equipped, participated as leaders in an attack on the Avisio viaduct (a few miles north of Trento on the Brenner Pass rail line) by the 301st Group of the Fifteenth Air Force. Out of the 21 Azon bombs released, four were direct hits. The rest of the group, using normal methods, released their loads of 1,000-pound GP simultaneously with the Azons. Photo interpretation showed a 70-foot gap in the viaduct, which would effectively block traffic through the vital Brenner Pass. At the same time that Avisio was being bombed other planes were attacking the Bolzano marshalling yards, thus causing more interruption on this link between Germany and Italy.

It was not until the last of May that the Eighth Air Force was equipped with Azon bombs, although it had requested them in early April. The Eighth felt that these bombs could be successfully used against the increasing number of CROSSBOW, communication, and tactical targets it would be called upon to destroy prior to and after D-day. Headquarters, AAF replied that the current procurement contract called for only 10,000 Azons and a decision to manufacture more would depend upon the success obtained by the Fifteenth. Nevertheless, the Eighth was advised to observe the operations in the MTO and state its requirements based on these observations at the earliest

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practical date. On 8 May, Spaatz requested 10 B-24's equipped for Azon bombing, and two days later he was notified that this number was being diverted from the China-Burma-India theater to the ETO. Upon arrival these were assigned to the 96th Combat Wing of the 2d Bombardment Division. The first mission in which they were used was on 31 May when 14 out of 25 Azon bombs were released against French bridges with fair to good results. Five of the bombs were jettisoned over the English Channel and six were returned to base.¹¹ Three days prior to this, uncontrolled glide bombs were used in a raid on Cologne, but the unsuccessful results led to a recommendation¹² that no more of these bombs be ordered for the Eighth Air Force.

In May, which saw the beginning of the concentrated drive on Rome (DIADEM) and the final preparations for a cross-Channel invasion of France (OVERLORD), the operations of MASAF against rail transportation were divided largely between Italian and French communication centers. It was on 12 May, too, that the Fifteenth Air Force celebrated its first "1,000 sortie day" and dropped the record tonnage of the year to date. On that day, 1,143 sorties were flown in cooperation with the ground forces in Italy, and 1,912 tons of bombs were rained down on a combination of railroad yards, airfields, and other military targets. Although the percentage of bombs dropped by MASAF on railroad installations in May was less than half of the total for all targets (45.8 per cent), the actual number of tons (13,910 tons) was greater than at any previous time and no other target system received nearly so much. Of the total, the Fifteenth dropped 13,257 tons and the 205 Group, RAF dropped 653 tons. In addition to the railroads, MASAF also attacked other transportation facilities, putting 3,726 tons on harbors and docks and 872 tons on highways.¹³

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The 205 Group, RAF started the May campaign off on 1/2 May with an attack on the Alessandria marshalling yards and the Genoa docks and rail yards. This was followed on 2 May by Fifteenth Air Force raids against Castelmaçgiore, Parma, Ancona, and La Spezia marshalling yards and the Orbetello and Faenza railroad bridges. Generally, the important transportation targets were north of Pisa-Rimini, although some south of this line were singled out for attack in direct cooperation with the ground armies. The Florence-Rome routes were attacked at Arezzo, Orvieto, and Fornovo di Taro. On the east coastline from Rimini southward strikes were made at Ancona, Fano, Porto Civitanova, Porto San Giorgio, San Benedetto, Giulianova, Teramo, Tortoreto, Montesilvano, and Roseto. Southeast of Rome, the railroad and highway junction at Valmontone was bombed.

In the north there was a systematic hitting of key junction points and then a blocking of the lines between these places. On the through rail line between Piacenza and Rimini, these two cities and the chief junctions with the Brenner Pass and east-west railroads such as Parma, Modena, and Bologna were attacked to check traffic entering this region for transshipment southward. Then between these places, marshalling yards and other railroad installations at Cesena, Fidenza, San Rufillo, Faenza, Imola, and Forli were bombed. On the west coast, the Recco viaduct was attacked again as well as both Genoa and La Spezia. These attacks effectively slowed rail movements of supplies and reinforcements to the battle areas at a critical time.

In order to prevent east-west traffic from leaving or entering Italy, Alessandria, Milan/Lambrate, and Vercelli in the northwest, and Casarsa, Latisana, Padua, Vicenza, Treviso, Mestre, Ferrara, and Mantua in the northeast were attacked. The eastern points, such as Padua and Vicenza, not

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only connected with the Balkans but also with the Brenner Pass, and such places as Ferrara and Mantua fed northern traffic to the Piacenza-Rimini line. The third transportation system attacked was the Brenner Pass railroads, which were the most direct avenues to Germany. The rail installations to receive the chief weight of Allied bombs were those at Bolzano, Borgo, Bronzolo, Colle Iscara, Trento, and the Avisio viaduct.¹⁴

In the latter part of May a system of priorities within each of four groups of localities was established for railroads in southern France. These were, according to priority: (1) Chambéry, Grenoble, and Ambrérieux; (2) Toulon/Carnoules and then Nice; (3) Lyon/Mouche, Lyon/Vénissieux, Lyon/Vaise, St. Etienne, and Badam/Givors; (4) Avignon, Marseilles/St. Charles, Marseilles/La Blancharde, and Nîmes. In addition certain bridges on the routes to Italy were to be attacked in conjunction with raids on the above-named places. These bridges were near St. Pierre d'Albigny over the Isère River on the Modane route or, as an alternate, the Meana viaduct on the Italian side of the same line. On the coastal line the Var River bridge just west of Nice or the bridges at Ventimiglia and Taggia were ready for reattack.¹⁵

The campaign against French railroads began on 25 May when 575 aircraft of the Fifteenth were dispatched against the marshalling yards at Ambrérieux, Toulon/Carnoules, Lyon/Vénissieux, and Givors to interdict traffic to southern French ports and to Italy over the Mt. Cenis line. A total of 858.75 tons of bombs were dropped with Lyon/Vénissieux receiving 367.5 tons, Toulon/Carnoules 265.25 tons, Givors (just south of Lyon) 128 tons, and Ambrérieux (northeast of Lyon) 98 tons. The next day the Fifteenth was out again in force and put 246 tons on the Lyon/Vaise marshalling yards, 247 tons on Lyon/Mouche, 180

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tons on Chambéry, 158.75 tons on Grenoble, 439.5 tons on St. Etienne, 242.75 tons on Nice/St. Roch, and 94.5 tons on the Var River bridge. On 27 May four more marshalling yards were attacked. Avignon received the largest tonnage (274 tons), then Nîmes (234.75 tons), Marseilles/St. Charles (165.5 tons), and Marseilles/La Blancharde (119.75 tons). In these three days the Fifteenth hit 14 of the most important marshalling yards in southern France with a total of 3,198.75 tons of bombs, seriously crippling transportation in that area while still maintaining pressure on the Italian rail communication system.

For the first three days of June no attacks were made by MASAF on Italian or French railroads. Then on 4 June, the day Rome fell, the Fifteenth made a series of attacks against the lines leading from France to Italy. The Var River bridge was raided with 79 tons of bombs. The Antheor viaduct received 84 tons which did practically no damage. On the Modane route to Turin, the Orelle railroad bridge on the French side was bombed with 80 tons of GP and on the Italian side the Gad railroad bridge was struck with 116 tons. The Recco viaduct was bombed with 117 tons of general purpose bombs as a part of the mission against Genoa. The marshalling yards attacked were Turin (262.75 tons), Genoa (1,712.5 tons), Savona (69.35 tons), and Novi Ligure (67.5 tons).

The following day the Fifteenth turned its attention again to the Fiacenza-Rimini railroad system. A series of bridges on lines south to La Spezia, Florence, and other points were attacked with a total of 471.5 tons of bombs, with results varying from poor at Pioppi to excellent at Vado. These bridges were at Fornovo di Taro (100 tons), Pioppi (78.5 tons), Vado (59 tons), Marradi (114 tons), and Rimini (120 tons). The marshalling

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yards which were attacked on 5 June were: Ferrara with 131.8 tons, Forli with 64 tons, Faenza with 74 tons, Castelmaggiore with 188.25 tons, and Bologna with 169.5 tons.

In the European theater there was no land battle actually in progress as there was in Italy, and therefore USSTAF attacks were not very heavy during the first quarter of 1944. After the Eighth Air Force came under SHAEF in April the weight of the attacks increased, but generally speaking, the bombing of French and German rail communications by the strategic air forces was subordinate to other target systems in POINTBLANK. The responsibility for transportation was largely that of the tactical air forces and the RAF until just before and after D-day, when a systematic attempt was made to interdict all traffic to the front lines.

Prior to April most of the damage inflicted by the Eighth Air Force on rail transportation resulted from PFF bombing of industrial centers, from attacks on secondary targets^{and targets} of opportunity, or from bomb falls incidental to attacks on aircraft factories and other industrial objectives. Examples of the first type are the PFF bombing of Munster on 4 January, of Frankfurt on 2 March, and of Berlin on 6 March. In all these cases the rail lines suffered varying degrees of damage. In several instances rail transportation was attacked as a target of opportunity. On 11 January, 70 tons of bombs were dropped on the rail and engineering components center of Bielefeld, 26 miles southwest of Osnabrück, as a target of opportunity (T/O). The same day the rail and armament center of Meppen, north of Lingen on the Dortmund-Ems Canal, was hit with 154 tons as another T/O. The Poix viaduct on the Amiens-Rouen line was another such target on 14 January and received 27 tons. Other targets of opportunity during the first three months of 1944 in which

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either rail lines, marshalling yards, or repair facilities were damaged were: Helmstedt, 20 February; Lingen, 21 February; Hamm, 23 March; and Osnabrück, 23 March. Of these places, Hamm was by far the most important. It was the largest yard in Germany, dealing in general traffic and handling most of the business between the Ruhr and north and central Germany. It had a capacity for 10,000 freight cars a day. Sixty-nine tons of incendiaries and 143 tons¹⁸ of GP were dropped on the marshalling yards, causing fairly severe damage.

Often in the Eighth Air Force's attacks on aircraft or ball-bearing factories rail transportation or repair facilities suffered some damage. On 24 February the locomotive factory at Gotha was hit in the attack on the aircraft factories in that city. The same day the marshalling yards at Schweinfurt were the recipients of some bombs in the raid against the VKF and Kugelfischer ball-bearing works. At Würth on 25 February about 28 miles of track were either destroyed or displaced in the attack against the Messerschmitt plant. In the attack against the VKF installation at Berlin/Erkner on 8 March, the Schwartzkopf locomotive works and railroad station at¹⁹ Berlin/Waldau and the Grunewald yards were heavily hit.

The Eighth did have one marshalling yard as a primary target in March. This was at Münster, a strategic railroad junction of east-west lines. The first attack was on 11 March. The target was completely overcast, however, and it was necessary to use PFF equipment to drop the 78 tons of GP and 157.5 tons of IB bombs. Münster was attacked again on 23 March as a secondary target on the Brunswick mission of that day. Only a fair amount of harm was done by²⁰ the 132 tons of mixed bombs.

More damage was inflicted by the RAF Bomber Command than by the Eighth, during the first three months of 1944. The area attacks of the British

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naturally damaged some railroad installations and during March itself the RAF attacked seven marshalling yards as primary targets. The first of these was on 6/7 March when 263 planes dropped 1,407 tons of bombs with excellent results on the Trappes marshalling yards southwest of Paris. The next night the yards at Le Mans, between Paris and Nantes, were bombed, and were rebombed on 13/14 March with heavy damage resulting from both raids. The Amiens/Longeau marshalling yards were extensively wrecked on 15/16 and 16/17 March, and then followed attacks on the railroad yards at Laon (23/24 March), Aulnoye (25/26 March), Courtrai (26/27 March), and Vaires (29/30 March). In these nine raids 1,311 RAF planes participated and 6,873 tons of bombs were dropped. This was 26.4 per cent of the total RAF Bomber Command tonnage for March.

Although it was obviously impossible to knock out completely ^{the whole} Nazi rail transportation system, the British Ministry of Economic Warfare (MEW) reported that the series of attacks on the French railways had considerably limited traffic and created a heavy demand for switches, crossings, rails, ties, wire, cable, and other equipment--all of which were difficult to procure. Coal distribution had also been seriously affected, and at one time the coal stocks of the Paris gas works were down to a few hours' supply. One of the largest running sheds in the Region Est had a half day's supply. MEW also stated that there was a great increase in the number of trains held up in the yards and sidings because of the inability of other yards and stations to handle them. In the middle of February it was estimated that this number was about 250, and by the end of March it had risen to between 500 and 550.

During the first half of April, the attention of the Eighth was still focused on aircraft factories, airdromes, and supporting installations and

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no transportation was attacked as a primary target. Some damage was done to a rail line in Strasbourg when that city was attacked as a T/O on 1 April. In the attack on Posen on 9 April some IB were seen to fall on a locomotive works and in the marshalling yards which handled freight going to the Russian front. The chief damage, ^{however,} was to buildings. On this same day, one B-24 also bombed the Tullie marshalling yards as a target of opportunity on the Marienburg mission. ²³

In the last half of the month, however, the Eighth reinforced the RAF attacks with four raids on marshalling yards as primary targets. The first of these was against Hamm on 22 April, when 638 aircraft loosed 1,551 tons of mixed bombs on the marshalling yards, creating huge fires among rolling stock and buildings, and wrecking the tracks in sidings, through lines, sorting yards, and hump and choke points. Three days later, nearly 600 bombers were dispatched against GAF installations in France and Germany and against the Mannheim marshalling yards. Because of bad weather only seven planes were able to find and bomb the latter place, and only 12.6 tons of GP and four tons of IB were dropped. The resulting damage was very slight, since most of the bombs dropped outside the target area. On 27 April, 118 aircraft heavily damaged the sidings and locomotive sheds and repair shops with 341.75 tons of bombs at the Blainville-sur-l'Eau marshalling yards on the main route from Germany to Paris. The same day, 72 bombers hit the yards at Chalons-sur-Marne, on the Paris-Stuttgart line, with 215 tons of general-purpose bombs leaving severe damage in their wake. ²⁴

Some further damage was inflicted on transportation in attacks on targets of opportunity and secondary targets. On 18 April four bombers put nearly 10 tons on the Limburg marshalling yards, and other planes temporarily

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disrupted traffic at Velsen, Salzwedel, Bad Wilsnack, and Buchalz. The next day five aircraft attacked the yards at Soest, but the 10 tons dropped missed the target. Also on 19 April, eight planes hit the Coblenz railroad yards, a secondary target, with 16 tons of GP bombs, with the engine sheds being hardest hit. This same target was struck as a T/O three days later when 50 aircraft dropped 58.6 tons of bombs, but very little additional damage occurred. Installations at Landau marshalling yards, on the Karlsruhe-Zweibrücken route, were damaged by 16 bombers dropping 40 tons of GP, but the through lines were not cut. The fighters also contributed to the general attack by strafing yards, locomotives, trains, and other transportation facilities. For example, on 8 April, 68 fighters shot up 15 locomotives, marshalling yards, and factories in the Mannheim and Coblenz areas, and from 18 to 29 April they accounted for 35 locomotives.

Again it was the RAF Bomber Command which contributed the most toward the destruction of rail communications. During the first two weeks of April seven of the eight major RAF attacks were against the marshalling yards on the France-Germany routes, and in the last half of the month 11 yards were struck. Altogether 3,236 planes took part in these raids and 16,407 tons of bombs were dropped. This was 53.4 per cent of the RAF's total tonnage for April.

In the middle of April, 25 French and Belgian marshalling yards were put in third priority for the Eighth Air Force--GAF and CROSSBOW targets preceding them. The destruction of these yards was a part of a joint effort by the Eighth, RAF Bomber Command, and the Ninth Air Force to disrupt transportation to such an extent that the Germans could not readily move reinforcements and supplies to the battle areas when the Normandy invasion began.

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Table 19

UNITED STATES GOVERNMENT
 WASHINGTON, D.C. 20540

<u>Marshaling Yard</u>	<u>No. Men Working</u>	<u>Total Tons of Bombs</u>	<u>Date</u>
Villeneuve St. Georges	210	1,100.96	9/10
Lille	226	1,170.70	9/10
Leon	154	846.72	10/11
Ternier	149	721.23	10/11
Lour	172	1,047.20	10/11
Mont-Beirel	124	686.93	10/11
Bellegarde	130	607.40	10/11
Terrier	110	535.00	10/19
Leuven/Boisvillie	239	1,324.00	10/19
Paris/Bois-le-Bois	160	710.00	10/19
Paris/Juvigny	209	1,129.00	10/19
Paris/Le Jambelle	221	1,217.00	20/21
Leon	101	539.00	20/21
Obtigny	124	612.00	20/21
Leon	135	679.00	22/23
Villeneuve St. Georges	195	839.00	26/27
Commen	114	525.00	27/28
Auloye	205	820.00	27/28
Total	3,206	16,406.92	

* U.S.S.R., accidentally record of results, 1-20 Apr 4.

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The Eighth Air Force was assigned chiefly the task of destroying the locomotive and maintenance facilities. This air force began its attacks on these targets on 1 May when 314 of its bombers dropped 1,007.5 tons of bombs on four French and two Belgian marshalling yards, with results varying from fair to excellent.²⁸

No more attacks were made until 7 May. On that date 67 bombers attempted to bomb the Liège yards through 8/10 to 9/10 cloud. Nineteen of the bombers dropped 54.5 tons of bombs with unobserved results. The following day 56 planes laid 160.5 tons on the yards at Brussels with fair results. On 9 May a return visit was paid to Liège, where 224 tons were left, and 53 aircraft put 132.5 tons on Luxembourg. The results were good and excellent respectively for these places. The Eighth's biggest day for transportation targets during the first half of the month was 11 May. On that day it hit three marshalling yards in France, two in Belgium, two in the Duchy of Luxembourg, and three in Germany with a total of 669 heavy bombers and 1,944 tons of bombs. The results were fair to good for the French yards; poor for those in Belgium; good for Luxembourg, except Bettemburg which was unobserved; and very good for two of the German targets, but poor at Saarbrücken where most of the bombs fell inside the town instead of on the railroads. An attack on the Osnabrück yards by 177 airplanes on 13 May completed the Eighth Air Force's offensive against transportation for the first two weeks of May. In this raid 471.5 tons of high-explosive and incendiary bombs were dropped with good coverage²⁹ of the marshalling yards and the steel mill of Klocknerwerke A.G.

During the last half of May the Eighth made 38 attacks on marshalling yards, all but eight of which were primary targets. Twenty-three were located in France, Belgium, and Holland, and 15 were in Germany.

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REPORT AIR FORCE AIRBORNE AND AIRCRAFT CRYSTAL
16-31 BY 1944**

<u>Date</u> BY	<u>Marshalling Yard</u>	<u>Tons</u>	<u>Results</u>
20	Ches, France	172.5	Very Good
22	Charente, France	152.5	Good
	Epirail, France	72.0	Good
	Ches, France	102.0	Unobserved
	France (secondary target)	58.0	Unobserved
	Charente, France	359.6	Unobserved
	Charente (target of opportunity)	122.0	Unobserved
25	Ches, France	220.0	Good
	Ches, France	137.5	Good
	Ches, France	240.2	Good
	Ches, France	80.0	Good
	Ches, France	127.2	Good
	Ches, France	90.0	Severe
	Ches, France (secondary target)	50.0	Poor
	Ches/Ches/Ches/Ches, Chis	192.0	Fair-Good
	Ches/Ches/Ches/Ches, Chis	102.2	Fair
	Ches, Chis	241.5	Fair-Good
	Ches, Chis (target of opportunity)	26.00	Poor
27	Ches, Germany	383.0	Good
	Ches, Germany	269.0	Good
	Ches, Germany	213.0	Good
	Ches, Germany	207.5	Fair-Good
	Ches, Germany	240.5	Fair-Good
	Ches, Germany	127.0	Good
	Ches, France	251.0	Good
28	Ches, Germany	105.0*	Poor
	Ches, Germany	40.0	Poor
	Ches, Germany (target of opportunity)	11.4	Poor
29	Ches, France	173.5	Good
	Ches, France	130.0	Good
	Ches/Ches, Chis	11.7	Fair
31	Ches, Germany	140.0	Good
	Ches, Germany	230.7	Fair
	Ches, Germany	122.0	Good
	Ches, Germany (secondary target)	120.0	Fair
	Ches, Chis (target of opportunity)	12.0	Unobserved
	Ches, Chis (target of opportunity)	26.5	Fair
		1,007.25	
		60,000	

* Uncontrolled life boats.
 ** Total, as it could be determined, 16-31 by 44; 11th Air Force
 Statistical Section, Monthly Report of Operations, by 44.

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A total of 6,097.45 tons of mixed bombs were dropped on these places, with generally good results. This was nearly 17 per cent (16.77) of the total tonnage dropped on all targets for the whole month. The heaviest attacks were made on 27 May when a total of 1,968 tons were dropped on one French and six German marshalling yards. The next two heaviest days were on 23 and 25 May. On the former, 4 French and 2 German targets were hit with 826 tons, and on the latter date 1,747 tons were laid on 12 French and Belgian yards.³⁰

During these same two weeks the RAF Bomber Command operated on five nights against seven French and two German marshalling yards. On 19/20 May, 350 planes dropped a total of 1,909.6 tons on Boulogne (627.2 tons), on Tours/St. Pierre des Corps (591.4 tons), and Orleans/Les Aubrais (691 tons). This latter place was hit again on 22/23 May with 489.4 tons, and the same night 115 planes struck Le Mans with 432.3 tons. On the night of 24/25 May 401 FAF bombers raided Aachen marshalling yards, dropping 2,021 tons with good results. On 27/28 May the yards at Aachen/Rothe Erde received 905 tons and the Nantes railroad junction got 240 tons. The last raid for the month was on 28/29, when 114 aircraft dropped 460 tons on the Angers marshalling yards. Altogether 6,457.3 tons of bombs were dropped in these nine attacks. This was 54 per cent of the total RAF Bomber Command tonnage for all targets in the last two weeks of May.³¹

In June prior to D-day the Eighth attacked only three rail transportation targets. On 2 June, the railroad junctions of Massy-Palaiseau and Paris/Achères, and the Paris/Juvisy marshalling yards were attacked by 158 planes. At Massy-Palaiseau 46 of the aircraft wrecked tracks, buildings, and rolling

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stock and scored hits on the overpasses and flyovers with 71.5 tons of bombs. At Paris/Achères, 76 planes dropping 208.25 tons cratered the area between the junction and the choke point of the marshalling yards and cut the main lines to the northwest and west. The Paris/Juvisy yards received 108 tons from 36 bombers which damaged the choke point, the bridge over the Orge River, and cut through-tracks to Paris. On D-day, 6 June, the Fougères marshalling yards south of Avranches were attacked but no bombs fell in the yards. Five hits were made, however, on the main line to the beachhead.

The RAF operated on three nights against transportation targets prior to the Normandy landings. On 31 May/1 June, 235 tons were dropped on the Saumur marshalling yards, inflicting moderate damage to the tracks. This important center on the Paris-Orleans-Nantes line was revisited the following night, 1/2 June, and an additional 282.24 tons completely destroyed the junction point. Trappes marshalling yards were also hit on 31 May/1 June with 837 tons, and bombed again on 2/3 June with 528.64 tons. In both attacks severe damage was inflicted. Ninety-nine RAF bombers also struck the Tergnier yards, a junction point on the Paris-Brussels and Abbeville-Chalons-sur-Marne routes, with very good results on 31 May/1 June. 32

By D-day a total of 114 rail centers in Northern France and adjacent areas had been attacked in accordance with the NEPTUNE plan by both the AAF and RAF in the ETO with 71,157 tons of bombs. Of this the Eighth Air Force heavies were responsible for 10,008 tons and the RAF Bomber Command for 46,712 tons. In addition to these tonnages, the Eighth also dropped more than 5,000 tons on rail targets in western Germany and on the Franco-German border which were included in the plan for OVERLORD. There is no

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doubt but that the attacks on French communications were a great help in making OVERLORD a successful operation, although in an over-all estimate it can be said that they did not accomplish as much ^{was} as hoped for. Between 1 March and D-day total French rail traffic was reduced by about 60 per cent from what it had been in January and February. In the latter two months traffic had averaged about what it had been in 1943. This reduction did not mean, however, that this much essential military movement was cut. As a rule, military traffic was mixed with civilian, and in early 1944 it was estimated that about two-thirds of the army freight was carried in this manner. This composed about one-third the total freight traffic of civilian trains. When the capacity of French railroads began to shrink in the spring a larger share was allotted to the Wehrmacht. The cut in nonmilitary traffic, of course, meant less carrying of materials for war production, less food for war workers, and less of other things essential to a war economy, and in the long run adversely affected the German ability to wage war. ³³

It was in a tactical sense that the attack on rail transportation had most value. ^{It.} Gen. O. N. Bradley believed that the bombing of the French railroad system prior to D-day prevented the Germans from accumulating the full store of supplies necessary to meet the invasion and from shipping them to the front for immediate support. His belief is supported by captured German generals, such as Colonel General von Vietinghoff, Supreme Commander in the Southwest, and General Wolff, SS-Obergruppenfuehrer and general of the Waffen-SS, who stated that although a landing on the Continent would always have been possible with superior air and sea power, the failure of the transportation system, because of bombing, prevented bringing up adequate reinforcements to contain or liquidate the beachhead. Other generals maintained that

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a landing was not only possible but, because of a deteriorating German military situation, would have succeeded without attacks on transportation. Yet success would have required a much larger Allied commitment of troops, and losses would have been far heavier. An example of the immediate effect of Allied bombing on the bringing up of reserves is the case of the 9th and 10th SS Panzer Divisions. These units were moved by rail from Poland to Nancy, where they detrained and began to move by road some 400 miles to the front. It took them as long to get from eastern France to Normandy as it had taken to bring them from the Russian battle front to the railhead at Nancy. Some units of the Adolf Hitler Panzer Division took a week to get from Louvain to Caen because of the chaotic state of the
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railroads.

A third phase of the offensive against rail transportation was the attack on Balkan marshalling yards. Whereas the attacks against Italian, German, and French railroad systems were directly connected with American and British operations, the Balkan raids were primarily designed to aid the Russians and the Partisans. The attacks on the Balkan railroads were also much more simple operations than those against the French, German, and Italian systems whose complexity of organization often allowed for quicker resumption of business. Balkan transportation was one of the weakest links in Axis communications. Most of the main lines were single-tracked, and even before the war rolling stock and mileage were barely sufficient for peacetime needs. The heavy German demands severely taxed the capacity, and therefore attacks on a few key points could accomplish much to slow
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down traffic in and out of this area.

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One of these key rail centers was Sofia, Bulgaria which had been attacked for the first time on 24 November 1943. The new year was only four days old when 108 B-17's from the Fifteenth set out again to bomb the city and marshalling yards. Clouds completely obscured the target, however, and only five bombs were dropped. In fact, they were jettisoned. Eighty-one tons were dropped instead on Dupnitsa on the line southward from Sofia to the Greek border, and six bombs were dropped on the Scutari highway bridge in Albania with moderate success. Another attempt was made on 10 January to hit the Sofia marshalling yards, and 418 tons were dropped on the city as a whole. The Skoplje yards were also bombed by 35 B-24's with 82 tons of bombs. The results were fair. These two raids constituted the major part of the Fifteenth Air Force's first "500 tons day." Sofia was again the target for 160 B-17's on 24 January, but once more clouds made bombing impossible, and instead Vratza, northeast of Sofia on the rail line from the Bulgarian capital to Craiova, Rumania, was hit with 114 tons of bombs.

During February, MASAF, tied down by weather, commitments to the ground forces, and POINTBLANK, practically ignored the transportation system of the Balkans. No attacks against it occurred in the first half of the month and only three in the last half. On 24 February, 27 B-17's dropped 81 tons of bombs on the Fiume oil refinery and torpedo works as a secondary target. A small railroad yard and roundhouse adjacent to the refinery were damaged in the course of events. The next day the Fiume marshalling yards were struck as a secondary target by 16 B-24's which dropped 37 tons, scoring a number of hits in the center of the yards. Also on the same day the railroad at Pola was damaged somewhat when 27 B-17's dropped 81 tons on the harbor.

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The first half of March was also devoid of attacks against Balkan transportation, but in the last two weeks of the month, the strategic Sofia marshalling yards were hit five times as a primary target, four of these times being by the 205th Group, RAF. The attacks came on 15/16 March, 16/17 March, 24/25 March, 29/30 March, and 30 March. The last was the heaviest of all. A total of 367 aircraft (114 B-17's and 253 B-24's) of the Fifteenth dropped 960 tons on the yards, creating much havoc on tracks, choke points, and sidings, and among rolling stock. In the four attacks by the 205th Group, RAF approximately 367 tons were dropped, but not all with good results. Two of the raids were made through heavy overcast, with little or no damage resulting to transportation facilities. Other primary railroad targets in the last half of March were Plovdiv, Bulgaria (18/19 March), and Knin and Metkovic in Yugoslavia (19 March). At the former place, 37 Wellingtons, Halifaxes, and Liberators dropped nearly 54 tons with poor results. At Knin, the 85 tons dropped cut all of the through lines, cratered the yards, damaged the station, and started many fires, but at Metkovic where 51 tons of bombs were left, there was practically no important damage and all of the through tracks were left open.³⁸

The transportation centers selected to be bombed were those whose destruction would aid either the Partisans or the Russians, and as the situation of either changed so did the bombing plans. On 9 March, Portal, who had the CCS authority to establish priorities in the Balkans, designated Sofia and other Bulgarian towns as topping the list. Then came Bucharest, and in third place was Budapest. On 21 March he announced to Spaatz and Wilson that in view of the Russian advance, German difficulty with Rumanian transportation, and the political situation in that country, Bucharest would be given highest priority.

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Sofia and other Bulgarian towns would be in second priority, and because of political developments Budapest would not be bombed without further orders. A week later, again because of the Russian advance, Portal modified this directive. The Germans on this front were having plenty of trouble trying to get Rumanian railroads to function smoothly, and since they were developing facilities at Galatz and Constanta, and their communications were largely restricted to the railroad route through Hungary and Rumania, Ploesti would succeed Sofia as second priority. Budapest was once more added to the list and the rail priorities then became: (1) Bucharest; (2) Ploesti; (3) Budapest; (4) Sofia and other Bulgarian towns.³⁹

The more or less sporadic bombing of Balkan communications in the first quarter of 1944 gave way to a really concentrated attack in April. As the Russian Army advanced, MASAF's efforts against the railroads on which the Germans were dependent became more closely coordinated with the fighting front.⁴⁰ By early April the Red Army had cut the rail communications between the north and south German forces, thus forcing the Nazi troops in the Ukraine and Bessarabia to be entirely dependent upon the Rumanian railroads for supplies, reinforcements, and withdrawal. Heavy bombing of these lines would reduce the enemy's ability to fall back and regroup his armies for a counterattack. In light of this tactical situation, Portal established on 4 April the following^{priorities}: (1) Bucharest and Ploesti railroad facilities; (2) Budapest railroad targets, but temporarily much lower in importance; and (3) Bulgarian towns. These standings remained substantially the same for the rest of the month.⁴¹

Toward the end of April it became apparent that the Germans might attempt a very large withdrawal from all of the Balkans when it became impossible to hold Galatz. The retreat from the Eastern Front would congest

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the Rumanian and Hungarian railroads north of the Danube, and preclude their use by the troops in Greece, Bulgaria, and Yugoslavia. These forces would be limited to the Orient Express route from southeastern Bulgaria through Sofia, Nis, Belgrade, and Zagreb. From Greece the escape route ran from Salonika through Veles and Skoplje where the line divided--the eastern branch joining the Orient Express at Nis and the western branch running north to Kraljevo, Lapovo, and thence to Belgrade. If these roads were blocked prior to any general withdrawal, the cause of the Partisans would be greatly aided. The enemy, isolated from supplies and reinforcements and prevented from moving out, could be more easily cut to pieces by the local patriots who at the same time would be supplied by the Allies, largely from the air. As a result MAAF intelligence section recommended the bombing of the following rail communication centers in the order named: Belgrade, Nis, Skoplje, Kraljevo, Veles, and Lapovo.⁴²

In addition to helping the immediate military situation, the bombing of rail lines would also aid in the war of industrial attrition. Germany received substantial shipments of chrome ore, copper, antimony, and lead from the Balkans and Turkey. Ambassador Steinhardt in Turkey requested late in April that the Orient Express route between Sofia and Turkey be bombed, particularly near the Turkish border, in order to strengthen the Allied position in the forthcoming negotiations with Turkey over chrome consignments to Germany. General Arnold believed, however, that the present bombing priorities were satisfactory to stop such freight movements and that the revision necessary to carry out Steinhardt's suggestion was not warranted.⁴³

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The April offensive against transportation in southeastern Europe began on 2 April when 29 B-17's and 35 B-24's of the Fifteenth Air Force attacked the marshalling yards at Brod and Bihac respectively. The next day Brod received a return call, while other small formations struck the yards at Knin and Drnis. A much larger force of 268 B-24's caused widespread damage to the Budapest marshalling yards with 690 tons of bombs. This was in conjunction with an attack on the aircraft factories in that city. A few hours later planes of the 205 Group, RAF dropped 116.68 tons of mixed bombs in an area raid which further increased the already existing damage. This was the first time this Hungarian city had been bombed. The Fifteenth hung up another "first" on 4 April when it attacked Bucharest for the first time; 863 tons of bombs were dropped on the marshalling yards with excellent results by 220 B-24's and 93 B-17's. The next day Floesti was hit by the Fifteenth for the first time. A total of 231 B-17's and B-24's left 444.5 tons of 500-pound GP and 144.2 tons of IB on the yards, against aggressive opposition and at a cost of 11 bombers. The same day, 179 tons were dropped on Nis marshalling yards and 67 tons on those at Leskovac. On 16 April, the Fifteenth bombed Turnu Severin on the main line from Belgrade to Craiova for the first time. Fair to excellent results were achieved with 375 tons. The preceding night the same target had been well covered with 151 tons left by the 205 Group, RAF. Also on 16 April, the Brasov marshalling yards were bombed for the first time with 316 tons and a return visit was paid to Nis, where 27 tons were dropped with poor results.⁴⁴

During the whole month of April the Fifteenth made 26 attacks and the 205th Group, RAF seven attacks against major Balkan transportation centers.

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Those hit more than once by the Fifteenth were: Brod and Bucharest four times each; Floesti and Niš three times each; Drnis and Turnu Severin twice each; and Bihac, Knin, Budapest, Leskovac, Brasov, Zagreb, Sofia, and Belgrade/Sava marshalling yards once each. In the seven attacks by the 205 Group, RAF, Budapest was raided three times and Plovdiv twice. Turnu Severin was hit once as was Nikšić. The latter was a daylight raid on 8 April by 11 Wellingtons which dropped 11 tons of bombs on the marshalling yards. In these 33 attacks severe damage was inflicted on most of the yards and large amounts of rolling stock were destroyed. Despite the ill effects resulting from these bombings, such as further strain upon physical capabilities, increasing labor difficulties, and a breakdown of telegraphic communications which slowed down forwarding by alternate routes, military traffic particularly in Rumania and Hungary remained very heavy. It was the economic traffic which suffered most, and the frequently changing embargoes, made to meet military exigencies, created much confusion among shippers, who found it almost impossible to do business.⁴⁵

Priorities for May remained practically the same, with Rumanian and Hungarian targets retaining first place. Also the mining of the Danube River became a top priority. Oil refineries were given priority next to transportation toward the end of the month, while chromium plants in Yugoslavia and the Tungram electrical works in Budapest were put in third place.⁴⁶ The May attacks against Balkan transportation were begun on the night of 3/4 and continued with little letup throughout the month. The heaviest attacks took place in the first two weeks, with the Fifteenth hitting Turnu Severin twice, and Bucharest, Floesti, Brasov, Pitesti, Craiova, Cămpina, and Knin once each. The British 205 Group struck at Bucharest and Budapest twice each. In addition to the above-named

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marshalling yards the Fifteenth unsuccessfully attacked the Belgrade/Pancevo railroad bridge, and the 205 Group, RAF hit the bridge at Pitesti once and that at Filiasi twice. At the latter place, however, the damage was negligible and did not impede traffic. The three biggest days in this period were 5-7 May. The former was celebrated as the first "1500 ton day" for the Fifteenth when 1,564 tons of bombs were dropped on Rumanian and Yugoslavian targets, the largest portion of which (1,255 tons) was laid on Ploesti. The three-day campaign of 5-7 May began on the night of 4/5 when 205 Group RAF Wellingtons and Halifaxes dropped 89 tons of mixed bombs on the Budapest/Rakos and Budapest/Ferenovakos marshalling yards. In the daylight attacks by the Fifteenth, 1,255 tons were dropped on the Ploesti yards and pumping station in an outstandingly successful operation. Heavy damage was wrought on tracks, rolling stock, and other railway facilities, and huge fires were started in the near-by oil installations. In addition to the Ploesti raid, 117 tons of bombs were dropped with good results on the yards at Turnu Severin.⁴⁷

On 6 May the Fifteenth dropped 101 tons of bombs on the Turnu Severin marshalling yards, 344 tons on transportation facilities and an aircraft factory at Brasov, 140 tons on Pitesti, 210 tons on Craiova, and 328 tons on Câmpina. The oil installations at the latter place were bombed that night by the 205 Group, RAF. The same night other aircraft of this organization attacked the Bucharest industrial area with 76 tons of bombs, achieving several hits in the marshalling yards, and a few Wellingtons bombed the Pitesti and Filiasi railroad bridges. The following day, 7 May, the Fifteenth covered the Bucharest yards, choke points, roundhouse, repair sheds, and workshops and destroyed ^{large} quantities of rolling stock with 1,114 tons of bombs.

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Other bombers of the Fifteenth tried to damage the Belgrade/Pancevo railroad bridge on this same day with 105 tons of bombs, but with little success. That night two Wellingtons returned to the Filiasi bridge with four tons, but no damage resulted. No further attacks were made on Balkan transportation until 10 May when Knin was bombed with little damage by 19 aircraft dropping 33 tons, and that night the 205⁴⁸ Group, RAF aimed 66 tons of bombs at the Budapest/Rakos yards by ETA methods.

Attacks in the last half of May were very light in comparison to the first half. With the emphasis on DIADEM, southern France, and other types of objectives the Fifteenth attacked only five Balkan transportation centers, some of them alternate targets, with a total of 570 tons of bombs. These places were Nis (131 tons), and Belgrade (280 tons) on 18 May; Varazdin (33 tons), located southeast of Maribor, on 24 May; Zagreb (93 tons) on 30 May; and Turnu Severin (33 tons) on 31 May. The 205⁴⁹ Group, RAF flew no missions against Balkan communication targets in this period.

By 1 June the attacks on the railroad centers in southeastern Europe had created a really serious transportation bottleneck which worried the Germans considerably. This was evidenced by the Nazi efforts to transfer large quantities of military traffic from the railways to the Danube River, and the increasing German control over Hungarian and Rumanian railroad administration. The Giurgiu-Ruse train ferry was also reserved exclusively for the army and it was operated on a 24-hour schedule. Likewise the enemy's order of battle in Yugoslavia revealed that his principal concern was for the safety of vital rail routes.⁵⁰

In June, prior to D-day, MASA^F operated on one night and two days. On 1/2 June the 205⁵¹ Group, RAF dropped 72 tons of bombs on Szolnok marshalling

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yards and bridge. Despite the fact that most of the bombs were dropped through thick haze by ETA a heavy concentration was scored on the yards, both choke points were cut, and all main-line tracks were obstructed by craters and wrecked rolling stock. The Fifteenth followed this up with another attack on Szolnok the next day, 2 June, along with raids on Miskolc, Szeged, Simeria, Cluj, Debreczan, and Oradea. A total of 1,276 tons of bombs were dropped on these places with very good results. The next raids were made on 6 June. On that day, 28 aircraft of the Fifteenth, unable to bomb their primary target--the Iron Gate Canal--dropped 84 tons on Belgrade marshalling yards and a railroad bridge over the Sava River with good coverage, blocking most of the through lines. On another mission 137 B-24's loosed 333 tons on the Brasov yards, damaging portions heretofore untouched and destroying a considerable amount of rolling stock. ⁵¹

As a means of further impeding Balkan transportation, the Danube River was also mined. The possibility of attacking this traffic artery was discussed as early as January 1944, but at that time the project was not too favorably considered. It was believed that concentration on certain important river and rail junctions where goods were transshipped, such as Belgrade, would more effectively tie up river freight than the actual mining of the river. Likewise it would be more profitable to destroy certain engineering features, such as the locks and dam at Vilshofen above Passau, Germany, or the Iron Gate ship canal at Turnu Severin, Rumania, than to strike directly at shipping on the river. The best time to attack the latter was during the ^{winter} months when the Danube was frozen and the ships were packed hull to hull in the harbors at Giurgiu, Ruse, Budapest, Bratislava, and such places.

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Nevertheless, as the tide of war on the Eastern Front went against the Germans the Danube highway became more and more important, and in March consignments via the river exceeded rail dispatches by 200 per cent. By the middle of May, bomb damage to Balkan railroads had increased the enemy's reliance on the Danube and much of the armaments going to Rumania went by this route as did coal for railroad use. At the same time the entire fleet of a Hungarian river transportation company with carrying capacity of 150,000 tons was taken over for military use.⁵²

The first of the mine laying operations began on 8/9 April when the 205th Group, RAF laid 12 half-ton mines and 28 x 1,600-pounders in the Danube below Belgrade. After the mines were laid the planes machine-gunned ships and settlements. The next operation was on 12/13 April. Wellingtons and Liberators of the same RAF outfit put 97 x 1,000-pound and 10 x 1,600-pound mines in the Danube, again below Belgrade, and afterwards strafed river shipping. These two operations, in which 137 mines were laid, caused so much disruption of traffic that Portal recommended continued mining of the Danube along with the attacks on Rumanian rail centers. It was decided, therefore, to employ up to one wing of Wellingtons and one squadron of RAF Liberators for this work during the "moon period" (full moon) in May. The decision as to the exact places where the mines were to be laid was left to MASAF, except that none were to be below Turnu Severin.⁵³

On 5/6 May the 205th Group, RAF dropped 105 mines, and on 9/10 put 48 more in the river in the Novi Sad area. The next moon period suitable for mine laying was set for 29 May-8 June, and this time two wings of Wellingtons and one Liberator squadron of the British contingent of MASAF were made available for this work. During the same period the Iron Gate

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Canal was to be attacked with sufficient force to ensure a maximum amount of damage to this structure. Again, however, no mines were to be laid below Turnu Severin. The first attack in this period took place on 29/30 May when 12 of the British Liberators successfully deposited 72 mines in the ^(Komorn) Komorn region of the Danube. The next night 9 B-24's laid 129 mines in the river east of Belgrade, while 23 Wellingtons, 8 Halifaxes, and 2 Liberators dropped 83 tons of GP bombs on the Iron Gate Canal with good results. ⁵⁴

By June, it was fully apparent that the mining of the Danube was paying dividends. Although traffic continued to some extent there had been several complete suspensions varying from a few days to two weeks in the areas mined. These stoppages, even though temporary, had caused a congestion of goods at numerous points along the line, such as at Ruse, Svištov, Turnu Severin, Bratislava, Vienna, and Pegensburg, which necessitated rerouting over the already overburdened Hungarian and Rumanian railroads. There had also been a considerable hold-up of coke shipments to Bulgaria and of hard coal badly needed by the Rumanian railways. In addition, there had been, of course, ⁵⁵ the destruction of a number of barges and tankers.

The Danube was not the only place where mine-laying activities were carried out. The RAF Bomber Command extensively mined the waters along the coast of France and the Baltic to the Gulf of Danzig. From 1 April to 30 June this organization laid 7,181 mines in these areas. The effect of British mine-laying projects was to strain seriously the German mine-sweeping service, interfere with U-boat training, and endanger merchant shipping. It was estimated that the mining of the Kiel Canal and Heligoland Bight cost the enemy ⁵⁶ nearly 1,500,000 tons of imports in the first five months of 1944.

It is difficult to assess the value of the attacks on transportation for just the few months covered by this report, and conclusions must, as a rule,

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be reached from an over-all view. Attacks on transportation were of more immediate value when made in a tactical sense, that is, in support of some ground campaign, than when planned as a strategic blow at the war economy. This was especially true of the Italian, French, and German railways, which were much more complex than those in the Balkans, but even in the latter the greatest benefit to be derived from the bombing of the transportation system was the aid given the Russian advance. Yet all added up to a final collapse when taken in connection with all other factors. No one target system was exclusively vital.

There were several reasons why it was next to impossible to paralyze completely the enemy's transportation. The Germans entered the war with an excellent system. There was a planned overcapacity to take care of military needs, and maintenance standards were higher even than those in the United States. This overcapacity plus a network of rivers and canals to move slow and bulky freight, allowed for numerous alternate routes for essential traffic when a main line was blocked. The system was well administered, too, and as a rule the Germans were able to open at least one track within 24 to 48 hours after even a disastrous bombing. In spite of strains imposed upon the transportation system, it was more or less adequate until the late spring of 1944. It was also something of a paradox that regardless of the amount of damage to and destruction of rolling stock, the German position in this matter improved as the ^{German} armies were pushed closer and closer to the boundaries of the Reich. This was particularly true of locomotives. The shortage was serious at the beginning of 1943, but by the time of D-day it was estimated that the enemy had 63,000 locomotives available while his requirements were only 60,000.⁵⁷

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Tactically, the bombing^g of transportation systems gave trouble in shipping military supplies and reinforcements or in making a withdrawal on an active front such as in the Italian or Russian battle areas. The heavy bombing of rail centers in France just prior to D-day prevented the Germans from moving troops quickly from one point to another to bolster sagging lines. The systematic destruction of the French and Belgian railways, coordinated with the land advance, did much to disrupt the plans of the Wehrmacht to make a strong defensive stand in France, but the density of the network prevented a total collapse and allowed for retreat to the Rhine. By strict curtailment of civilian requirements, it was possible to supply the German Army with most essential supplies until the Ardennes offensive. After that the system went to pieces rapidly. Milch claimed that the Allied program was almost faultless. First, transportation to the west of the Rhine was destroyed and then by selected areas, east of this river until the Elbe was reached. By this time no transportation was possible. A million workers were taken out of the armament factories to make communication repairs, but the Allied ground advance was so rapid that the Germans lost the race. ⁵⁸

Industrially, the immediate situation was not so bad as the tactical, but was serious enough to interfere with production schedules. The effects were not greatly felt, however, until May and June when the Fuhr communications were concentrated upon. Some German leaders stated that attacks on transportation were more disastrous than those on the factories, particularly after the dispersal program was initiated and production became more and more dependent upon the facility of movement of parts and raw materials. Combined with the attacks on oil the transportation situation grew steadily worse as the shortage of petrol greatly reduced the amount of trucking possible and the railroads had to be relied on almost entirely. ⁵⁹

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The results of attacks on water transportation varied. The mining of the Danube, as already pointed out, caused considerable worry to the Germans and some dislocation of their river traffic. In Germany, itself, with its vast ^{network} of waterways, the bombing of the system had little effect, except for the attacks on certain features like the Dortmund-Ems and Mittelland canals, until almost the very end of the war. RAF mining operations in the Baltic, however, were more effective, and despite the German attempts to clear shipping lanes, the mines gradually got the edge on the defense measures. U-boat training was also seriously interfered with, and the German Navy ⁶⁰ seemed unable to cope with the situation.

In the final analysis the attack on the German transportation system must be viewed in the light of all other phases of the CBO program and the tactical implications involved. It was a major but not the sole cause for German defeat. The collapse came finally as a result of many factors, including a coordination of effort by the Allied land, sea, and air forces.

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Chapter IX

ATTACK ON OIL, CHEMICALS, AND RUBBER

The third most important system attacked during the period covered by this study was that of petrol, oil, and lubricants (POL). Adequate oil supply had always been an important problem in the Nazi economy and despite all attempts to fill the shortages it remained tight and was a major controlling factor in military operations. The chief sources of supply were a small production of crude oil around Hannover which had met about 7 per cent of peacetime needs; a large refining industry around Hamburg and Bremen for imported crude; and a synthetic oil industry in the Ruhr, in Silesia, and around Leipzig.

The German government had realized that a war could very possibly cut off oil imports from the Western Hemisphere and the Middle East, and so as early as 1933 steps were taken to assure as much self-sufficiency as possible. Subsidies were granted to encourage exploratory drilling and in this manner several new fields were discovered and developed within Germany which increased crude production from 238,000 tons in 1933 to 1,052,000 tons in 1940. The development of a synthetic oil industry was another method adopted to assure the steady flow of POL products. Despite the extensive coal deposits on which it was based it was a high-cost enterprise, but the private business interests which operated it were protected by a high tariff on all imported oil, and the industry was thus able to expand from a yearly production of 1.3 million metric tons in 1938 to a rate of 4.5 million by early 1944.

The most important of the synthetic plants were those using the Bergius hydrogenation process, because it was by this method that practically all

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aviation gasoline was produced. In 1942 when it became apparent that the "blitzkrieg" was turning into a war of attrition, attempts were made to build additional hydrogenation plants and expand production in the already existing ones. The program was successful in part, at least until the second quarter of 1944, as the amount of aviation gasoline produced by this process jumped from 847,000 metric tons in 1941 to 1,745,000 metric tons in 1943. The bombing program of 1944 reduced the output, however, to 996,000 tons for that year, although in the first quarter the plants were producing¹ at a yearly rate of 2,012,000 metric tons.

In addition to increased production, the German plan also called for the accumulation of substantial surplus stocks, especially of aviation gasoline, and of Diesel and fuel oils. The reserve supply of the former was to be 1,500,000 tons and of the latter, 2,800,000. These goals were not reached, however, by the beginning of the war, and the Nazis entered the conflict with less than six months' supply of all liquid fuels based on wartime requirements. Yet, the first year of the war did not tax the German supply, but in fact supplemented it. The conquest of Poland added that country's crude oil production to the Nazi reserve, and after the fall of France it was discovered that the captured stocks of gasoline amounted to more than had been expended in the campaign. Likewise, pressure applied to Hungary and Rumania made available considerable amounts of additional POL. In 1943, about 2,000,000 tons, chiefly motor gasoline and Diesel oil, were imported² into Germany from those countries.

As the war dragged on and German hopes for a quick victory vanished, further attempts were made to keep an adequate supply of oil flowing into the Reich. After the stalemate of the 1941 campaign against Russia, the

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UNITED STATES DEPARTMENT OF COMMERCE, 1941-1944**
(In thousands of metric tons)

	Aviation Gasoline	Motor Gasoline	Diesel Oil	Jet Oil	Lubricat- ing Oil	Other**	Total
<u>1941</u>							
Crude refining**	11	157	257	192	585	400	1,612
Hydrogenation	327	519	329	70	0	257	2,107
Fischer-Tropsch		221	119		11	110	474
Coal tar distillation		33	88	541	2	35	692
Alcohol		33					60
Gasol	31	330				300	697
<u>1942</u>							
Crude refining**	7	174	677	73	557	450	1,729
Hydrogenation	1,340	239	752	122	17	275	2,772
Fischer-Tropsch		121	97		3	112	440
Coal tar distillation		35	58	662	1	36	830
Alcohol		0					0
Gasol	43	322				243	585
<u>1943</u>							
Crude refining**	2	160	420	80	767	500	1,933
Hydrogenation	1,713	336	717	135	35	343	2,431
Fischer-Tropsch		304	99		15	113	484
Coal tar distillation		54	94	820		37	935
Alcohol		10					18
Gasol	33	320				302	657
<u>1944</u>							
Crude refining**	3	115	456	30	614	330	1,653
Hydrogenation	301	238	313	63	24	176	1,375
Fischer-Tropsch		130	65		10	71	306
Coal tar distillation							(
Alcohol		433	35	723		352	(1,578
Gasol	45						(

* Includes kerosene, liquefied gases, solvent naphthas, gasoil, and paraffin.
 ** Includes products from imported crude and unfinished oils.
 *** U. S. Strategic Petroleum Reserve, Oil Division Fiscal Report, 25 Aug 45, pp. 19-20.

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Nazis turned their attention toward securing the Caucasian oil fields and also began their drive across northern Africa to reach the oil of the Middle East. The failure of these moves practically sealed the fate of Germany, and its oil situation grew progressively worse. The attacks by the strategic air forces on the production of oil, both crude and synthetic, therefore, were one of the greatest contributions of the air forces toward the defeat of Germany.

In spite of the vital position of German POL no real attempts were made to knock out production until almost the middle of 1944. In 1940, the RAF made five token attacks on the Leuna plant, but thereafter this important synthetic installation was left alone until 12 May 1944. Other raids against oil until the spring of 1944 were desultory and relatively ineffective. The most important of these was the daring and spectacular attack by the Ninth Air Force against Floesti in August 1943, but it had only a temporary effect. Although an estimated 4,000,000 tons of refining capacity was knocked out for varying periods of time, this only eliminated a cushion of excess capacity, and except for about 70,000 tons of products estimated to have been destroyed, output was hardly affected. Actually, exports of Rumanian oil to Germany increased and allowed the Nazis to build up their stocks just prior to D-day to their highest level since May 1941.

There were several reasons for this delay in hitting the enemy's oil supply. First there was a large excess crude oil refining capacity and this would have to be destroyed first if output was to be reduced. This meant that there would have to be constant bombings to prevent recuperation, and if the job was to be thorough all refineries and synthetic plants should be attacked simultaneously. To do this required a larger number of heavy

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bombers and long-range escort planes than the air forces had available prior to the spring of 1944. Likewise bases were needed which were within range of all installations, and these were not secured in the MTO until late 1943 when the Fifteenth began operations out of Foggia and its satellite fields. Secondly, an economical campaign against oil demanded first that air supremacy be gained, and it was not until after the Big Week in February that the GAF could be dismissed as a serious threat to Allied freedom of the skies. As discussed in Chapter II, however, USSTAF in March 1944 did recommend that oil have priority over transportation in its plan for the completion of the CBO, but SHAEF finally decided in favor of transportation. Nevertheless, the Fifteenth Air Force began its attacks on Rumanian oil fields in April, and in the middle of May, 18 refineries were assigned to MAAF as non-POINTBLANK filler targets. In the latter part of this month, Portal definitely gave second priority in the Balkans to the Rumanian, Hungarian, and Austrian refineries. On 20 April the Eighth Air Force was directed to strike the Brück, Leuna, Magdeburg, Ruhland, Zeitz, and Böhlen synthetic plants, and it began the operations in May. On 8 June, Spaatz announced that the primary strategic aim of USSTAF was now to deny oil to the enemy's armed forces. The offensive against oil was on.

In 1944, prior to April, attacks on oil were practically nonexistent. In an attack on the Fiume torpedo factory on 21/22 January by the 205th Group, RAF, some bombs fell on the oil refinery, starting fires and damaging several of the storage tanks. The same night, 585 Lancasters, Halifaxes, and Mosquitoes of the RAF Bomber Command attacked Magdeburg with 1,138 tons of high-explosive and 1,371 tons of incendiary bombs, causing damage to the

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Junkers aero-engine factory, synthetic oil plant, and ship canal. On the night of 31 January, 33 Wellingtons of the 205 Group, RAF aimed 56 tons at the Trieste oil refinery with rather unsatisfactory results. Most of the bombs were scattered and fell largely to the south of the target, although a few bursts were seen at the base of the oil pier. On 24 February, 27 Fifteenth Air Force B-17's, unable to reach their primary objective of Steyr, dropped 81 tons on the Fiume oil refinery and torpedo works with excellent results. The next day 16 B-24's in a raid on that city's marshalling yards scored a few more hits on the refinery, adding further damage. No attacks were made in March, although at the beginning of the month Spaatz told Arnold he was anxious to try oil now that the GAF had been disposed of, but as yet USSTAF was not cleared to hit Floesti. Floesti would have to be destroyed first, he said, or any other attacks on oil would be futile. About the middle of the month Arnold notified him that the CCS had no objections to attacking Floesti at the first opportunity afforded by the weather, and the stage was now set for the Battle of Floesti. ⁶

The first of the April attacks began on the third of the month when the Fifteenth hit the aircraft factory, marshalling yards, and oil refinery at Budapest, and the following day the Prahova refinery at Bucharest was damaged in an attack on that city's marshalling yards. Another marshalling yard attack on 16 April at Brasov inflicted some damage on the vacuum oil refinery, but the history-making raids had started on 5 April when the Battle of Floesti had been launched. On that day, 95 B-17's and 136 B-24's from the Fifteenth Air Force directed 588.7 tons of mixed bombs at the marshalling yards, but some of the bombs spilled over into the refinery district and created so much havoc that the oil installations thereafter received

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the main weight of succeeding attacks. From 5 April to 19 August, 19 daylight heavy-bomber missions and one P-38 dive-bomb attack were made. The 205¹ Group, RAF flew four night raids. In the three months, April-June, 3,183 bombers, or 38 per cent of the available bomber units in MASAF, were dispatched against this target, and 6,201 tons of bombs were dropped. Despite the fact that Floesti was one of the most heavily defended spots in Europe, only 113 of the heavies were lost in these three months--54 to enemy aircraft, 53 to flak, and 6 to other causes. The three April attacks eliminated the excess refining capacity, and the succeeding raids cut deeply into the current production, with the low point being reached in mid-June when only two small refineries were left active. The strengthening of ground defenses, particularly by an effective smoke screen, allowed for some recovery after this date until the capture of Floesti by the Russians in August permanently denied this important source of oil supply to the enemy and made Germany more than ever dependent upon synthetic products.⁷

The Floesti installations were not the only crude oil refineries attacked. The Steau Romana company at Campina, the second largest Rumanian refinery, was hit by the 205 Group, RAF on the night of 5/6 May in the first of its raids against the Rumanian oil fields. Thirty aircraft dropped nearly 35 tons of bombs which blanketed the storage tanks, refinery plant, and railroad yards, and started fires which were visible for 60 miles. This group made no more attacks on Rumanian oil targets, however, until the latter part of July. The following day, 6 May, the Fifteenth Air Force's mission against the Campina marshalling yards also scored some hits on the refinery. On 14/15 May, the 205 Group, RAF dispatched eight Liberators against the Porto Marghera refineries near Venice. Five of the planes found the target and laid 14 tons

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on it. The Fifteenth visited the same place on 19 May and left 179.75 tons of GP. Porto Marghera was hit again on 25 May by the same air force with 168.25 tons of 500-pounders. The oil installations at La Spezia were also damaged on 19 and 22 May when the harbor and railroad facilities of that port were attacked.
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Although the Eighth Air Force had some 20 German natural oil refineries on its target list none of these were attacked in the period covered by this study, but the bombing of such cities as Brunswick, Bremen, Berlin, and Essen indirectly affected the production of crude oil products by inflicting heavy damage on refining-equipment factories. One of the most important and disastrously hit of these plants was the Wilke Werke A.G. in Brunswick. Other such manufacturing establishments which suffered a similar fate were Karl Fischer, Julius Pintsch, and Rheinmetall Borsig in Berlin; Francke Werke A.G. at Bremen; and Krupp in Essen.
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The biggest contribution of the Eighth was the destruction of the synthetic oil plants, most of which were within the range of this air force. Although its campaign did not get underway until May, two unsuccessful strikes were made in April. On the 11th of that month a large force of four-engine bombers (917) were dispatched against numerous targets in north and central Germany. Fifty-two of the aircraft dropped 120.5 tons of GP and IB on the Hydrierwerke Pölitz A.G. at Pölitz, but results were unsatisfactory. Another mission against aircraft factories and four synthetic oil plants on 21 April was recalled because deteriorating weather prevented assembly and rendezvous.
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The real campaign against synthetic oil began on 12 May when the Eighth successfully struck five important plants in the Leipzig and Chemnitz areas. The most important of these were the I. G. Farbenindustrie A.G. works at Merseburg/Leuna. Here was not only the largest hydrogenation production in Germany but a place at which nitrogen and other important chemicals were manufactured. Over 220 planes raided this place, dropping a little over 500 tons of high-explosive bombs with such devastating results that the plant closed down completely for 10 days. This was the start of the Battle of Leuna which paralleled the Fifteenth's Battle of Ploesti, and before the end of the war Leuna was raided 20 times by the Eighth and twice by the PAF Bomber Command. A total of 6,552 bombers made these attacks, dropping 18,328 tons¹¹ of bombs.

Also on 12 May the Braunkohle Benzin factories at Zeitz and Böhlen were bombed, when 111 aircraft dropped 260 tons on the former place and 89 planes dropped 194 tons on the latter. A Pfc prisoner of war, captured in Italy, stated that when he was home on leave in Böhlen he learned that in this attack as many workers were drowned in the floods of oil loosed by the bombs as were killed and injured by the explosions. At Lützkendorf 172 tons of bombs fell from 89 bombers, and 140 planes attacked Brux, southeast of¹² Chemnitz in Czechoslovakia, with 311 tons of high explosives.

The events of 12 May were, according to Speer, the materialization of a nightmare that German leaders had had for over two years. They went to work immediately, however, to repair the damage and get the plants back into operation. Speer appointed one Edmund Geilenberg as General Commissioner for Immediate Measures and gave him priority on men and materials needed to bring

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the plants into production again. By the time of the next attacks on 28 May, production at Leuna, for example, had reached 8 per cent of normal, and in spite of the second bombing was running at 75 per cent of capacity in early July.¹³

The oil offensive was resumed on 28 May when Zeitz, Leuna, and Lützkendorf were rebombed and Ruhland, Magdeburg, and Leipzig plants were struck for the first time in the new push. At the first place, 187 planes dropped 447 tons of GP on the Braunkohle Benzin works. The plant at Ruhland was hit with about 70 tons which severely damaged two of the three water gas installations. Lützkendorf got another dose of 155 tons, and Magdeburg received 114 tons. The Moblis low-temperature, carbonization, and coal-tar treatment plant at Leipzig, a secondary target, was hit by eight planes and 20 tons of bombs. Leuna had only 151 tons dropped on it this time but this was sufficient to knock the plant out until 3 June, when it was able to resume partial operations. The next day, 29 May, 224 planes plastered the Hydrierwerke factory at Pölitz with 547 tons of bombs, achieving very good results. No more attacks were made on oil by the Eighth until 14 June, when raids were commenced against crude oil refineries at Emmerich, Hannover, Bremen, Hamburg, Harburg, and Ostermoor. On the return trip from a shuttle bombing mission to Russia a refinery at Drohobycz, Poland, was also hit. The synthetic plants attacked in June were: Braunkohle at Magdeburg (20 June); Hydrierwerke at Pölitz (20 June); Braunkohle at Ruhland (21 June); and Braunkohle at Böhlen (29 June). Altogether in the first six months of 1944 the Eighth, Fifteenth, 205 Group, RAF, and the RAF Bomber Command dropped over 23,600 tons of bombs on Axis oil installations of all kinds.¹⁴

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Table 22

TONNAGES DROPPED ON OIL TARGETS BY EIGHTH AND FIFTEENTH AIR FORCES,
205 GROUP (RAF), AND RAF BOMBER COMMAND
JANUARY-JUNE 1944*

January	114 tons
February	81 tons
March	0 tons
April	570 tons
May	5,146 tons
June	17,697 tons
 TOTAL	 23,608 tons

* U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, p. 41.

Closely related to and often integrated in the oil industry were the chemical, explosive, and rubber industries. Chemicals, in spite of their importance, were not made a primary target system. There were 10 chemicals which were most vital to Germany's war economy--nitrogen, methanol, calcium carbide, sodium cyanide, ethylene, tetraethyl lead, sulphuric acid, caustic soda, chlorine, and sodium carbonate. The most important of these were nitrogen and methanol, and since over 90 per cent of these chemicals were produced by the synthetic oil plants the attacks on the latter also affected the supply of these products. Two synthetic oil complexes alone, Leuna and Ludwigshafen, accounted for about 60 per cent of the nitrogen and 40 per cent of methanol output, and they also manufactured 76 per cent of the enemy's ethyl chloride necessary for tetraethyl lead. Large tonnages of other chemicals were made in non-oil producing plants, but despite their importance they received very little attention from the strategic bombers.

Although 14 important chemical plants were damaged in 1943 the production of chemicals and explosives was not seriously affected until the oil offensive

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was launched in May 1944. During the first five months of this year, the Eighth Air Force struck 14 times, damaging nine factories, and the RAF Bomber Command 21 times at 19 establishments, but the chief damage inflicted on the industry in this period stemmed not so much from precision attacks as from the PFF bombing of chemical centers by USSTAF and night area bombing by the RAF. From 1 May 1944 to the end of the war 62,915 tons of bombs were dropped on the chemical industry, but of this, 58,202 tons were aimed at the oil-chemical plants, and only 4,713 tons fell on chemical factories which were not a part of the oil complexes. Thus 92 per cent of the total tonnage put on the chemical industry was incidental to the attack on
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 oil.

Rubber, like chemicals, was intimately tied in with oil, and although it was a critical war item, it was left pretty much alone until affected by the campaign against synthetic oil. Germany had entered the war with practically no stock pile of rubber and the blockade soon cut off supplies of crude, so that the Germans became almost entirely dependent upon synthetic and reclaimed rubber. Nevertheless, the enemy was able to meet its requirements, even though at times supplies were dangerously low. Very early the Nazis had realized the necessity for rubber and the dangers which would confront them should the supply of crude be lost, and so they had begun an expansion program for synthetic manufacture. Synthetic rubber production was thus raised from 1,100 tons in 1936 to 130,000 tons by 1944, and the industry reached an all-time high in March 1944 with a monthly output of 12,787 tons. To produce this amount Germany had only one small and three large synthetic plants--Schkopau, Hüls, Ludwigshafen, and Leverkusen--and Ludwigshafen did not begin production until March 1943. The products

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of these plants plus reclaimed rubber and a negligible amount of crude were then manufactured into various articles by 278 processing factories of which 53 were major fabricators--11 making tires, 13 manufacturing mechanical goods, and 29 fabricating other rubber products.

Despite the importance of rubber in modern warfare, the synthetic plants were not assigned a priority until ¹⁰June 1943, when they were put in third place. On 22 June, the Eighth attacked Huls and closed the plant for one month, but within seven months it was operating again at nearly 100 per cent of capacity. On 10 November 1943, synthetic rubber was given a first-priority category, and on 1 December the Eighth struck Leverkusen. The Eighth made five PFF attacks on Ludwigshafen (30 December 1943, 7 January, 11, 29 February, and 1 April 1944) prior to the opening of the synthetic oil offensive on 12 May, and the RAF also made several night area raids on this place. Altogether in the period 10 June 1943-12 May 1944 only 3,367 tons of bombs were directed against synthetic rubber plants, but from this latter date to the end of the war an additional 15,736 tons were dropped. Out of this total of 19,103 tons, of which the Eighth was responsible for 10,805 tons, about 75 per cent fell on Ludwigshafen, where oil was the primary target. This did not mean that synthetic rubber did not suffer, because as the oil plants were put out of commission production in the rubber plants ceased. Schkopau relied entirely on Leuna for its supply of hydrogen, and when Leuna was bombed out Schkopau was eliminated. Huls lost production when its supply of gas from the Scholven and Gelsenberg synthetic oil plants was cut off. The destruction of the oil factories at Ludwigshafen and the chemical plants at Leverkusen stopped rubber production at those places.

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The 278 fabricating plants did not offer much in the way of a good target system, since they were scattered. In fact, only 443 tons of bombs were aimed specifically at the rubber-processing plants from 1 September 1939 to 8 May 1945. Of this, 233 tons were dropped prior to 10 November 1943 and the remainder after 12 May 1944. The USAAF was responsible for 441 tons and the RAF for only two. Numerous tire and other rubber plants suffered varying degrees of damage, however, in area raids, and in this sort of operation the RAF played the larger role. The production of the fabricating plants was also limited as the supplies of raw materials were cut off through the bombing of the synthetic oil and rubber factories. Likewise as the transportation system deteriorated under Allied bombing it became next to impossible to move to the processing plants what raw materials there were. For example, in the middle of 1944, 1,500 tons of Buna at Schkopau could not be shipped out because of lack of transportation, and supplies of raw materials at Continental Gummiwerke in Hannover were reduced from an equivalent of six weeks' production in January 1944 to two days' production in December 1944 for the same reason.

Since the campaign against oil and its allied industries did not get underway until April and May 1944, the real effects of the bombing program were not felt until the late summer and early autumn. Up to May the RAF and USAAF had dropped 509,206 tons of bombs on enemy targets in Europe, but only 1.1 per cent (5,670 tons) were on German oil installations. None of these attacks caused an important loss in German oil production, however, and the developing shortages were due in large part to the enemy's inability to expand production at a rate commensurate with increasing needs. After the attention of the strategic bombers was focused on oil in the

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spring, production began to fall rapidly, and by July had dropped to 50 per cent of pre-attack levels. With the loss of Floesti to the Russians and continued bombing of remaining refineries and synthetic plants, a low point of 23 per cent of pre-attack output was reached in September. ²⁰

No single raid regardless of its severity, permanently stopped production, and it was the continually repeated bombings which caused the breakdown. At the start of the oil offensive recuperation was fairly rapid, and through the Gellenberg organization Germany was able to get individual plants into partial production in a remarkably short time. These quick repairs were accomplished by cannibalizing equipment from badly bombed installations and new plants under construction, but as the bombers kept returning, these sources of repair parts dried up and the time between production periods lengthened. According to Milch the bombing which was the most effective and which hindered recuperation in spite of cannibalization was that done by the American air forces. He did not mean to imply that the British were not good flyers, but the system of day bombing made it possible to achieve greater accuracy and thus accomplish greater destruction. In night bombing each aircraft, as a rule, dropped its bombs individually, and while this ensured that not all bombs would miss the target "it also meant it was never possible to obtain a really concentrated effect." He estimated that on an average although between 25 and 30 per cent of American bombs completely missed the target at least 70 per cent hit it and resulted in "crater upon crater and that really smashed the target to bits."²¹

The Germans had felt the need for additional oil, of course, two years before the great attacks began. The 1942 program for increasing the number

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of GAF pilots was seriously hampered by the inability to secure enough aviation gasoline. Thus while the Germans were losing an increasing number of pilots with only a small replacement, the American air forces were increasing in both personnel and equipment. By July 1944 the average American pilot had four to five times as much training in operational aircraft as the German pilot. This decline in pilot quality made for greater losses of aircraft and naturally curtailed operations. The lack of oil also affected the quality of the German aircraft. By August 1944 the final run-in time for airplane engines had to be reduced from two hours to one-half hour because of lack of aviation fuel. Some aircraft types, such as the He-177, had to be grounded because they consumed too much of the dwindling supplies of gasoline, and the emphasis placed on setting jet-propelled planes into production in 1944 was in part an effort to stretch this precious fuel.²²

In general, captured responsible army and government officials agreed that the attacks on oil were some of the most effective of the CBO program, and the loss of this vital product was one of the most decisive causes for Germany's defeat. Speer said the assault which began on 12 May "caused the first serious shortages of indispensable basic products and therefore the greatest anxiety for the future conduct of the war." Milch remarked that every day that passed without an attack on oil, the Germans said: "Thank God, they haven't bombed the synthetic oil plants yet! . . . Let's hope they go on bombing air-frame factories; as long as they don't bomb the synthetic oil plants." Speer also testified that although a minimum of motor fuel and Diesel oil was produced to the very end of the war, aviation gasoline production was so limited from June 1944 onward that the Luftwaffe needs could not be anywhere nearly filled. By late summer and early fall, production of fuel

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was further cut because of the loss of the Rumanian fields; and the break-down in transportation, which prevented the transfer of oil from the refineries to the using agencies, along with the destruction of storage facilities, naturally affected the refinery output. ²³

Some men, such as Keitel, placed the attack on chemical production as the second most important factor accounting for the fall of Germany. The two most vital chemicals in the war economy were nitrogen and methanol needed for the manufacture of explosives. Since chemicals were only slightly affected, however, prior to the beginning of the oil offensive, the Germans had ample ammunition until the middle of 1944. The severe losses resulting from the bombings after 12 May brought about revisions of allocations even to the principal users; and methanol, for example, used in making high explosives and chemical warfare items, was strictly rationed. The cut in nitrogen production by the end of July was so great that allocations for fertilizer were drastically cut and finally eliminated altogether. The situation became so serious that gradually more and more rock salt (used as an extender and filler) and less explosives were used in shells, mines, and bombs. By ²⁴ early 1945 heavy ammunition was adulterated with as much as 70 per cent salt.

As pointed out previously, production of synthetic rubber suffered as much or more from the bombing of the oil factories as from direct attacks, and the vast number of rubber fabricators did not offer a well-concentrated target system. The damage to these factories was not sufficient to be a major factor in defeat, and the lack of rubber did not seriously affect military operations, although at times inventories reached dangerously low levels. Despite the fact that production of synthetic rubber had fallen from a high of over 12,000 tons in March 1944 to a low of 2,000 tons in December,

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there was an increase to 3,500 tons by February 1945, which was a higher production rate than in 1939. In general the effect of the attack on oil, chemicals, and rubber can be summed up in a letter from Speer to the Fuehrer on 30 August 1944: "If the attacks on the chemical industries [including synthetic oil] continue in September in the same strength and with the same precision as in August, the production of chemicals will be still further decreased, and the last stocks will be consumed. Then those very materials essential for continuation of modern warfare will be unavailable in the most important fields."²⁵

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Chapter X

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CONCLUSION

The chief targets for the strategic bombers in the first six months of 1944 were the aircraft and ball-bearing factories, transportation, and the oil, chemical, and rubber industries, but in the course of bombing these targets, other industries were also sought out and attacked or they suffered incidentally from the raids on near-by installations or industrial areas. Steel and nonferrous plants, for example, were never priority targets, but in 1943 16 steel and 8 nonferrous plants were bomb-damaged, and in the first nine months of 1944 17 steel and 9 nonferrous factories suffered from Allied bombs. Most of the damage inflicted on these metal works came from area bombing by the RAF rather than from precision attacks. About 90 per cent of German steel production was centered in 36 cities, and during the war 167,000 tons, or 12 per cent of all tonnage dropped on Germany, were directed at these municipalities. Only 5,924 tons were aimed at steel as a precision target. There were no precision attacks on steel during the first six months of 1944, but approximately 20,000 tons of bombs fell on the aforementioned 36 cities.

These attacks had little effect on the supply of steel for armaments, at least until the middle of 1944, because the Wehrmacht early overestimated its needs and because the occupation of western Europe in 1940 added 300,000 tons a month to the German output. Along with Swedish imports it was thus possible to allot more and more steel for nonmilitary uses and for the stock pile. By the second quarter of 1944, out of a total supply of slightly more than 2,000,000 tons only about 1,400,000 tons went directly to armaments

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programs. The greatest loss of production in the first half of 1944, too, was from air-raid alarms rather than air-raid damage. Thus, the steel situation did not become serious until late 1944 and early 1945 when the heavy attacks on the Ruhr and central Germany crippled the industry, but even then it was the breakdown of transportation which turned what ordinarily would have been a temporary disruption into a permanent collapse.²

The nonferrous plants--particularly those working with copper, zinc, and aluminium--received very little damage, and since they were not singled out as specific targets but were included in area raids, their destruction was a more or less hit-and-miss proposition. Furthermore, there was an excess capacity in most of them, and therefore the damage inflicted did not materially affect war production. The Allies did show some concern over chrome, however, and in the spring of 1944 after the diplomats had succeeded in stopping Turkish shipments attention turned toward Balkan sources. In the middle of May, Arnold signalled Eaker that it might be worthwhile to attack the ore-concentrating plants around Skoplje, Yugoslavia. It was believed that Germany's sole source of chrome was then in those plants and that their destruction might eliminate the already low supply and impose an additional burden on the transportation system by necessitating the shipment of raw ore to other plants. The Committee of Operations Analysts did not believe, however, that these factories were worth much of an expenditure of force, and therefore Arnold suggested such attacks be assigned to freshman missions. Shortly after this Portal put the chrome-concentration works at Radusa and Hanrijevo (both near Skoplje) and the Tunggram factory at Budapest on the list of targets of opportunity in the Balkans, but no attacks were made prior to 6 June.³

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Table 23

LOSS IN INGOT PRODUCTION DUE TO VARIOUS CAUSES, JANUARY-JUNE 1944*
(In thousands of metric tons)

Month	Air Raid Alarms	Air Raid Damage	Shortages of Gas, Power, Raw Material, Labor, etc.	Other Causes	Total Losses	Actual Production
Jan	120	40	80	100	340	2,560
Feb	110	50	80	100	340	2,480
Mar	150	50	70	70	340	2,670
Apr	150	40	90	80	360	2,490
May	100	170	60	140	470	2,470
Jun	70	180	70	100	420	2,510
Total	700	530	450	590	2,270	15,130
Total, 1944	1,190	3,050	1,120	1,140	6,500	25,840

* U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 78.

Some of the chief users of steel--the tank, motor car (M/T), and armored force vehicle (AFV) industries--suffered very little from direct aerial bombardment until the late summer of 1944. In the early years of the war Germany had more than a sufficient supply of these items, and the few attacks in 1943 did not affect production to any great extent. Nor did the sporadic attacks in the first six months of 1944 have much harmful effect. Like steel, these industries, during the period covered by this study, suffered most from the RAF area raids, and it was not until summer, when they were given a high priority rating, that the Wehrmacht began to feel the pinch of shortages. The big decline in production and the resulting disastrous effects took place after July when German losses on all fronts exceeded supply, and much of the

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excess manufacturing capacity had disappeared because of its diversion to airplane manufacture. Even then the output of assembly plants was reduced not so much by direct attack as from shortages of such things as hulls, torsion bars, and drives. This condition had resulted from raids on components plants and the disruption of transportation which prevented the parts from flowing to final assembly centers.⁴

Other large consumers of steel were the plants producing guns and shells, but they were never a primary target system. Heavy ordnance manufacture was generally carried on in the Ruhr, and again the area attacks by the RAF against the cities in this region usually resulted in some damage to these factories. The fabricators of lighter ordnance were widely scattered, and as in other countries many small engineering and light-metal plants were converted to this type of work. Altogether there were approximately 5,000 heavy and light ordnance factories, many of which were unidentifiable as such from the air, and even the U. S. Strategic Bombing Survey was unable to determine the exact tonnage expended on this industry, although 3,000 tons were specifically aimed at certain of the Ruhr plants during the course of the whole war. The over-all effects on the armament industry were insignificant, however, and production increased until very late in 1944.⁵

Another industry which suffered very little from bombing was that of machine tools. Although there was discussion of its importance among the planners of strategic bombing it was never a priority target system, and most of the damage it received was from spill-overs and area attacks. At no time did the enemy seem to be held up because of a lack of machine tools, and even when factories were damaged they were quickly put into operation again. This was due largely to the facts that: (1) Germany enjoyed an excess capacity; (2) the heavy tools were not damaged by bombs beyond repair unless hit directly;

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(3) Germany relied more upon general-purpose tools and highly skilled labor than on the highly complicated automatic and semiautomatic tools and semi-skilled labor commonly employed in the United States. However, severe damage resulted from fires which burned out the electric motors supplying the power.
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The most effective attacks by the strategic bombers up to 6 June 1944, therefore, were against the aircraft, ball-bearing, oil, chemical, and rubber industries and against transportation. Of these the ball-bearing industry was, perhaps, the most overrated as to importance and expected results of bombardment. Although the industry was concentrated and offered a good target, the failure to follow up with return attacks after the initial bombardment in 1943 allowed for recuperation and countermeasures. It was possible, therefore, for the Germans to adopt the slogan: "No equipment was ever delayed because bearings were lacking." Nevertheless the enemy was worried over the possible consequences of a shortage, and time and energy were spent in an attempt to meet such an eventuality. The chief countermeasures were redesign, salvage, and Swedish imports. The attacks on the aircraft industry combined with the campaign to knock the GAF out of the air were highly successful. Not only did the failure of the GAF to protect the homeland after the Big Week contribute to the breakdown of military economy, but its inability to support the ground forces left the infantry exposed to the merciless air attacks of the Allies. One captured general, Von Senger, the commanding general of the XIV Panzer Corps, stated that the lack of air support put the Germans in the same position as the Ethiopians had occupied when attempting to stop the mechanized Italian Army with ancient guns and spears.
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Transportation, too, was a vital spot in Germany's armor, but for reasons stated in Chapter VIII it was a difficult target to destroy. Once battle was joined by the opposing ground forces, however, attacks on transportation bore more visible fruit. As the German armies retreated on all fronts and congested the railroads at the same time that the aerial attacks were stepped up, the transportation system could not stand the strain and like the "one hoss shay" went to pieces.

Of equal importance with the attacks on the aircraft industry and on transportation was the campaign against oil and chemicals. To some of the Germans this was the death blow. It must be remembered that Speer had said that fear of attacks on synthetic oil had been a nightmare for two years. Despite the disaster heaped upon Germany by these raids, the U. S. Strategic Bombing Survey reported that still better results could have been obtained by a more careful selection of targets. The failure to destroy completely the ethyl plants was pointed out as a weakness because, without ethyl, high-grade aviation gasoline was impossible. Likewise more attention should have been paid to explosive and propellant plants. These factories were vulnerable to air attack and if struck hard enough their recuperation would have been very slow. As it was, the shortage of powder and explosives which developed in the latter part of 1944 was due to a lack of basic materials, such as nitrogen and methanol, rather than to direct bombing of the ammunition factories.

Despite the great weight of bombs dropped on German industry, the civilian economy was not so hard hit that war production had to be diverted to prevent disintegration of the home front. It was not until near the end of the war

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that the whole economy began to go to pieces and civilian discontent mounted rapidly. This was due, however, to the military collapse almost as much as to civilian bombing. The grumblin' over the lack of coal for civilian production and domestic heating in late 1944, for example, was the result of the breakdown of transportation and of German inability under the circumstances to recuperate rather than the result of any direct attack on the population. The large-scale bombing of Germany did have a morale value of sorts, however, although in some cases it built instead of lowered morale. One captured German said the people regarded the attacks on cities as "Terror Raids" and this strengthened their determination to "see it through." Some army officers claimed that civilian bombing had a more pernicious effect on the morale of front-line troops because of worry over their home folk than it had upon the residents of the affected cities. Speer claimed that in those cities which were accustomed to air raids the citizens developed a fatalistic frame of mind, and fears and feelings were gradually dulled. Nevertheless, it is estimated that 305,000 civilians were killed in air attacks; 750,000 were wounded; between 18,000,000 and 20,000,000 were deprived of essential services such as gas, water, and electricity; and 5,000,000 were forced to evacuate their homes completely. So many people could not be affected without loosening to some extent the Nazi stranglehold on the populace and weakening the position of the government.

Generally speaking, the German army officers and government officials conceded that strategic bombing had a tremendously disastrous effect. Some even said the war could have been won entirely by the long-range ^{heavy} bomber, but the desire to end the war as soon as possible forced the combined use of air, land, and sea forces. From the enemy's point of view, however, Allied

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strategy had several defects. Speer criticized the lack of a logical system of attack. American and British efforts were too dispersed, and instead of expending time and energy on a number of targets, the Allies should have singled out one target system and completely flattened it so that recuperation would have been slow enough to allow bombing of another system until time to return to the first. The Allies had realized this, of course, and the concentrated campaigns against aircraft production in February and oil from May onward were examples of this type of bombing. But often weather or other factors, such as the necessity for supporting ground forces (as was frequently the case in Italy), prevented following this course without interruption. Another criticism was the priorities given by the Allies to the various target systems. In Speer's opinion, for example, the following should have been the priorities in the air war: (1) key points in basic industries; (2) transportation and communications; (3) front-line positions for psychological effect on troops; (4) final stages of manufacture, such as assembly plants; (5) towns; (6) naval installations, shipping, and air fields. Goering put oil first, then communications, aero-engines, airframes, ball-bearings, and airfields in that order. Goering's conviction that oil should have been first was shared by several other generals, but, as already pointed out, the Allies had good reason for waiting as long as they did. The skies had to be cleared of the GAF first.

Just as the American Civil War has been studied as an example of the first of modern wars, that is, where a fighting front extends over a very long line instead of a single point of contact between two armies, so will World War II be studied as a departure from orthodox warfare. Historically,

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the objective of any war is to destroy the enemy's army in the field. That was a prime goal in this war, but with an air arm capable of striking far behind the front lines it was possible to destroy the sources which supplied field armies and enabled them to fight. One German general hazarded the guess that at a future time it would not be necessary to put an army in the field if satisfactory methods of destroying the industry behind it could be found.

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G L O S S A R Y

AAF/MTO	Army Air Forces/Mediterranean Theater of Operations
AC/AS	Assistant Chief of Air Staff
A/D	Airdrome
AEAF	Allied Expeditionary Air Forces
AFAEP	AC/AS Plans
AFDAO	Air Ordnance Officer
AFV	Armored Force Vehicle
AGO	Office of the Adjutant General
AGWAR	Adjutant General, War Department
AIA	Atelier de L'Air Industriel
BTO	Bombing through overcast
BMW	Bayerische Motoren Werke
C/AS	Chief of Air Staff
CBO	Combined Bomber Offensive
CCRC	Combat crew replacement center
CCS	Combined Chiefs of Staff
CEP	Circular Probable Error
COPC	Combined Operational Planning Committee
DB	Daimler-Benz
DKF	Deutsche Kugellager Fabrik
ETO	European Theater of Operations
ETOUSA	European Theater of Operations, United States Army
GAF	German Air Force
GO	General Order
HBS	Heavy Bombardment Squadron
JCS	Joint Chiefs of Staff
L/G	Landing Ground
MAAF	Mediterranean Allied Air Forces
MASAF	Mediterranean Allied Strategic Air Force
MEW	Ministry of Economic Warfare (British)
MIAG	Muhlenbau u. Industrie A. G.

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MID	Military Intelligence Division, WDGS
MIS	Military Intelligence Service
MM&D	Material, Maintenance, and Distribution
M/T	Motor Transport
MTO	Mediterranean Theater of Operations
M/Y	Marshalling yard
OC&R	Operations, Commitments, and Requirements
Opsum	Operational Summaries
ORS	Operational Research Section
PFF	Pathfinder Force
FOL	Petrol, oil, and lubricants
POW	Prisoner of War
PRO	Public Relations Officer
RAF	Royal Air Force
SAC	Supreme Allied Commander
SCORU	Statistical Control Unit
SHAEF	Supreme Headquarters, Allied Expeditionary Forces
SRO	J. Schmidt-Roost ball-bearing company
T/O	Target of Opportunity
USAFIME	U. S. Army Forces in the Middle East
USSAFE	U. S. Strategic Air Forces in Europe
USSTAF	U. S. Strategic Air Forces in Europe
VKF	Vereinigte Kugellager Fabrik

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Chapter I

1. A German general captured in Italy after serving on the Eastern Front, claimed that there was no comparison between Russian and Anglo-American air forces. The latter operated with huge armadas both strategically and tactically, while the former did not have enough planes or trained personnel to do effective bombing of cities or industries. The most effective operations of the Russian Air Force were the night nuisance raids over the front lines. The general also attributed part of the ineffectiveness of the Red Air Force to the fact that it was thought of as a part of the Russian Army. (Hq, MAAF, POW Intel. Sec., "Miscellany . . . statements made by German officers previously associated with a great variety of units in Italy, 23 Jul 45," KO 21435.) There is a possibility, of course, that the Russians were deliberately careful not to destroy German property which they might find useful. Another captured general who had formerly commanded the LIX Corps on the Eastern Front also commented on the totally different air warfare conducted by the Americans and British on the one hand and the Russians on the other. He claimed the latter were most anxious not to destroy German industrial machinery and were quick to put it back to work when it fell into their hands, while the Anglo-American policy was one of complete destruction. Captured Personnel and Material Br., MID, WD, Report, "Observations on the Allied Air Offensive against Germany . . . from a German General of Infantry captured 1 April 1945 . . .," 11 Apr 45, KO 6869.
2. GM-OUT-36626 (15-5-44), Arnold to Spaatz, Eaker, Devers, #WARX 36626, 14 May 44.
3. GM-OUT-33135 (6-5-44), Westlake, signed Surles, to Spaatz for PRO, #War 33135, 6 May 44.
4. For this phase of development, see AAF Reference History: No. 2.
5. Lt. Gen. Ira C. Eaker, "Report of . . . on U. S. Army Air Forces Activities in the United Kingdom covering the period from February 20, 1942 to December 31, 1943" (hereafter cited as Eaker Report), Appendix, "Air Force Plans" and Exhibit 1.
6. Ibid., Exhibit 4, "Casablanca Directive, 21 Jan 43."
7. Committee of Operations Analysts, Report, 8 Mar 43, ltr., Lt. Gen. H. H. Arnold, CG AAF, to AC/AS Management Control, 9 Dec 42.
8. Ibid., memo, Committee of Operations Analysts to Lt. Gen. H. H. Arnold, Report of Committee of Operations Analysts with respect to Economic Targets within the Western Axis, 8 Mar 43.
9. Ibid.

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10. Ibid., "Overall Summary of Report of Committee of Operations Analysts."
11. CGS, Plan for Combined Bomber Offensive from the United Kingdom, 14 May 43, Inclosure B.
12. Ibid.

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Chapter II

1. CCS, Plan for Combined Bomber Offensive from the United Kingdom, 14 May 43, Inclosure B. For details of the 1943 offensive against the GAF in being and production see, AAF Reference Histories: Nos. 10, 18, and 19.
2. Plan for the Completion of the Combined Bomber Offensive, 5 Mar 44, ltr., Maj. Gen. F. L. Anderson to Col. Williamson et al., 12 Feb 44.
3. Ibid.
4. Plan for the Completion of the Combined Bomber Offensive, 5 Mar 44.
5. Ibid.
6. Ibid., Sup. No. 1.
7. Conference between Generals Anderson and Fairchild, 2 Mar 44, WD-TC-299 (3-3-44).
8. Plan for the Completion of the Combined Bomber Offensive, 5 Mar 44, Sup. No. 1.
9. Ibid., App. G. More specifically the Eighth Air Force areas were: Ruhr-Kassel; Hamburg-Hannover; Berlin-Leipzig; Stettin-Danzig; Frankfurt-Nuremberg. The Fifteenth Air Force areas were: Munich; Prague-Breslau; Vienna-Budapest; Ploesti-Bucharest.
10. Ibid., Sup. No. 10.
11. Ibid.
12. See Tables 1 and 2 for the synthetic plants and crude oil refineries selected for attack. See App. 1 for the list of refineries in the Balkans, Poland, Austria, and Germany.
13. Conference between Generals Anderson and Fairchild, 2 Mar 44, WD-TC-299 (3-3-44).
14. Plan for the Completion of the Combined Bomber Offensive, 5 Mar 44.
15. Ibid., App. A.
16. Ibid., App. G.
17. Plan for the Completion of the Combined Bomber Offensive, 5 Mar 44.
18. Ibid., and Apps. D and G.

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19. Ibid., App. C. All five targets were assigned to the Eighth Air Force.
20. Ibid. and Apps. D and G. The only bomber factory assigned to the Fifteenth was at Oberpfaffenhofen. All the rest were allocated to the Eighth.
21. Ibid., Supp. No. 4.
22. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 25.
23. Conference between Generals Anderson and Fairchild, 2 Mar 44, WD-TG-299 (3-3-44).
24. Plan for the Completion of the Combined Bomber Offensive, 5 Mar 44, Sup. No. 6.
25. Ibid., Sup. No. 3.
26. Ibid., Sup. No. 5.
27. Ibid., Sup. No. 8.
28. Ibid., Sup. No. 7. Altogether there were nine major tire factories included on the target list. These were: Hannover/Vahrenselderstrasse; Hannover/Wordhafen; Hannover/Marienwerder; Bata at Zlin, Czechoslovakia; Firelli at Milan, Italy; Dunlop at Hanau; Phoenix at Hamburg/Harburg; Fulda at Fulda; and Metzler at Munich. All but Bata, Firelli, and Metzler were assigned to the Eighth Air Force. These three were the responsibility of the Fifteenth. Ibid., and App. C.
29. Ibid., ltr, Lt. Gen. Carl Spaatz to Gen. Dwight D. Eisenhower, 5 Mar 44.
30. CM-OUT-3829 (9-3-44), Arnold to Spaatz for Anderson, #F-673, 9 Mar 44.
31. The committee which prepared the USSTAF Plan for the Completion of the Combined Bomber Offensive claimed that at the time of the heavy February attacks when the GAF was at its peak strength it had been unable to prevent the destruction by air of widely distributed selected precision targets. And the results of the Big Week left the GAF "powerless to prevent the destruction by our Air Forces of any system of targets we may now select for the accomplishment of our real aim." Plan for the Completion of the Combined Bomber Offensive, 5 Mar 44.
32. CM-IN-17908 (25-3-44), Spaatz to Arnold, unnumbered, 24 Mar 44.
33. Ibid. USSTAF estimated that to effect a 30 per cent reduction in German rail traffic in a year, 500 targets would have to be successfully attacked. Of these targets 250 were major workshops of heavy construction. Since military traffic was only about one-fifth of the total German traffic, strategic attacks would have very little military effect. Plan for the Completion of the Combined Bomber Offensive, 5 Mar 44, App. E.

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- 34. GM-IN-17908 (25-3-44), Spaatz to Arnold, unnumbered, 24 Mar 44.
- 35. Ibid.
- 36. GM-IN-19221 (27-3-44), Spaatz to Arnold, #U-60193, 26 Mar 44.
- 37. GM-IN-9791 (14-4-44), Spaatz to Arnold, #U-60909, 13 Apr 44.

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Chapter III

1. Eaker Report; History of the Directorate of Intelligence, USSTAF, Jan 44-May 45.
2. See Eaker Report, Exhibit No. 1.
3. Eaker Report. For objectives to be attacked, see ibid., Exhibit No. 2.
4. Eaker Report.
5. Ibid., Exhibit No. 4, "Casablanca Directive, 21 Jan 43."
6. See Chap. I, this study.
7. Eaker Report. The value of this committee is attested to by Spaatz's statement that its planning of the entire operation of 20 February 1944, in which over 1,000 heavies were dispatched, alone justified the existence of the agency. Other of the COPC plans, although not so spectacular, had also proved worthwhile. CM-IN-15147 (22-2-44), Spaatz to Arnold, Eisenhower, Eaker, et al., #K-3816, 21 Feb 44.
8. History of the Directorate of Intelligence, USSTAF, Jan 44-May 45.
9. Narrative History of Headquarters, Eighth Air Force, Feb 44.
10. History of MAAF, 10 Dec 43-1 Sep 44, V, ltr., Maj. W. F. R. Ballard, Chief, Target Sec., Hq, MAAF to Col. George C. McDonald, A-2, Hq, MAAF, 27 Dec 43.
11. Ibid.
12. Ibid., V, Notes on MAAF Counter-Air Program, Part I, The Evolution of the Bombing Policy; ibid., VIII, ltr, Air Ministry to RAF Bomber Command, USSTAF, MAAF, 28 Jan 44; CM-IN-13056 (20-1-44), Spaatz to Arnold, #K-3189, 20 Jan 44. For these targets see Table 3.
13. History of MAAF, 10 Dec 43-1 Sep 44, VIII, Ltr, Air Ministry to RAF Bomber Command, USSTAF, MAAF, 28 Jan 44.
14. Ibid.; Narrative History of Headquarters, Eighth Air Force, May 44, Annex F, ltr, Lt. Gen. Carl Spaatz to CG's of 8th, 9th, 15th Air Forces, 20 Apr 44.
15. CM-CUT-5627 (13-2-44), CGS to Eisenhower, #109, 12 Feb 44; History of MAAF, 10 Dec 43-1 Sep 44, VIII, ltr, C/S Air Ministry to Gen. Wilson (Ref. No. OZ-831, undated).

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16. It was not until 6 June that the CCS, in COSMED 124, gave first priority for the Mediterranean to the Floesti oil industry and the destruction of all German oil facilities became the primary objective of all strategic air forces. History of MAAF, 10 Dec 43-1 Sep 44, I, 134.
17. Oil had always been considered as an important target, but it was considered to involve too many targets at too great a range in the days before long-range fighter escort was perfected, and, therefore, the cost of destruction was thought to be too high. By the end of 1943 the German oil situation was already strained without bombing. A captured order of the Quartermaster General of the German High Command, dated 13 December 1943, stressed the need for conservation. Motor fuel, it said, was scarce and the situation would become still more serious in the days to come. Restrictions on use of oil would have to be imposed in January or the army would be unable to move its armored equipment and fast troops "at the decisive hour." *Ibid.*, V, Notes on MAAF Counter-Air Program, Part I; CM-IN-17908 (25-3-44), Spaatz to Arnold (unnumbered), 24 Mar 44.
18. History of MAAF, 10 Dec 43-1 Sep 44, VIII, ltr, Air Ministry to RAF Bomber Command, USSTAF, MAAF, 28 Jan 44. See p. 32, this study.
19. CM-IN-5768 (8-5-44), Spaatz to Arnold, #U-61850, 8 May 44.
20. Narrative History of Headquarters, Eighth Air Force, Jan-Jun 44. The aircraft targets had supplanted the submarine installations which held first place in early and middle 1943.
21. History of MAAF, 10 Dec 43-1 Sep 44, II, Directive for Unification of Command in the Mediterranean, CCS 387/3 (Sextant), 5 Dec 43.
22. *Ibid.*, I, 133-34; *ibid.*, VII, Air Plans, MAAF, 1 Jan 44-25 Mar 45.
23. CM-IN-5768 (8-5-44), Spaatz to Arnold, #U-61850, 8 May 44; History of MAAF, 10 Dec 43-1 Sep 44, I, 134, 230.
24. Air Ministry to USSTAF, #AX-440, 27 Feb 44.
25. CM-IN-5768 (8-5-44), Spaatz to Arnold, #U-61850, 8 May 44.
26. Directive, Air Marshal A. W. Tedder, Air C-in-C, MAAF to Hq NASAF, 3 Jan 44, in History of the Fifteenth Air Force.
27. History of MAAF, 10 Dec 43-1 Sep 44, II, ltr, CG, USSTAF to CG, 15th Air Force, 11 Jan 44. For a list of priorities for January-February 1944, see Table 4.
28. For example, in the latter part of April the Wiener Neustadter Flugzeugwerke at Fischamend was removed from second priority because of severe damage and the aircraft factory at Bad Vöslau put in its place. The IAR aircraft factory at Brasov was moved from ninth to third priority. Successful attacks on other fighter factories led to increasing importance of the Fiat Aeritalia at Turin and the Macchi factory at Varese and the addition of them to the list of primary targets. Heretofore they had been of secondary importance and were to be attacked only in case weather kept the higher-priority targets from being hit. They were omitted entirely. (Cont'd)

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28. (Cont'd.) however, from the May list. Redline, MT 151 IE, Eaker to Twining, 22 Apr 44; see also Tables 5 and 6.
29. For priorities for April and May 1944, see Tables 5 and 6.
30. See Table 6.
31. History of MAAF, 10 Dec 43-1 Sep 44, VIII, ltr, Lt. Gen. Carl Spaatz to Lt. Gen. Ira G. Eaker, 3 Feb 44.
32. CM-IN-10557 (15-2-44), CCS to Wilson and Spaatz, COSMED 33, 15 Feb 44.
33. CM-IN-10485 (15-3-44), Portal to Wilson and Spaatz, COSMED 55, 9 Mar 44.
34. CM-IN-4575 (7-3-44), CCS to Wilson, COSMED 53, 6 Mar 44.
35. History of MAAF, 10 Dec 43-1 Sep 44, XXV, PT 228 IE, Eaker to Timberlake for Slessor, 16 Mar 44.
36. CM-OUT-13745 (24-3-44), Arnold to Spaatz, #WAR 13745, 24 Mar 44. The priority systems in force were: (1) Italian campaign; (2) POINTBLANK; and (3) Balkan areas.
37. CM-IN-19010 (27-3-44), CCS to Wilson and Spaatz, COSMED 71, 25 Mar 44.
38. MC 3309, Teletype, Spaatz to Arnold, 24 Mar 44.
39. CM-IN-17789 (25-3-44), Portal to Arnold (Pt. 2), #AX-779, 25 Mar 44;
CM-IN-17765 (25-3-44), Portal to Arnold (Pt. 3), #AX-779, 25 Mar 44.
40. CM-OUT-14086 (25-3-44), Arnold to Spaatz for Portal, #WAR-14086, 25 Mar 44.
41. CM-IN-19511 (27-3-44), Portal to Arnold, #AX-902, 27 Mar 44.
42. CM-IN-5000 (7-6-44), Portal to Wilson and Spaatz, COSMED 124, 6 Jun 44.

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Chapter IV

1. The official abbreviation of this organization was changed in February 1944 from USSAFE to USSTAF in order to avoid confusion with the air forces in the Far East. Narrative History of Headquarters, Eighth Air Force, Feb 44, Annex E, ltr, Lt. Gen. Carl Spaatz to "Persons on Distribution E," 4 Feb 44.
2. For the early history and vicissitudes of the Eighth Air Force, see AAF Reference History: No. 2.
3. Originally the bomb divisions had been under the VIII Bomber Command, but when that organization was inactivated and its personnel and functions were absorbed by Headquarters, Eighth Air Force, the bomb divisions were elevated to the position of major subordinate commands and operated directly under the Eighth Air Force Headquarters.
4. For charts showing the organization of the Eighth Air Force during various periods of its history, see Eighth Air Force, Tactical Development, August 1942-May 1945 (July 45), App. A.
5. See Chart I for organization of the Fifteenth Air Force in December 1943 and June 1944. For a history of the 885 HBS (SP), see AAF Reference History: No. 21.
6. The problems involved in TO operations in general are well illustrated by a letter from General Eaker to General Arnold a few months after the former took command of MAAF: "You are quite right. This is a new kettle of fish from U.K. The job there was clean cut. We had really but one major program: to deliver the maximum bombload against German industry. Here we have three primary tasks and many, many subsidiary ones. The primary tasks are: the accomplishment of POINTEBLANK . . . the support of land armies . . . and keeping the sea lanes open and protecting the logistic establishments In addition, we have such odorous morsels, or secondary commitments, as re-equipping the French, maximum lift to the Balkan partisans, moving out of Africa . . . and moving into Italy and getting on with the Continental war. There we had no Army to worry about. There also we had no Navy to get along with Sometimes I am not quite certain whether this job is going to broaden me or flatten me. In any case, I am certain it will change my shape or size." History of MAAF, 10 Dec 43-1 Sep 44, II, ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 6 Mar 44.
7. Ibid., II, App. A, CCS 387/3 (Sextant), "Directive to C-in-C, Allied Forces, North Africa, 5 Dec 43"; ibid., II, GO 67, Allied Force Headquarters, 20 Dec 43.

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8. Ibid., II, App. A, CCS 387/3 (Sextant), "Directive to C-in-C, Allied Forces, North Africa, 5 Dec 43."
 9. Ibid., XI, 23d SOCFU, Monthly Statistical Summary of MAAF, No. 2 and No. 3 (Jan 44); ibid., I, 138.
 10. Ibid., II, Lt. Gen. I. C. Eaker, Report to General Arnold, 21 Mar 44.
 11. Ibid., II, "Fifteenth Air Force Operations," 7 Apr 44, Round-up Item No. 4, Eaker to Arnold; ibid., II, ltr, Lt. Gen. Ira C. Eaker to Lt. Gen. Jacob L. Devers, 6 Apr 44.
 12. Ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 79, 22 May 44.
 13. Ibid., II, teleprinter conversation, Eaker to Giles, 20 May 44.
 14. Memo, B.M. Giles to CG AAF, "Strategic Bombing of Germany," 30 Nov 43, in AG/AS Plans, P-III-D-8, Germany, Jan 43-Dec 44 (Office of AG/AS Plans).
 15. Memo, Maj. Gen. Clayton Sissell to C/AS, "Bombing Program in ETO," 27 Dec 43, in 353.41--Aerial Gunnery and Bombing (Classified Files).
 16. History of MAAF, 10 Dec 43-1 Sep 44, II, ltr, Maj. Gen. Ira C. Eaker to Air Marshal N. H. Bottomley, 9 Sep 43.
 17. Ibid., I, 142-44.
 18. Ibid., II, CCS 400/2, "Control of Strategic Air Forces in Northwest Europe and in the Mediterranean," 4 Dec 43.
 19. Ibid., II, CCS 400/2, "Control of Strategic Air Forces in Northwest Europe and in the Mediterranean," 4 Dec 43, Incl.; CM-IN-5028 (8-1-44), Spaatz to Arnold, #K-3008, 3 Jan 44.
 20. History of MAAF, 10 Dec 43-1 Sep 44, II, ltr, Lt. Gen. Carl Spaatz to Lt. Gen. Ira C. Eaker, et al., 5 Jan 44; CM-OUT-5627 (13-2-44), CCS to Eisenhower, #109, 12 Feb 44.
 21. History of MAAF, 10 Dec 43-1 Sep 44, II, "Conference Notes, 31 Dec 43"; CM-IN-548 (1-1-44), Smith, signed Devers, to Eisenhower, #R-9106, 1 Jan 44. See Chart II for organization of USSTAF.
 22. Ltr, Gen. H. H. Arnold to Lt. Gen. Carl Spaatz, undated, in 312.1--Operations Letters (Classified Files).
 23. Ltr, Lt. Gen. Carl Spaatz to Gen. H. H. Arnold, 1 Mar 44, in 312.1--Operations Letters (Classified Files).
 24. See Chapter II, this study.
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25. CM-IN-9791 (14-4-44), Spaatz to Arnold, U-60909, 13 Apr 44.
 26. History of MAAF, 10 Dec 43-1 Sep 44, II, CCS 400/2, "Control of Strategic Air Forces in Northwest Europe and in the Mediterranean," 4 Dec 43, Incl.; ibid., II, ltr, Lt. Gen. Carl Spaatz to Lt. Gen. Ira C. Eaker, et al., 5 Jan 44.
 27. CM-IN-16305 (23-3-44), Spaatz to Arnold, U-60045, 23 Mar 44.
 28. CM-OUT-13235 (23-3-44), Arnold to Spaatz for Portal, #WAR-13235, 23 Mar 44.
 29. CM-IN-17753, Pt. 1 (24-3-44), CM-IN-17789, Pt. 2 (25-3-44), CM-IN-17765, Pt. 3 (25-3-44), Portal to Arnold, #AX-779, 25 Mar 44. See Chap. III of this study for discussion of Balkan priorities.
 30. For example, during the Anzio campaign, B-17's from the Fifteenth attacked and seriously damaged the Villar-Perosa ball-bearing factory on 3 January, and on the same date, the Fiat aero-engine works were struck in the raid on the Turin marshalling yards. As a part of a sweep over the Balkans on 7 January, 48 B-17's dropped 87 tons of bombs on the Maribor aircraft factory in Yugoslavia, and the next day, following up a night attack by the 205 Group, RAF, 109 B-17's dropped 324 tons of bombs on the Reggio Emilia aircraft factory, leaving it two-thirds destroyed. Fifteenth Air Force, "Villar-Perosa Ball Bearing Factory and Turin-Lingotto Marshalling Yards Operation of 3 January 1944"; History of MAAF, 10 Dec 43-1 Sep 44, I, 156; ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 66, 21 Feb 44; ibid., IX, MAAF, Monthly Operations Bulletin, No. 10, Jan 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 16, 8 Jan 44. For MASAF's part in SPINGLE, DIADÉM, and at Cassino, see App. 16, this study.
 31. MAAF, Preliminary Study of Coordinated Attacks by USSTAF, Sup. A.
 32. For the details of these difficulties, see App. 16, this study.
 33. History of MAAF, 10 Dec 43-1 Sep 44, II, ltr, CG, USSTAF to CG 15th AF, 22 Feb 44.
 34. For the list of proposed coordinated attacks, see Table 7. For an account of the completed attacks, see App. 17, this study.

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Chapter V

1. Since all of these problems will be treated in detail in the various air force and other organizational histories, they are discussed only briefly in this study.
2. Narrative History of Headquarters, Eighth Air Force, Jan. 44.
3. Ibid.
4. History of MAAF, 10 Dec 43-1 Sep 44, III, memo, A-3, AAF/WTO to Lt. Col. James Parton, History of A-3 Section, AAF/WTO, 24 Oct 44.
5. Narrative History of Headquarters, Eighth Air Force, Jan, Apr 44.
6. History of MAAF, 10 Dec 43-1 Sep 44, XXIV, MAAF Incoming Message 49130, Arnold to Eaker, Devers, Spaatz, #WARX-41371, 26 May 44.
7. Narrative History of Headquarters, Eighth Air Force, Jan 44; ibid., Annex A, "Minutes of Commanders' Meeting, 21 January 1944."
8. CM-OUT-5338 (12-2-44), Arnold to Spaatz, #F-229, 12 Feb 44.
9. CM-IN-9926 (14-2-44), Spaatz to Marshall for Arnold, #K-3665, 14 Feb. 44.
10. Narrative History of Headquarters, Eighth Air Force, Jan 44, Annex A, "Minutes of Commanders' Meeting, 21 January 1944"; History of MAAF, 10 Dec 43-1 Sep 44, XXIV, FAFE-897, Twining to Eaker to Spaatz, #26175, 21 Apr 44.
11. Narrative History of Headquarters, Eighth Air Force, Feb 44.
12. History of MAAF, 10 Dec 43-1 Sep 44, XXIV, MAAF Incoming Message-48957, Arnold to Eaker, #WARX-41293, 26 May 44.
13. Ibid., XXIV, MAAF Incoming Message-2089, Twining to Eaker, #FAFE-806, 30 May 44.
14. Ibid., II, Incl. (ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 1 Jun 44), Suggested Items of Information for Inclusion in the "Roundup" by Maj. Gen. Twining.

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15. Ibid., XXIV, AF-OUT-2775, Eaker to Twining and Cannon, 14 Mar 44.
16. Ibid., FAF-597, Twining to Baker, #16780, 7 Apr 44.
17. Ibid., XXII, GS-332-IE, Eaker to Spaatz, #58, 9 Apr 44.
18. One problem in accuracy was presented by the use of different types of bombs. The same methods of aiming and release could not be applied to all kinds. A study of 22 out of 67 attacks made in June 1944 in which fragmentation bombs were used exclusively showed that 18 per cent of the attacks resulted in errors of 3,000 or more feet. The average error for the remaining 82 per cent was 1,570 feet, most of which was in range. To correct this, research was undertaken to determine a more effective aiming system for fragmentation bombing. Another problem in technique was to devise a heavy bomber formation which would give maximum protection to the individual planes and yet allow for a reasonable degree of accuracy. Too large a formation did not permit bombardiers to make necessary corrections on the bombing run, and too small a one did not give adequate protection. By May and June, however, the disappearance of the GAF and increased long-range fighter protection for the heavy bombers allowed the Eighth Air Force to reduce the size of the combat box from 18-21 planes to 12. This smaller size made for better bombing accuracy. A change like this, in turn, induced new problems, such as assembly and formation flying. It is easy to see, therefore, that a departure from established practice might possibly start a chain reaction necessitating a revision of a large part of the whole training program and operational procedures. Narrative History of Headquarters, Eighth Air Force, May /4; Lighthair Force, Operational Research Sec., Report on Bombing Accuracy for the Month of June 1944, 10 Jul 44, in ORS Archives.
19. Narrative History of Headquarters, Eighth Air Force, Jan-Mar 44.
20. Ibid., May 44. Another phase of training for D-day was inaugurated in late March. This was practice and perfection of predawn take-offs and assemblies in squadron formation. Since this type of maneuver would be called for in the initial attacks on D-day, it was planned that each group would hold at least one full dress rehearsal before this time. Such performance would give the crews the experience needed for mass assembly in the dark. Ibid., Mar 44.
21. History of MAAF, 10 Dec 43-1 Sep 44, II, ltr, Lt. Gen. Ira C. Eaker to Maj. Gen. Nathan F. Twining, 10 Mar 44.
22. Ibid., ltr, Maj. Gen. Nathan F. Twining to Lt. Gen. Ira C. Eaker, 15 Mar 44.
23. Ibid., Incl. (ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 1 Jun 44), Suggested Items . . . for Inclusion in the "Roundup" by Maj. Gen. N. Twining; ibid., VIII, MAAF Operational Instruction No. 25, 28 Apr 44; ibid., XXIV, AF-OUT-9307, Eaker to NOIC, Taranto, #M-18063, 22 May 44.

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24. Ibid., II, Lt. Gen. Ira C. Eaker, Report on Bombing Accuracy, MTO, 7 May 44. The following table shows the improvement of bombing accuracy in the Eighth Air Force in early 1944 on the basis of what was expected and what was observed. The fluctuations in expectancy are due to differences in bombing altitudes.

Month	Average Bombing Altitude	Per cent of Bombs Within 1,000 Ft. of Aiming Point	
		Expected	Observed
February	17,500	40	41.4
March	20,500	30	30.8
April	20,000	32	33.1

Eighth Air Force, OFS, Report on Bombing Accuracy for Month of April 1944, 8 May 44, in ORS Archives.

25. History of MAAF, 10 Dec 43-1 Sep 44, XXV, MAAF Incoming Message 39004, Spaatz to Arnold, #O-61982, 11 May 44; CM-IN-3301 (5-5-44), Eaker to Arnold, #M-16231, 4 May 44.
26. U. S. Strategic Bombing Survey, Summary Report (European War), September 30, 1945, 4-5. For Eighth Air Force accuracy, see Table 3.
27. Ltr, Maj. Gen. F. L. Anderson to Maj. Gen. B. M. Giles, 28 Apr 44, in 312.1--Operations Letters (Classified Files).
28. Narrative History of Headquarters, Eighth Air Force, Jan-Jun 44.
29. History of MAAF, 10 Dec 43-1 Sep 44, III, memo, A-3, AAF/MTO to Lt. Col. James Parton, History of A-3 Section, AAF/MTO, 24 Oct 44; ibid., II, Incl. (ltr., Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 1 Jun 44), Suggested Items . . . for Inclusion in the "Roundup" by Maj. Gen. N. F. Twining; ibid., VIII, MAAF Operational Instruction No. 44, 24 May 44.
30. No attempt is made here to discuss build-up or replacement of planes and crews, inasmuch as histories of the Eighth and Fifteenth Air Forces now in preparation will handle these matters in detail.
31. See Table 9.
32. Among specific spare-part items of which there was a serious shortage were glycol pumps, bomb-bay motors, prop control governor and assemblies, and Minneapolis-Honeywell electric supercharger regulators. Incl. No. 1 (ltr, Brig. Gen. L. P. Whitten to CG Air Service Command, 12 Mar 44), Report of Mr. H. B. Mitchell, Boeing Representative, 14 Feb 44, in 300--British Isles (Classified Files).

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33. History of MAAF, 10 Dec 43-1 Sep 44, II, Minutes of Special Meeting to Discuss Service Command Matters, 3 Mar 44; ibid., II, ltr, Lt. Gen. Ira C. Baker to Maj. Gen. Nathan F. Twining, 5 Mar 44.
 34. Eighth Air Force Statistical Control, Monthly Summary of Operations, Jan-Mar 44.
 35. History of MAAF, 10 Dec 43-1 Sep 44, XI, 23d SCOPU, Monthly Statistical Summary of Mediterranean Allied Air Forces, Jan-May 44.
 36. Teletype, Baker to Giles, 14 Mar 44, quoted in ibid., I, 45.
 37. In January the number of operational heavy bomber crews in the Eighth Air Force was 1,113 while the number of heavy bombers operational was 843. In May the number of operational crews was 1,382 while the number of fully operational bombers was 1,624. Eighth Air Force Statistical Control, Monthly Summary of Operations, Jan, May 44. See Table 10 for number of crews assigned and operational in the Eighth and Fifteenth Air Forces.
 38. Effective strength was the number of fully manned operational planes that could be put into combat. In some cases a crew might be intact but its airplane was grounded for repairs, or the aircraft might be ready to fly but some crew members were in the hospital or missing for other reasons. Whichever was the lower number--fully operational planes or fully operational crews--was considered effective strength per group. The air force effective strength was the total effective strengths of the groups.
 39. Eighth Air Force, Tactical Development, August 1942-May 1945, App. B.
 40. Ibid.; Narrative History of Headquarters, Eighth Air Force, Feb 44.
 41. Eighth Air Force, Tactical Development, August 1942-May 1945, 2-28.
 42. For damage and losses of heavy bombers from flak in the Eighth Air Force in the first five months of 1944, see Tables 11 and 12.
 43. Narrative History of Headquarters, Eighth Air Force, Mar 44, Annex A, "Minutes of Commanders' Meeting," 2 Mar 44.
 44. A training memorandum, "Requirements for Defense of Heavy Bomber Formations over Heavily Defended Areas," which described in detail successful evasion of flak, was published. Ibid., May 44; Eighth Air Force, Tactical Development, August 1942-May 1945, 25-27, 89.
 45. Ibid., 93.
 46. Ibid., 50, 97; U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 17.

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47. Eighth Air Force, Tactical Development, August 1942-May 1945, 52. Gen. Eaker felt that this relay system was one of the best and most valuable tactics developed in the war. History of MAAF, 10 Dec 43-1 Sep 44, II, ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 1 Jun 44, Incl. No. 3.
48. Eighth Air Force, Tactical Development, August 1942-May 1945, 52. Wing Commander Nigel Tangye, RAF, characterized the methods developed by the Americans to make long-range escort possible as reaching for the moon and getting it. Ltr, Wing Commander Nigel Tangye, RAF, to Dr. Bruce Hopper, 8 Mar 44, in 312.1--Operations Letters (Classified Files).
49. "We are fully aware that adequate long-range fighter escort is now more necessary than ever before to get our bombers to their targets and back with minimum losses," wrote Brig. Gen. H. A. Craig, Acting C/AS, MAAF in December 1943. "The greater the distance that fighter support can be provided the more effective will be our bombing results. As you know the personnel and equipment requirements of the Eighth Air Force have been given a high priority and we are certain that the results of your operations will continue to show improvement as your organization gains further experience." Ltr, Brig. Gen. F. A. Craig to Maj. Gen. J. E. Kepner, CG, VIII Fighter Command, 21 Dec 43, in 312.1--Operations Letters (Classified Files).
50. History of MAAF, 10 Dec 43-1 Sep 44, XXII, GS-15-IE, Eaker to Spaatz, 5, 26 Jan 44.
51. Ibid., II, ltr, Lt. Gen. Ira C. Eaker to Maj. Gen. B. M. Giles, 29 Feb 44; ibid., XXII, GS-214-IE, Eaker to Spaatz, 36, 6 Mar 44; ibid., II, ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 6 Mar 44.
52. GM-IN-13067 (26-2-44), Spaatz, signed Devers, to Arnold, 4EN-1914, 25 Feb 44.
53. History of MAAF, 10 Dec 43-1 Sep 44, II, ltr, Lt. Gen. Ira C. Eaker to Lt. Gen. Carl Spaatz, 29 Feb 44; ibid., XXIII, AF-IN-1376, Cannon to Hq, MAAF, 5 Mar 44; ibid., II, ltr, Lt. Gen. Ira C. Eaker to Maj. Gen. B. M. Giles, 6 Mar 44; ibid., XXIII, AF-OUT-3156, Egan to CG's of 12th and 15th Air Forces, 28 Mar 44; ibid., XXIII, AF-OUT-834, Eaker to Arnold, 7 Jun 44; ibid., II, ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 1 Jun 44.
54. Ibid., I, 45-46; ibid., II, ltr, Maj. Gen. H. A. Craig to Lt. Gen. Ira C. Eaker, 22 Mar 44; ibid., II, ltr, Maj. Gen. B. M. Giles to Lt. Gen. Ira C. Eaker, 25 Mar 44; ibid., XXIII, AF-OUT-6891, Eaker to Twining, 28 Apr 44; ibid., II, ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 1 Jun 44; ibid., XXIII, AF-OUT-834, Eaker to Arnold, 7 Jun 44.
55. Ibid., II, Lt. Gen. Ira C. Eaker, Report to General Arnold, 21 Mar 44.

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56. Ibid., II, ltr, Gen. Ira C. Eaker to Gen. H. H. Arnold, 7 Apr 44, Round-up Item No. 4; ibid., ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 1 Jun 44, Incl. No. 3.
57. CM-OUT-4443 (12-1-44), Marshall to CG ETO, #R-8007, 12 Jan 44, in OPD 370.5 ETO, 12 Jan 44.
58. Narrative History of Headquarters, Eighth Air Force, Jan and Apr 44.
59. Ibid., Jan, Feb, Mar (Annex D), Apr 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44.
60. Narrative History of Headquarters, Eighth Air Force, Feb 44, Annex A, "Minutes of Commander's Meeting," 8 Feb 44; ibid., Mar 44; ltr, Brig. Gen. F. H. Griswold to Maj. Gen. B. M. Giles, 21 Mar 44, in 312.1--Operations Letters (Classified Files).
61. Narrative History of Headquarters, Eighth Air Force, May 44, Annex F, ltr, Lt. Gen. Carl Spaatz to CG's of 8th, 9th, and 15th Air Forces, 20 Apr 44; U.S. Strategic Bombing Survey, Interview No. 56, Reichsmarshal Hermann Goering, 29 Jun 45, KO-18990; Hq, Air POW Interrogation Det., MIS, 9th AF, Hermann Goering, 1 Jun 45, KO-13951.
62. Eighth Air Force, Tactical Development, August 1942-May 1945, 85.
63. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, A-2 Sec Air Intelligence Weekly Summary, No. 72, 3 Apr 44; CM-IN-15582 (21-4-44), CGS to JSM, #COS (W) 3, 20 Apr 44.
64. Narrative History of Headquarters, Eighth Air Force, Feb, Apr 44; History of MAAF, 10 Dec 43-1 Sep 44, XIII, MAAF, Central Mediterranean Operational Summary, No. 48, 9 Feb 44, No. 59, 20 Feb 44, No. 121, 22 Apr 44.
65. There were 21 actual days of operation in April for the Eighth Air Force and on 17 of these it operated in strength over Germany and occupied territory. In the MTO, the Fifteenth was able to operate on 12 days. Eighth Air Force, Tactical Development, August 1942-May 1945, 86; Eighth Air Force Statistical Control, Monthly Summary of Operations, Apr 44; CM-IN-16666 (22-5-44), Chiefs of Staff to JSM, #COS (W) 67, 18 May 44.
66. In May when Eaker was informed that the Balkan weather detachments under the jurisdiction of USAFIME were to be removed he urged their retention on the ground that the information furnished by them was vitally necessary for the efficient functioning of the Fifteenth Air Force. History of MAAF, 10 Dec 43-1 Sep 44, XXXIV, AF-OUT-8066, Eaker to Arnold, #M-16858, 10 May 44.

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67. For example, the Fifteenth made 51 weather reconnaissance flights in January, only 3 in February, 90 in March, 127 in April, 128 in May, and 129 in June. In the Eighth Air Force the shortage of P-38's and maintenance difficulties led to the use of B-17's to aid in this work. The chief objection to using the Flying Fortress for weather reconnaissance was the increased cost for these operations and the additional personnel required to maintain them. The number of B-17's engaged in weather flights was gradually reduced, however, as more P-38's became available. 23d SCORU, Monthly Statistical Summary of MAAF, Jan-Jun 44; Narrative History of Headquarters, Eighth Air Force, Apr 44.
68. Ibid., Mar, May 44.
69. Aircraft equipped with these aids were known as Pathfinders (PFF).
70. Eighth Air Force, Tactical Development, August 1942-May 1945, 64-65; P&R, Col. D. C. Doubleday, Chief, Equipment Division, to Air Communications Officer, Overland Blind Bombing Systems, 21 Dec 43, in 312.1--Operations Letters (Classified Files).
71. In February, the Eighth started a school at Alconbury to give instruction in the use of H2X equipment. Planning for an H2X PFF in the Fifteenth Air Force started in December 1943 when a group of experts from Headquarters, AAF arrived in the MTO to advise on training and techniques and to study requirements. The first major H2X mission of this air force was on 15 April in the raid against Bucharest and Floesti. Eighth Air Force, Tactical Development, August 1942-May 1945, 65; P&R, Col. D. C. Doubleday to Air Communications Officer, Overland Blind Bombing Systems, 21 Dec 43, in 312.1--Operations Letters (Classified Files); ltr, Brig. Gen. F. L. Anderson to Maj. Gen. B. M. Giles, 17 Nov 43, in ibid.; Narrative History of Headquarters, Eighth Air Force, Feb 44; History of MAAF, 10 Dec 43-1 Sep 44, VIII, Report on Dr. Bowles' Mission, 23 Dec 43-1 Jan 44, 4 Jan 44; ibid., XXII, GS-250-IE, Eaker to Spaatz, #45, 14 Mar 44; GM-IX-12230 (17-4-44), Spaatz to Arnold, #U-61033, 17 Apr 44.
72. Eighth Air Force, ORS, Reports on Bombing Accuracy, Jan-May 44 in ORS Archives. For number of effective H2X sorties in the Eighth Air Force, see Table 13.
73. Eighth Air Force, Air Operations Report, Mission 264, 18 Mar 44.
74. History of MAAF, 10 Dec 43-1 Sep 44, II, Lt. Gen. Ira C. Eaker, Report to Gen. H. H. Arnold, "Status of our Pathfinder Force," 7 May 44.
75. Eighth Air Force, Tactical Development, August 1942-May 1945, 64; Eighth Air Force, "Report on Bombing Accuracy for Certain Air Force Heavy Bombardment H2X Operations, 25 May to 11 June 1944," 17 Jul 44, in 353.41--Bombing (Classified Files).

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76. See Table 14 for the actual days of operation in the Eighth Air Force for January-June 1943 and 1944, and Table 15 for mission failures in the Eighth for the first six months of 1944. The increased number of operational days in 1944 and gradual decrease of mission failures was due not to improved weather conditions but to better forecasting and use of blind bombing equipment. Before the end of the war, the Eighth was flying an average of 22 days a month out of a forecast of 24 operational days. Eighth Air Force, Tactical Development, August 1942-May 1945, 85-86; Eighth Air Force, ORS, Bombing Accuracy of the Eighth Air Force Bombardment Divisions, Combat Wings and Groups, in ORS Archives.
77. Ltr, Brig. Gen. F. L. Anderson to Maj. Gen. B. N. Giles, 17 Nov 43, in 312.1--Operations Letters (Classified Files); USSTAF, Semi-Monthly Record of Results, 16-31 Jan 44; Narrative History of Headquarters, Eighth Air Force, Mar-May 44. See Tables 11 and 12 for damage and losses due to rockets, pp. 79-80.
78. Ltr, Lt. Col. J. H. Cruitch, Technical Development Br., AFDAO to Chief of Ordnance, Technical Div, Bombs and Pyrotechniques, 3 Mar 44, in OGO.500--Germany (Classified Files); Narrative History of Headquarters, Eighth Air Force, May 44.
79. USSTAF, Air Intelligence Summary, No. 12, week ending 23 Jan 44, in A-2 Lib.
80. Maj. Gen. W. E. Kepner, "Summary of Report of VIII Fighter Command," 15 Dec 43, in 312.1--Operations Letters (Classified Files); memo, Brig. Gen. T. D. White to Gen. H. H. Arnold, Implications of the Air Battle on 11 January 1944, 16 Jan 44, in 384.5--Aerial Attacks (Classified Files); Narrative History of Headquarters, Eighth Air Force, May 44; CM-GTT-6142 (15-2-44), Arnold to Spaatz, #F-252, 14 Feb 44; CM-IN-15205 (22-2-44), Anderson to Arnold, #K-3826, 21 Feb 44; CM-IN-15582 (21-4-44), CCS to JSM, #COS (W) 3, 20 Apr 44.
81. Narrative History of Headquarters, Eighth Air Force, Mar-Apr 44; USSTAF, Semi-Monthly Record of Results, 16-31 Jan 44, 1-31 Mar 44, 1-15 Apr 44.
82. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 22, 25; U. S. Strategic Bombing Survey, Interview No. 56, Reichsmarshal Hermann Goering, 29 Jun 45, KO-18990; Captured Personnel and Material Br., MID, WD, Report, "Information on GAF Policies and Experience . . . obtained from a Field Marshal of the GAF Milch," 3 Jun 45, KO-18936; Hq, Air POW Interrogation Det., MIS, 9th AF, Hermann Goering, 1 Jun 45, KO-13951; Hq, Air POW Interrogation Det., MIS, 9th AF, Some Interesting Notes on the GAF Conversion Programs as Related by Maj. Jacob, IA-I Operations Head in the GAF Headquarters Staff, 11 Jun 45, KO-16728.

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83. Narrative History of Headquarters, Eighth Air Force, Jan 44; USAAF, U.K., Intelligence Summary, No. 9, week ending 2 Jan 44, in A-2 Lib.; Narrative History of Headquarters, Eighth Air Force, Mar 44, Annex F, Hq, ETOUSA, Immediate Release No. 8540, 29 Mar 44; Eighth Air Force, Tactical Development, August 1942-May 1945, 87; U. S. Strategic Bombing Survey, Interview No. 55, Field Marshal Wilhelm Keitel, 27 Jun 45, KO-18991; Captured Personnel and Material Br., MID, WD, Report, "Information Obtained from the Former German Minister of Armaments and War Production, Albert Speer . . .," 11 Jul 45, KO-21120; Captured Personnel and Material Br., MID, WD, Report, "Information on Effectiveness of Allied Air Raids and Various GAF Problems Obtained from a German Field Marshal Captured 4 May," 23 May 45, KO-15385; Hq, Air POW Interrogation Det., MIS, 9th AF, Hermann Goering, 1 Jun 45, KO-13951. See also Tables 11 and 12, pp. 79-80.
84. Narrative History of Headquarters, Eighth Air Force, Mar 44, Annex C, Narrative of Operations, 264th Operation, 18 Mar 44; USSTAF, Air Intelligence Summary, No. 16, week ending 27 Feb 44, No. 22, week ending 23 Apr 44, in A-2 Lib.
85. Ltr, Maj. Gen. Clayton Bissel to CG, NAAF, 2 Nov 43, in 371.1--Tactics (Classified Files); Eighth Air Force, Interpretation Report No. S.A. 1196, "Attack on targets at Friedrichshafen," 18 Mar 44; MASAF, Floesti: Summary of Operations and Results and Tactical Problems Involved in 24 Attacks Between 5 April-19 August 1944.
86. Eighth Air Force, Tactical Development, August 1942-May 1945, 89; Narrative History of Headquarters, Eighth Air Force, Jan, Feb 44; History of NAAF, 10 Dec 43-1 Sep 44, VI, NAAF, Air Intelligence Weekly Summary, No. 64, 7 Feb 44; ibid., XII, Opsum, Eaker to Spaatz, Portal, Arnold (Ref. No. AI-322), 3 Feb 44; ibid., XIII, NAAF, Central Mediterranean Operational Summary, No. 38, 30 Jan 44, No. 41, 2 Feb 44; CM-IN-14418 (20-2-44), Doolittle to Arnold, #K-3784, 20 Feb 44.

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Chapter VI

1. AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); U. S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45, pp. 67-69. For the attacks on the aircraft industry in 1943 and against the GAF in 1943-44, see AAF Reference Histories: Nos. 10, 19.
2. AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); History of MAAF, 10 Dec 43-1 Sep 44, V, Notes on MAAF Counter-Air Program, Pt. III.
3. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 11, 17; AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); History of MAAF, 10 Dec 43-1 Sep 44, V, MAAF, Special Intelligence Report No. 65, "Air Attack on German Single-Engine Fighter Production," 26 Dec 43. The decline in production in March was not altogether due to direct bombing. There was a reorganization of the aircraft industry and the changes in policy necessarily affected production.
4. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 14-16; AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); History of MAAF, 10 Dec 43-1 Sep 44, V, Notes on MAAF Counter-Air Program, Pt. III.
5. AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); U.S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45, pp. 27-28.
6. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 17, 19; U.S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45, pp. 24, 30, 32; U.S. Strategic Bombing Survey, Interview No. 56, 29 Jun 45, Reichsmarshal Hermann Goering, KO-18990; U.S. Strategic Bombing Survey, Interview No. 44, 9 Jul 45, Dr. Karl Frydag, Chief of Airframe Industry, KO-19001.
7. U.S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 18-19; U.S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45, p. 34.

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8. Out of 663 bombers dispatched on the 11 January attack, 60 were lost. Bomber claims against the enemy were 125-36-33. Escort was provided by 592 fighters, but adverse weather prevented full support on withdrawal. Five fighters were missing and six crash-landed in England as a result of battle damage. Fighter pilots claimed 27-6-14. On the 30 January raid 20 bombers were lost as against bomber claims of 46-19-16. Escort was provided by 635 fighters, four of which were lost. Fighter claims were 45-15-34. In spite of losses and bad weather these two attacks elicited high praise from General Arnold. Narrative History of Headquarters, Eighth Air Force, Jan 44; CM-OUT-5052 (13-1-44), Arnold to Spaatz, #A-5425, 13 Jan 44; CM-OUT-12222 (31-1-44), Arnold to Spaatz, #F-4, 31 Jan 44; USSTAF, Semi-Monthly Record of Results, 1-15 Jan 44; Eighth Air Force, Air Operations Report, Mission 176, 5 Jan 44.
9. No enemy aircraft were encountered in the Reggio Emilia attack and there were no losses. Escort was provided by 32 P-38's on penetration and by 32 P-47's on withdrawal. Opposition at Klagenfurt was light and there were no bomber losses, but four P-38's were missing. Bomber claims were 1-1-0, and fighters claimed 2-2-0. It was estimated that this raid cost the enemy three weeks' output. History of MAAF, 10 Dec 43-1 Sep 44, VIII, MAAF, Central Mediterranean Operational Summary, No. 16, 8 Jan 44, No. 24, 16 Jan 44; ibid., VI, AAF, Air Intelligence Weekly Summary, No. 62, 24 Jan 44; RAF Mediterranean Review, No. 6 (Jan-Mar 44), 18; USSTAF, Semi-Monthly Record of Results, 16-29 Feb 44.
10. AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); USSTAF, Semi-Monthly Record of Results, 1-31 Jan 44; RAF Mediterranean Review, No. 6 (Jan-Mar 44), 18. In January, Portal, Harris, Evill, Bottomley and Leigh-Mallory of the RAF, and Spaatz and Anderson of USSTAF agreed that the RAF should have first priority in attacks on towns associated with German fighter production and the ball-bearing industry. CM-IN-13056 (20-1-44), Spaatz to Arnold, #K-3189, 20 Jan 44.
11. History of MAAF, 10 Dec 43-1 Sep 44, II, ltr, Maj. Gen. F. L. Anderson to Lt. Gen. Ira C. Eaker, 1 Feb 44.
12. Eighth Air Force, Air Operations Report, Mission 210, 5 Feb 44; Eighth Air Force, Interpretation Report No. SA-900, 2 Feb 44, and No. K-1867, 9 Feb 44.
13. History of MAAF, 10 Dec 43-1 Sep 44, VIII, MAAF, Central Mediterranean Operational Summary, No. 53, 14 Feb 44.
14. USSTAF, Semi-Monthly Record of Results, 16-29 Feb 44.
15. Narrative History of Headquarters, Eighth Air Force, Feb 44; ibid., Annex C, Eighth Air Force, Narrative of Operations, 235th Operation, 25 Feb 44; USSTAF, Semi-Monthly Record of Results, 16-29 Feb 44; U.S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45, passim; AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe," (Cont'd.)

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15. (Cont'd.) January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 68, 6 Mar 44; ibid., XII, Opsum, Baker to Spaatz, Portal, Arnold (Ref. No. AI-311), 24 Feb 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 61-62, 22-25 Feb 44; MAAF, Preliminary Study of Coordinated Attacks by USSTAF, Sup. D; CM-IN-15147 (22-2-44), Spaatz to Arnold, Eisenhower, Baker, #K-3216, 21 Feb 44.
16. Narrative History of Headquarters, Eighth Air Force, Feb 44.
17. The above figures are compromises between conflicting statistics of various official reports, and should be considered as general rather than absolute. Differences are due, no doubt, to varying interpretations and standards. The picture as a whole, however, is essentially correct. USSTAF, Semi-Monthly Record of Results, 16-29 Feb 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, Feb 44; History of MAAF, 10 Dec 43-1 Sep 44, XI, SCORU, Monthly Statistical Summary of MAAF, No. 4, Feb 44; AG/AS Intel., Analysis Div., European Dr., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files).
18. Narrative History of Headquarters, Eighth Air Force, Feb 44; ibid., Mar 44, Annex D, Eighth Air Force Statistical Control, Monthly Summary of Operations, Jan-Mar 44; History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 68, 6 Mar 44; ibid., XI, SCORU, Monthly Statistical Summary of MAAF, No. 4, Feb 44.
19. The estimates of the cut in productive capacity must be taken with caution. In the enthusiasm engendered by the success of the CBO there was a tendency to overestimate the degree of destruction and underestimate the German ability to recuperate from attacks. Allied intelligence estimated an average monthly production of 655 single-engine fighters for the first half of 1944. The actual average was 1,581. For total airplane production the estimate was 1,870 per month, but actually it was 2,811. U. S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45, pp. 74-75; U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 18; USSTAF, Semi-Monthly Record of Results, Jan-May 44; Narrative History of Headquarters, Eighth Air Force, Mar 44, Annex A, "Minutes of Commanders' Meeting," 22 Mar 44. For acceptances of single-engine fighters for 1944, see Table 16.
20. Eighth Air Force, Tactical Development, August 1942-May 1945, 98. The hours of training a fighter pilot received before joining an operational unit were as follows:

Phase	1942	1943	1944
Elementary flying training	100	70	52
Fighter school	60	60	40
Operational training pool	50	16-18	20
 Total hours	 210	 136-138	 112

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21. Narrative History of Headquarters, Eighth Air Force, Mar 44; Eighth Air Force, Air Operations Report, Mission 259, 15 Mar 44, Mission 275, 23 Mar 44, Mission 284, 29 Mar 44.
22. Narrative History of Headquarters, Eighth Air Force, Mar 44; Eighth Air Force, Air Operations Report, Mission 262, 16 Mar 44, Mission 264, 18 Mar 44; Eighth Air Force, Interpretation Report SA-1188, 17 Mar 44, SA-1196, 18 Mar 44, DS-70, 31 Mar 44.
23. Narrative History of Headquarters, Eighth Air Force, Mar 44; Eighth Air Force, Air Operations Report, Mission 282, 27 Mar 44; USSTAF, Semi-Monthly Record of Results, 16-31 Mar 44.
24. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 71, 27 Mar 44; ibid., XII, Opsun, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-318), 18 Mar 44, (Ref. No. AI-338), 20 Mar 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 85, 17 Mar 44, No. 87, 19 Mar 44, No. 91, 23 Mar 44, No. 94, 26 Mar 44.
25. USSTAF, Semi-Monthly Record of Results, 1-30 Apr 44; Eighth Air Force, Target Priorities of the Eighth Air Force, 15 May 45, in A-2 Lib.; Narrative History of Headquarters, Eighth Air Force, Apr 44; ibid., May 44, Annex F, ltr., Lt. Gen. Carl Spaatz to CG's, 8th, 9th, 15th Air Forces, 20 Apr 44; USSTAF, Air Intelligence Summary, No. 27, week ending 14 May 44, in A-2 Lib.; CM-IN-16666 (22-5-44), Chiefs of Staff to JSP, "COS (A) 67, 18 May 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, Apr 44; AC/AS Intel., Analysis Div., European E., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); MAAF, Central Mediterranean Operational Summary, No. 100, 1 Apr 44, No. 129, 30 Apr 44; U. S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45.
26. Narrative History of Headquarters, Eighth Air Force, Apr 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, Apr 44.
27. Narrative History of Headquarters, Eighth Air Force, Apr 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, Apr 44.
28. Narrative History of Headquarters, Eighth Air Force, Apr 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, Apr 44; Eighth Air Force, Interpretation Report No. DB-47, 14 Apr 44; Eighth Air Force, Air Operations Report, Mission 301, 13 Apr 44.
29. Narrative History of Headquarters, Eighth Air Force, Apr 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, Apr 44; Eighth Air Force, Air Operations Report, Mission 315, 24 April 44; USSTAF, Semi-Monthly Record of Results, 1-15 Jun 44.
30. Ibid., 1-30 Apr 44.

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31. History of MAAF, 10 Dec 43-1 Sep 44, XIII, MAAF, Central Mediterranean Operational Summary, No. 101, 2 Apr 44, No. 102, 3 Apr 44, No. 112, 13 Apr 44; ibid., Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-357), 4, 14 Apr 44; ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 73, 10 Apr 44, No. 74, 17 Apr 44; Fifteenth Air Force, Tactical Mission Report, 13 Apr 44.
32. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 74, 17 Apr 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-346), 13 Apr 44; ibid., XIII, MAAF Central Mediterranean Operational Summary, No. 111, 12 Apr 44; USSTAF, Semi-Monthly Record of Results, 1-30 Apr 44.
33. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 75, 24 Apr 44, No. 76, 1 May 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-386), 17 Apr 44, (Ref. No. AI-400), 18 Apr 44, (Ref. No. AI-371), 25 Apr 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 115, 16 Apr 44, No. 116, 17 Apr 44, No. 123, 24 Apr 44; USSTAF, Semi-Monthly Record of Results, 1-30 Apr 44.
34. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 76, 1 May 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-363), 24 Apr 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 122, 23 Apr 44; Fifteenth Air Force, Tactical Mission Report, 23 Apr 44; USSTAF, Semi-Monthly Record of Results, 1-30 Apr 44.
35. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 76, 1 May 44, No. 77, 8 May 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-380), 26 Apr 44, (Ref. No. AI-325), 1 May 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 124, 25 Apr 44, No. 129, 30 Apr 44; USSTAF, Semi-Monthly Record of Results, 1-30 Apr 44.
36. History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-377), 7 May 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 135, 6 May 44.
37. Eighth Air Force, Air Operations Report, Mission 353, 12 May 44, 355, 13 May 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44; USSTAF, Semi-Monthly Record of Results, 16-31 May 44; History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 78, 15 May 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-308), 11 May 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 139, 10 May 44, No. 141, 12 May 44.
38. USSTAF, Semi-Monthly Record of Results, 16-31 May 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44.

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39. History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-376), 25 May 44; *ibid.*, XIII, MAAF, Central Mediterranean Operational Summary, No. 153, 24 May 44, No. 154, 25 May 44; USSTAF, Semi-Monthly Record of Results, 16-31 May 44.
40. *Ibid.*; Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44.
41. Total tonnage for all targets in May was 64,495 tons--36,344 tons by the Eighth and 28,151 tons by the Fifteenth. USSTAF, Semi-Monthly Record of Results, 16-31 May 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44; History of MAAF, 10 Dec 43-1 Sep 44, VI, SOCRU, Monthly Statistical Summary of MAAF, No. 7, May 44.
42. Narrative History of Headquarters, Eighth Air Force, May 44; USSTAF, Semi-Monthly Record of Results, 16-31 May 44; History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-338), 30 May 44; *ibid.*, XIII; MAAF, Central Mediterranean Operational Summary, No. 158, 29 May 44; Fifteenth Air Force, Tactical Mission Report, 29 May 44.
43. USSTAF, Semi-Monthly Record of Results, 16-31 May 44; History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-346), 31 May 44; *ibid.*, XIII, MAAF, Central Mediterranean Operational Summary, No. 159, 30 May 44; Fifteenth Air Force, Tactical Mission Report, 30 May 44.
44. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 81, 5 Jun 44.
45. USSTAF, Semi-Monthly Record of Results, 1-15 Jun 44. For attacks on airframes from 1 Jan to 6 Jun 44, see App. 3, this study.
46. AG/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 43, in 353.41--Bombing, Bulk (Classified Files); U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 22-25.
47. USSTAF, Semi-Monthly Record of Results, 1 Jan-31 May 44; U. S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45, p. 59; Eighth Air Force, Air Operations Report, Mission 228, 21 Feb 44; Eighth Air Force, Interpretation Report No. SA-1024, 23 Feb 44; CM-IN-12528 (13-2-44), Spaatz to Arnold, #K-3741, 17 Feb 44; History of MAAF, 10 Dec 43-1 Sep 44, XIII, MAAF, Central Mediterranean Operational Summary, No. 62, 23 Feb 44, No. 63, 24 Feb 44. For list of attacks on aero-engines, see App. 4, this study.
48. Narrative History of Headquarters, Eighth Air Force, Jan-Jun 44; USSTAF, Semi-Monthly Record of Results, Jan-Jun 44; History of MAAF, 10 Dec 43-1 Sep 44, VI; MAAF, Air Intelligence Weekly Summary, Jan-Jun 44; *ibid.*, XII, Opsuns, Eaker to Arnold, Spaatz, Portal, Jan-Jun 44; *ibid.*, XIII, MAAF, Central Mediterranean Operational Summary, Jan-Jun 44; Fifteenth Air Force, Tactical Mission Reports, Jan-May 44; Fifteenth Air Force, Bombing of Airfields in France. For a partial list of MAAF missions in support of ground operations, see App. 2, this study.

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49. USSTAF, Semi-Monthly Record of Results, Jan-Jun 44; USSTAF, Air Intelligence Summary, Jan-Jun 44; AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files). It must be remembered that other air forces such as the Ninth and Twelfth were also busy attacking airfields.
50. USSTAF, Semi-Monthly Record of Results, 1-15 Jan 44; ltr, Maj. Gen. W. L. Kepner to Maj. Gen. B. M. Giles, 1 Apr 44, in 312.1--Operations Letters (Classified Files).
51. Ibid., History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 64, 7 Feb 44.
52. AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 18; U. S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45, p. 6; U. S. Strategic Bombing Survey, Interview No. 56, 29 Jun 45, Reichsmarshal Hermann Goering, KO-18990.
53. Captured Personnel and Material Br., MID, WD, Report, "Information on GAF policies and experience . . . obtained from a Field Marshal of the GAF Wilch," 3 Jun 45, KO-18936; MAAF, POW Intel. Sec., Interview of Maj. Neubert, Operations Officers of the GAF General Staff in Italy, 28 Jun 45, KO-18418; MAAF, POW Intel. Sec., Interview of Maj. Bertelsmann, Army Staff Officer on the Staff of the Supreme German Commander in the Southwest, Col. Gen. Von Vietinghoff, 28 Jun 45, KO-18418.
54. Hq, Air POW Interrogation Det., MIS, 9th AF, Some Interesting Notes on the GAF Conversion Programs as Related by Maj. Jacob, IA-I Operations Head in the GAF Headquarters Staff, 11 Jun 45, KO-16728; History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 68, 6 Mar 44.
55. Captured Personnel and Material Branch, MID, WD, Report, "Information on GAF Policies and Experience . . . obtained from a Field Marshal of the GAF Wilch," 3 Jun 45, KO-18936; U. S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45, pp. 37-38, 47; U. S. Strategic Bombing Survey, Interview No. 44, 9 Jul 45, Dr. Karl Frydag, Chief of Airframe Industry, KO-19001.
56. U. S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45, pp. 71-72.
57. Ibid., 7-8; U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 17-18, 22-25; U. S. Strategic Bombing Survey, Interview No. 56, 29 Jun 45, Reichsmarshal Hermann Goering, KO-18990; Hq, Air POW Interrogation Det., MIS, 9th AF, Hermann Goering, 1 Jun 45, KO-13951.

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58. Ibid.; U. S. Strategic Bombing Survey, Interview No. 56, 29 Jun 45, Hermann Goering, KO-18990.
59. History of MAAF, 10 Dec 43-1 Sep 44, V, Notes on MAAF Counter-Air Program, Pt. II; USSTAF, Office of Director of Intel., "Impact of American Air Power on the German War Machine"; MAAF, Air Power in the Mediterranean, November 1942-February 1945, Feb 45, 71, Statement of Anti-Aircraft Officer taken prisoner by a Fifth Army patrol, 4 Dec 44. For changes in disposition of German fighter strength, Jan-May 44, see App. 5, this study.
60. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 22; USSTAF, Air Intelligence Summary, No. 31, week ending 11 Jun 44, in A-2 Lib.
61. MAAF, Air Power in the Mediterranean, November 1942-February 1945, pp. 30-31; History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 73, 10 Apr 44; CM-IN-5768 (8-5-44), Spaatz to Arnold, #U-61850, 8 May 44.

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NOTES

Chapter VII

1. For wartime use of antifriction bearings, see Table 17.
2. The 1943 attacks were as follows: 14 April, VKF, Stuttgart (RAF night raid); 17 August, VKF and Kugelfischer, Schweinfurt; 15 September, GMI, Paris/Blois Colombes; 14 October, VKF and Kugelfischer, Schweinfurt; 8 November, RIV, Turin; 10 November, RIV, Villar-Perosa; 11 November, SRO, Annecy; 1 December, RIV, Turin; 31 December, CAM, Paris/Blois Colombes and Paris/Ivry-sur Seine. History of MAAF, 10 Dec 43-1 Sep 44, V, MAAF, Air Attacks on the Axis Ball Bearing Industry. For a full account of the 1943 attacks, see AAF Reference History: No. 19.
3. GM-IN-2273 (4-3-44), USSAF to WAR, #K-2014, 3 Mar 44; ltr, Gen. H. H. Arnold to Lt. Gen. Carl Spaatz, 23 Jan 44, in AC/AS Plans, WP-III-D-3-Germany (AC/AS Plans); USSTAF, Semi-Monthly Record of Results, 16-29 Feb 44. For pre-attack sources of supply see App. 6, this study.
4. History of MAAF, 10 Dec 43-1 Sep 44, XIII, MAAF, Central Mediterranean Operational Summary, No. 12, 3 Jan 44; Fifteenth Air Force, "Villar-Perosa Ball Bearing Factory and Turin-Lingotto Marshalling Yards Operations of 3 January 1944"; RAF Mediterranean Review, No. 6 (Jan-Mar 44), 10; U. S. Strategic Bombing Survey, The German Anti-Friction Bearings Industry, Nov 45, Exhibit B; Narrative History of Headquarters, Eighth Air Force, Jan 44.
5. The raids on Ellersfeld were: 2/3 Feb, 4 Mosquitoes, 4 tons of bombs; 4/5 Feb, 1 Mosquito, 1 ton; 7/8 Feb, 4 Mosquitoes, 4 tons; 8/9 Feb, 3 Mosquitoes, 3 tons; 9/10 Feb, 3 Mosquitoes, 4.8 tons; 11/12 Feb, 2 Mosquitoes, 2 tons; 12/13 Feb, 1 Mosquito, 1 ton. U. S. Strategic Bombing Survey, The German Anti-Friction Bearings Industry, Nov. 45, Exhibit B.
6. Ibid.; USSTAF, Semi-Monthly Record of Results, 16-29 Feb 44; History of MAAF, 10 Dec 43-1 Sep 44, XIII, MAAF Central Mediterranean Operational Summary, No. 62, 23 Feb 44.
7. USSTAF, Semi-Monthly Record of Results, 16-29 Feb 44; U. S. Strategic Bombing Survey, The German Anti-Friction Bearings Industry, Nov 45, p. 30 and Exhibit B.
8. Narrative History of Headquarters, Eighth Air Force, Mar 44; ibid., Annex C, Eighth Air Force, Narrative of Operations, 252d Operation, 8 Mar 44; USS AF, Semi-Monthly Record of Results, 16-29 Feb 44; U. S. Strategic Bombing Survey, The German Anti-Friction Bearings Industry, Nov 45, Exhibit B; History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 72, 3 Apr 44; War Room Monthly Summary of Operations, RAF Command [RAF], 1944.

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9. USSTAF, Semi-Monthly Record of Results, 1-15 Apr 44; U. S. Strategic Bombing Survey, The German Anti-Friction Bearings Industry, Nov 45, Exhibit B; History of MAAF, 10 Dec 43-1 Sep 44, V, ltr, Maj. W. F. R. Ballard, Chief of Target Intel., MAAF to AC/AS Intel., 15th Air Force, 8 Apr 44; ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 73, 10 Apr 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-348), 3 Apr 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 101, 2 Apr 44; Fifteenth Air Force, Tactical Mission Report, 2 Apr 44.
10. U. S. Strategic Bombing Survey, The German Anti-Friction Bearings Industry, Nov 45, p. 2 and Exhibit B; USSTAF, Semi-Monthly Record of Results, 1-15 Apr 44, 16-31 May 44; Narrative History of Headquarters, Eighth Air Force, Apr 44; Eighth Air Force, Air Operations Report, Mission 301, 13 Apr 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, Apr 44. For list of attacks on the ball-bearing industry, see App. 7, this study.
11. U. S. Strategic Bombing Survey, The German Anti-Friction Bearings Industry, Nov 45, Exhibit B.
12. AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files). This decrease in supply, however, was not entirely due to bomb damage and lack of imports. Some of it was the natural consequence of the dispersal of plants, which necessarily immobilized machinery for a time. U. S. Strategic Bombing Survey, The German Anti-Friction Bearings Industry, Nov 45, p. 2.
13. Ibid., 1; AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files). For supply and requirements for the first six months of 1944, see Table 18.
14. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 29; Hq, Air POW Interrogation Det., MIS, 9th AF, Hermann Goering, 1 Jun 45, KO-13951; U. S. Strategic Bombing Survey, Interview No. 3, Dr. Kaether, Focke-Wulf Company, 24 Apr 45, KO-23696; Captured Personnel and Materiel Br., MID, WD, Reports, "Information on Effectiveness of Allied Air Raids . . . Obtained from a German Field Marshal Captured 4 May," 23 May 45, KO-15385, "Information on GAF Policies and Experience . . . Obtained from a Field Marshal of the GAF," 3 Jun 45, KO-18936, "Information Obtained from the Former German Minister of Armaments and War Production, Albert Speer . . .," 11 Jul 45, KO-21120; AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files).
15. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 80, 29 May 44. The Nazis were very much worried over the effect on morale of the inability of the GAF to stop the Allied bombing and used numerous techniques to restore popular faith in the efficiency

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15. (Cont'd.) of the Luftwaffe. On 13 March the Berliner Boersen-Zeitung stated: "If the inhabitants of the capital were surprised that, despite the heavy defenses and heavy losses, isolated enemy formations reached the capital in formation, it must be remembered that this need not be interpreted as a sign of strength at all." The Volkischer Beobachter said: "If occasionally they fly in a clear sky without at the moment being pursued by the dreaded German fighters, only the layman is fooled by this and then only for a few minutes In their case the closed drill formation is not a sign of strength." (USSTAF, Semi-Monthly Record of Results, 16-31 Mar 44). Since the propagandists argued that the perfection of formation was a sign of weakness, it is also entirely probable that the claims of salvage might be more propaganda to impress the Germans with the strength of GAF defenses. It would intimate that enough Allied planes were brought down from which bearings could be taken to more than offset loss in production.
16. History of MAAF, 10 Dec 43-1 Sep 44, V, MAAF, Air Attacks on Axis Ball Bearing Industry; MAAF, POW Intel. Sec., Interview with Dr. Hjalmar Schacht, 29 May 45, KO-13330; memo, Brig. Gen. H. A. Craig to C/S, Ball Bearings Supplied to Germany by Sweden, 1 Dec 43, in 000.800--Germany (Classified Files); CM-IN-2273 (4-3-44), USSAFE to WAR, #K-4014, 3 Mar 44; CM-OUT-6883 (16-3-44), Col. Gaylord, AFAEP to CG USSTAF, #F-850, 16 Mar 44.
17. Captured Personnel and Material Br., MID, WD, Report, "Information Obtained from the Former German Minister of Armaments and War Production, Albert Speer . . .," 11 Jul 45, KO-21120.

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 NOTES

Chapter VIII

1. For a discussion of the selection of transportation as first priority see Chaps. II and IV, this study.
2. Gen. O. N. Bradley and Air Effects Committee of the 12th Army Group, Effect of Air Power on Military Operations in Western Europe, Wiesbaden, Germany, 1945, p. 13.
3. History of MAAF, 10 Dec 43-1 Sep 44, V, MAAF, Special Intelligence Report, No. 64, "Interdiction of Rail Traffic Supplying Enemy Forces in Central Italy," 24 Dec 43.
4. Ibid., XI, SCORU, Monthly Statistical Summary of MAAF, No. 3, Jan 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 10, 1 Jan 44, No. 39, 31 Jan 44; ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 62, 24 Jan 44, No. 64, 7 Feb 44. The total tonnage figures include about 800 tons of bombs dropped on Balkan targets.
5. USSTAF, Semi-Monthly Record of Results, 1-29 Feb 44; History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 65, 14 Feb 44, No. 66, 21 Feb 44, No. 68, 6 Mar 44; ibid., VIII, MAAF, Operations Instructions No. 8, 18 Feb 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-331), 4 Feb 44, (Ref. No. AI-380), 9 Feb 44, (Ref. No. AI-389), 10 Feb 44, (Ref. No. AI-323), 15 Feb 44, (Ref. No. AI-333), 16 Feb 44, (Ref. No. AI-346), 17 Feb 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 40, 1 Feb 44-No. 68, 29 Feb 44; ibid., XI, SCORU, Monthly Statistical Summary of MAAF, No. 4, Feb 44.
6. Ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 85, 3 Jul 44; ibid., XI, SCORU, Monthly Statistical Summary of MAAF, No. 5, Mar 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-311), 4 Mar 44 (Ref. No. AI-379), 12 Mar 44, (Ref. No. AI-387), 13 Mar 44, (Ref. No. AI-355), 23 Mar 44, (Ref. No. AI-363), 24 Mar 44, (Ref. No. AI-305), 29 Mar 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 69, 1 Mar 44-No. 99, 31 Mar 44; Fifteenth Air Force, Historical Summary--First Year of Operations, 1 Nov 44. For direct support given to the land forces in transportation matters, see special AFSSO study by Maj. Harris G. Warren, "The Mediterranean Allied Air Forces in Operation SHINGLE, 1 January-18 March 1944."
7. History of MAAF, 10 Dec 43-1 Sep 44, VI, ^{MAAF} Air Intelligence Weekly Summary, No. 73, 10 Apr 44, No. 74, 17 Apr 44, No. 75, 24 Apr 44, No. 77, 8 May 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-357), 4 Apr 44, (Ref. No. AI-392), 8 Apr 44, (Ref. No. AI-338), 21 Apr 44, (Ref. No. AI-380), 26 Apr 44, (Ref. No. AI-325), 1 May 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 100, 1 Apr 44-No. 129, 30 Apr 44; CM-IN-3381 (5-4-44), Eaker to Arnold, #EN-9124, 4 Apr 44.

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8. Ltr, Col. W. F. McKee, Deputy, AC/AS, OC&R to Exec. Dir., AAF Board, 5 Feb 44, in 471.6--Bombs (Classified Files); memo, Brig. Gen. H. M. McClelland to Brig. Gen. H. A. Craig, Change in Assignment--Project 92542R, 17 Feb 44; in ibid. memo, Brig. Gen. M. E. Gross to Brig. Gen. H. A. Craig, Azon Project, undated, in ibid.; memo, Brig. Gen. B. W. Chidlaw to Maj. Gen. O. P. Echols, Guided Missiles Program, 1 Mar 44, in 380--Programs and Projects (Classified Files); CM-OUT-12386 (29-2-44), Arnold to CG 15th Air Force, #653, 29 Feb 44; CM-OUT-6826 (16-3-44), Arnold to Devers for Eaker, #873, 15 Mar 44.
9. History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-371), 25 Apr 44; ibid., Opsum, Eaker to AGWAR, Spaatz, Portal (Ref. No. AI-316), 30 Apr 44; memo, Col. J. F. Phillips, Actg. Chief Materiel Div., AC/AS MM&D to Maj. Gen. O. P. Echols, Guided Missiles Program, 28 Apr 44, in 380--Programs and Projects (Classified Files); CM-OUT-19518 (6-4-44), Arnold to Devers for Eaker, #WARX-19518, 6 Apr 44; CM-IN-16625 (23-4-44), Twining to Arnold for McClelland and Wright, #KC-1232, 19 Apr 44; CM-IN-1312 (2-5-44), Twining to Arnold, #KC-142, 2 May 44.
10. CM-IN-10730 (14-5-44), Eaker to Arnold, #WR-534, 14 May 44; CM-IN-11265 (15-5-44), Twining to Eaker and Spaatz, #BP-1611, 15 May 44.
11. CM-IN-576 (1-4-44), Spaatz to Arnold, #U-60383, 1 Apr 44; CM-OUT-18352 (4-4-44), McClelland, signed Arnold, to Spaatz, #WAR-18352, 4 Apr 44; CM-IN-5993 (8-5-44), Spaatz to Arnold, #U-61874, 8 May 44; CM-OUT-34693 (10-5-44) Arnold to Eisenhower for Spaatz, #WARX-34693, 10 May 44; Narrative History of Headquarters, Eighth Air Force, May 44; ibid., ltr, Col. Richard E. Sims, Ord. Officer, Eighth Air Force to Ord. Officer, USSTAF, 9 Jun 44.
12. Memo, Col. James H. Wallace, Chief Bombardment Br., to AC/AS, OC&R, Glide Bomb Operations Against Cologne . . . , 31 May 44, in 000.800--Germany (Classified Files); Narrative History of Headquarters, Eighth Air Force, May 44; ibid., ltr, Col. Richard E. Sims, Ord. Officer, Eighth Air Force, to Ord. Officer, USSTAF, 9 Jun 44.
13. The Fifteenth dropped 3,033 tons on harbors and docks and 263 tons on highways. The 205 Group, RAF dropped 693 tons on the former and 609 tons on the latter. History of MAAF, 10 Dec 43-1 Sep 44, XI, SCORU, Monthly Statistical Summary of MAAF, No. 7, May 44; Fifteenth Air Force, Historical Summary--First Year of Operations, 1 Nov 44.
14. History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-337), 3 May 44, (Ref. No. AI-349), 4 May 44, (Ref. No. AI-358), 14 May 44, (Ref. No. AI-366), 15 May 44, (Ref. No. AI-375), 16 May 44, (Ref. No. AI-399), 18 May 44, (Ref. No. AI-326), 20 May 44, (Ref. No. AI-351), 23 May 44, (Ref. No. AI-385), 26 May 44, (Ref. No. AI-327), 29 May 44, (Ref. No. AI-338), 30 May 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 130, 1 May 44-No. 160, 31 May 44.
15. Ibid., VIII, Redline, Spaatz to Eaker (IE-619-CS), undated.

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16. Ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 81, 5 Jun 44; ibid., XII, Consum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-385), 26 May 44, (Ref. No. AI-399), 27 May 44, (Ref. No. AI-317), 28 May 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 154, 25 May 44-No. 156, 27 May 44; Fifteenth Air Force, Tactical Mission Report, 25, 26, 27 May 44; USSTAF, Semi-Monthly Record of Results, 16-31 May 44.
17. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 82, 12 Jun 44; ibid., VII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-390), 5 Jun 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 164, 4 Jun 44, No. 165, 5 Jun 44; USSTAF, Semi-Monthly Record of Results, 1-15 Jun 44.
18. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 61; USSTAF, Semi-Monthly Record of Results, 1 Jan 44-31 Mar 44; Narrative History of Headquarters, Eighth Air Force, Jan-Mar 44; ibid., Mar 44, Annex C, Eighth Air Force, Narrative of Operations, 275th Operation, 23 Mar 44; ibid., Mar 44, Annex F, ETOUSA, Immediate Release No. 8525.
19. USSTAF, Semi-Monthly Record of Results, 1 Feb 44-15 Mar 44; Narrative History of Headquarters, Eighth Air Force, Mar 44; U. S. Strategic Bombing Survey, Transportation Division Report No. 2, Oct 45, pp. 29-31.
20. USSTAF, Semi-Monthly Record of Results, 1-31 Mar 44; Eighth Air Force, Air Operations Report, Mission 255, 11 Mar 44.
21. RAF Bomber Command Quarterly Review, No. 9 (Apr-Jun 44); USSTAF, Semi-Monthly Record of Results, 1-31 Mar 44.
22. USSTAF, Air Intelligence Summary, No. 25, week ending 30 Apr 44, in A-2 Lib.
23. USSTAF, Semi-Monthly Record of Results, 1-15 Apr 44.
24. Narrative History of Headquarters, Eighth Air Force, Apr 44; USSTAF, Semi-Monthly Record of Results, 16-30 Apr 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, Apr 44; USSTAF, Air Intelligence Summary, No. 27, week ending 14 May 44, in A-2 Lib.; Eighth Air Force, Air Operations Report, Mission 311, 22 Apr 44.
25. USSTAF, Semi-Monthly Record of Results, 1-30 Apr 44.
26. Ibid. For list of MAF marshalling-yard targets in April, see Table 19.

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27. In the over-all air plan for Operation NEPTUNE (amphibious part of OVERLORD), issued 15 April, a series of "strategic rail centers, and in particular those which include servicing and repair facilities essential to the enemy for maintenance of rail communications in Northern France, the Low Countries and Western Germany" were selected for immediate attack. The chosen targets lay along a belt extending from the mouth of the Loire River at Nantes through Orleans and the Paris region, thence northward into Belgium and eastward into Alsace-Lorraine, Luxembourg, and Germany. AAF Evaluation Board in ETO, Effectiveness of Air Attack against Rail Transportation in the Battle of France, Jun 45, pp. 7, 9.
28. The targets were: Metz, 124.5 tons; Feims, 171 tons; Saarewemines, 189 tons; Troyes, 156 tons; Brussels, 210; and Liège, 157 tons. Eighth Air Force, Target Priorities of the Eighth Air Force, 15 May 45, in A-2 Lib.; Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44; Narrative History of Headquarters, Eighth Air Force, May 44.
29. Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44; Narrative History of Headquarters, Eighth Air Force, May 44. The 11 May marshalling-yard targets were: France--Belfort (187.5 tons), Epinal (167.5 tons), Mulhouse (190.5 tons); Belgium--Brussels (251.3 tons), Liège (350.2 tons); Duchy of Luxembourg--Bettemburg (104.5 tons), Luxembourg (157.5 tons); Germany--Ehrang (160.9 tons), Konz-Karthaus (216 tons), Saarbrücken (153.2 tons).
30. USSTAF, Semi-Monthly Record of Results, 16-31 May 44; Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44; Narrative History of Headquarters, Eighth Air Force, May 44. For list of Eighth Air Force attacks on marshalling yards for the last half of May, see Table 20.
31. USSTAF, Semi-Monthly Record of Results, 16-31 May 44.
32. Ibid., 1-15 Jun 44.
33. AAF Evaluation Board in ETO, Effectiveness of Air Attack against Rail Transportation in the Battle of France, Jun 45, pp. 9-14, 66-67.
34. Gen. O. K. Bradley and Air Effects Committee of the 12th Army Group, Effect of Air Power on Military Operations in Western Europe, Wiesbaden, Germany, 1945, pp. 13-14; Hq, MAAF, POW Intel. Sec., "Factors in Germany's Defeat," 14 Jun 45; RAF Bomber Command Quarterly Review, No. 9 (Apr-Jun 44). See also statement of POW Oberst Hans Poeffner, one time commanding officer of the Office of the General des Transportwesens West, in AAF Evaluation Board in ETO, Effectiveness of Air Attack against Rail Transportation in the Battle of France, Jun 45, pp. 145-51.
35. USSTAF, Semi-Monthly Record of Results, 16-31 Jan 44; RAF Mediterranean Review, No. 6 (Jan-Mar 44), 18-19.

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36. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 63, 31 Jan 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 13, 4 Jan 44, No. 18, 10 Jan 44, No. 32, 24 Jan 44.
37. USSTAF, Semi-Monthly Record of Results, 1-29 Feb 44; History of MAAF, 10 Dec 43-1 Sep 44, XIII, MAAF, Central Mediterranean Operational Summary, No. 40, 1 Feb 44-No. 63, 29 Feb 44.
38. Ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-302), 16 Mar 44, (Ref. No. AI-318), 18 Mar 44, (Ref. No. AI-330), 20 Mar 44, (Ref. No. AI-383), 26 Mar 44, (Ref. No. AI-322), 31 Mar 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 84, 16 Mar 44, No. 85, 17 Mar 44, No. 87, 19 Mar 44, No. 93, 25 Mar 44, No. 98, 30 Mar 44; USSTAF, Semi-Monthly Record of Results, 1-31 Mar 44.
39. CM-IN-10435 (15-3-44), Chief A/S to Wilson and Spaatz, #COSMED-55, 9 Mar 44; CM-IN-15302 (22-3-44), Chief A/S to Wilson and Spaatz, #COSMED-67, 21 Mar 44; CM-IN-20466 (29-3-44), Chief A/S to Wilson and Spaatz, #COSMED-72, 28 Mar 44. For an example of German difficulty with Rumanian railroads, see App. 8, this study.
40. The rapid Russian advance in Rumania and the developing situation in the Crimea led the JCS to fear the possibility of some unfortunate contacts between USSTAF and the Red Air Force. The JCS, therefore, directed Maj. Gen. John R. Deane, Chief of the U.S. Military Mission in Russia, to inquire whether or not Russia would care to indicate where and when it did not desire USSTAF activity. Thereupon began a long series of conferences over the establishment of a bomb line and the advisability of sending an American air liaison officer to the southern group of Russian armies. A temporary bomb line was agreed upon on 21 April, and the Soviets consented to a continuation of Anglo-American bombing of Bucharest, Floesti, and Sofis, but requested that Constanta be reserved for the Red Air Force. The Russians were definitely opposed to a liaison officer with the armies in the field, however, and suggested instead that air liaison be coordinated in Moscow. Such an agreement was reached in the latter part of April, and in June the temporary bomb line was abolished, leaving all decisions to be worked out by the American Military Mission and Moscow. The coordination plan was only partially successful, however, since the Soviet High Command was extremely reluctant to make a definite commitment on target priorities. It gave as its reason that such a designation would give away the nature of the next offensive, but Deane felt there was also another reason. This was that the Russians did not want to have to acknowledge that British and American bombing contributed in any way to their successes. CM-OUT-21660 (11-4-44), JCS to Deane, #MIR-21660-M-81, 11 Apr 44; CM-IN-15508 (21-4-44), Deane and Burrows to Wilson, #OZ-2082, 21 Apr 44; CM-IN-17462 (24-4-44), Deane to JCS, #463, 23 Apr 44; CM-IN-2900 (4-5-44), Deane and Burrows to War Cabinet Officers, #OZ-2363, MIL-1205, 4 May 44; CM-IN-4469 (6-5-44), Chiefs of Staff to JSM, #COS-(W)-36, 5 May 44; CM-IN-15041 (20-5-44), Deane to Spaatz, unnumbered, 10 May 44; CM-IN-9051 (11-6-44), Deane to Eaker, #674, 11 Jun 44.

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41. GM-IN-3007 (5-1-44), Chief A/S to Wilson and Spaatz, #COSMED-79, 4 Apr 44; GM-IN-13133 (18-1-44), Chief A/S to Wilson and Spaatz, #COSMED-89, 18 Apr 44; GM-IN-18545 (25-1-44), Chief A/S to Wilson and Spaatz, #COSMED-93, 25 Apr 44.
42. History of MAAF, 10 Dec 43-1 Sep 44, V, LAAF, Intelligence Sec., "The Balkan Situation--Possibilities of Air Attack," 24 Apr 44. For the story of supplying the Partisans by air, see MAF Reference History: No. 21.
43. GM-GUT-26193 (21-1-44), Arnold to Spaatz for Portal and Wilson, #AEX-26193, 21 Apr 44; History of MAAF, 10 Dec 43-1 Sep 44, V, memo, T. J. Wilson, Jr., Deputy Director, Combined Economic Warfare Agencies, AFHQ, Liaison Officer with Intel. Sec., HQ, MAAF to Group Captain Guard, Economic Significance of Transport Interruption in the Balkans, 22 Apr 44.
44. Ibid., XII, Opsum, Baker to Arnold, Spaatz, Portal (Ref. No. AI-348), 3 Apr 44, (Ref. No. AI-357), 4 Apr 44, (Ref. No. AI-372), 5 Apr 44, (Ref. No. AI-376), 6 Apr 44, (Ref. No. AI-386), 17 Apr 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 101, 2 Apr 44, No. 102, 3 Apr 44, No. 103, 4 Apr 44, No. 104, 5 Apr 44, No. 115, 16 Apr 44; Fifteenth Air Force, Tactical Mission Report, 3, 4, 5 Apr 44.
45. History of MAAF, 10 Dec 43-1 Sep 44, II, Lt. Gen. Ira C. Baker, Report to Gen. H. H. Arnold, "Outline of Current Air Effort," 7 May 44; ibid., XII, Opsum, Baker to Arnold, Spaatz, Portal (Ref. No. AI-346), 13 Apr 44, (Ref. No. AI-357), 14 Apr 44, (Ref. No. AI-378), 16 Apr 44, (Ref. No. AI-400), 18 Apr 44, (Ref. No. AI-348), 22 Apr 44, (Ref. No. AI-371), 25 Apr 44, (Ref. No. AI-316), 30 Apr 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 107, 8 Apr 44, No. 111, 12 Apr 44, No. 112, 13 Apr 44, No. 114, 15 Apr 44, No. 116, 17 Apr 44, No. 117, 18 Apr 44, No. 119, 20 Apr 44, No. 120, 21 Apr 44, No. 123, 24 Apr 44, No. 128, 29 Apr 44; USSTAF, Semi-Monthly Record of Results, 16-30 Apr 44; USSTAF, Air Intelligence Summary, No. 27, week ending 14 May 44, in A-2 Lib.; GM-IN-16666 (22-5-44), Chiefs of Staff to JSM, #COS-()-67, 18 May 44.
46. GM-IN-23315 (30-5-44), Chief A/S to Wilson and Spaatz, #COSMED-117, 30 May 44.
47. History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Baker to Arnold, Spaatz, Portal (Ref. No. AI-358), 5 May 44, (Ref. No. AI-369), 6 May 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 133, 4 May 44, No. 134, 5 May 44; Fifteenth Air Force, Tactical Mission Report, 5 May 44.
48. History of MAAF, 10 Dec 43-1 Sep 44, VI, LAAF, Air Intelligence Weekly Summary, No. 78, 15 May 44; ibid., XII, Opsum, Baker to Arnold, Spaatz, Portal (Ref. No. AI-377), 7 May 44, (Ref. No. AI-385), 8 May 44, (Ref. No. AI-304), 9 May 44, (Ref. No. AI-308), 11 May 44, (Ref. No. AI-339), 12 May 44, ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 135, 6 May 44, No. 136, 7 May 44, No. 137, 8 May 44, No. 139, 10 May 44, No. 140, 11 May 44; Fifteenth Air Force, Tactical Mission Report, 7 May 44; GM-IN-16422 (22-5-44), Spaatz to Arnold, ()

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49. History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-376), 25 May 44, (Ref. No. AI-346), 31 May 44, (Ref. No. AI-357), 1 Jun 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 147, 18 May 44, No. 159, 30 May 44, No. 160, 31 May 44; USSTAF, Semi-Monthly Record of Results, 16-31 May 44.
50. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 82, 12 Jun 44; ibid., V, memo, T. W. Wilson, Jr., to Group Captain Luard, Balkan Communications, 1 Jun 44.
51. Ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 82, 12 Jun 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-315), 7 Jun 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 166, 6 Jun 44.
52. Ibid., V, MAAF, Special Intelligence Report No. 66, "Danube River Traffic," 13 Jan 44; USSTAF, Semi-Monthly Record of Results, 16-31 May 44; CM-IN-9750 (13-5-44), AFHQ to War Dept, #F-44950, 13 May 44; CM-IN-12243 (17-5-44), AFHQ to War Dept, #F-44950, 16 May 44.
53. History of MAAF, 10 Dec 43-1 Sep 44, VIII, MAAF, Operations Instructions No. 15, 25 Apr 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-314), 10 Apr 44, (Ref. No. AI-357), 14 Apr 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 108, 9 Apr 44, No. 112, 13 Apr 44; CM-IN-18545 (25-4-44), Chief A/S to Wilson and Spaatz, #COSMED-93, 25 Apr 44; CM-IN-6488 (9-5-44), Chief A/S to Wilson and Spaatz, #COSMED-105, 9 May 44.
54. History of MAAF, 10 Dec 43-1 Sep 44, VIII, MAAF, Operations Instructions No. 42, 20 May 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-377), 7 May 44, (Ref. No. AI-308), 11 May 44, (Ref. No. AI-346), 31 May 44, (Ref. No. AI-369), 2 Jun 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 135, 6 May 44, No. 139, 10 May 44, No. 159, 30 May 44, No. 161, 1 Jun 44.
55. Ibid., V, memo, T. W. Wilson, Jr., to Group Capt. Luard, Balkan Communications, 1 Jun 44.
56. IAF Bomber Command Quarterly Review, No. 9 (Apr-Jun 44); CM-IN-16666 (22-5-44), Chiefs of Staff to JSM, #GCS-(W)-67, 18 May 44.
57. AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); U. S. Strategic Bombing Survey, Summary Report (European War), September 30, 1945, 12-13; U. S. Strategic Bombing Survey, Transportation Division Report No. 2, Oct 45, pp. 2, 29-31; USSTAF, Air Intelligence Summary, No. 29, week ending 28 May 44, in A-2 Lib.; Eighth Air Force, Target Priorities of the Eighth Air Force, 15 May 45, in A-2 Lib.

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58. AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); U. S. Strategic Bombing Survey, Interview No. 55, Field Marshal Wilhelm Keitel, 27 Jun 45, KO-18991; Captured Personnel and Material Br., MID, WD, Report, "Information from a General der Flieger taken prisoner on the high seas 15 May 1945," obtained in the U. S., 25 Jun 44, KO-18490; Captured Personnel and Material Br., MID, WD, Report, "Information on GAF Policies and Experience . . . Obtained from a Field Marshal of the GAF Milch," 3 Jun 45, KO-18936.
59. Captured Personnel and Material Br., MID, WD, Report, "Information Obtained from the Former German Minister of Armaments and War Production, Albert Speer . . .," 11 Jul 45, KO-21120; Hq, Air POW Interrogation Det., MIS 9th AF, Hermann Goering, 1 Jun 45, KO-13951; C.S.D.I.C. (Air), C.M.F., Report No. 565 (FN-930), Further Comments of a German Industrialist, 29 May 45, KO-12032.
60. Captured Personnel and Material Br., MID, WD, Report, "Information on the Effectiveness of Allied air raids . . . Obtained from a German Field Marshal Captured 4 May," 23 May 45, KO-15385; U. S. Strategic Bombing Survey, Interview No. 59, Grand Admiral Karl Doenitz, 28 Jun 45, KO-18987.

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NOTES

Chapter IX

1. U. S. Strategic Bombing Survey, Summary Report (European War), September 30, 1945, 8; U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 36, 39, 40; U. S. Strategic Bombing Survey, Oil Division Final Report, 25 Aug 45, pp. 19-20. For German production of petroleum products, 1941-1944, see table 21.
2. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 39, 40. At the outbreak of the war aviation gasoline in reserve amounted to 492,000 tons and for Diesel and fuel oils it was 1,500,000 tons.
3. Gen. O. N. Bradley and Air Effects Committee of 12th Army Group, Effect of Air Power on Military Operations in Western Europe, Wiesbaden, Germany, 1945, pp. 9-10.
4. U. S. Strategic Bombing Survey, Oil, Chemicals and Rubber Div., Team 46, Plant Report No. 1, Ammoniakwerke, Merseburg, Leuna, Germany, 1945; U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 41; AG/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files).
5. MAAF, Air Power in the Mediterranean, November 1942-February 1945, Feb 45, p. 38; Eighth Air Force, Target Priorities of the Eighth Air Force, 15 May 45, in A-2 Lib.; History of MAAF, 10 Dec 43-1 Sep 44, VIII, MAAF, Operations Instructions No. 40, 18 May 44; CM-IN-23315 (30-5-44), G/AS to Wilson and Spaatz, #COSMED-117, 30 May 44. For the list of the 18 refineries made non-POINTBLANK filler targets, see Table 6, p. 39, this study.
6. History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-315), 2 Feb 44, (Ref. No. AI-324), 25 Feb 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 40, 1 Feb 44, No. 63, 24 Feb 44; USSTAF, Semi-Monthly Record of Results, 16-31 Jan 44, 1-29 Feb 44; Note, Lt. Gen. Carl Spaatz to Gen. H. H. Arnold, undated but circa 1 Mar 44, in 312.1--Operations Letters (Classified Files); CM-OUT-7262 (17-3-44), Arnold to Spaatz, #F-270, 17 Mar 44; CM-IN-23315 (30-5-44), G/AS to Wilson and Spaatz, #COSMED-117, 30 May 44.

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7. The daylight attacks were made on 5, 15, 24 April; 5, 6, 18, 31 May; 6, 23, 24 June; 9, 15, 22, 28, 31 July; 10, 17, 18, 19 August. The P-38 dive-bomb attack took place on 10 June. The night attacks by the 205 Group, RAF were on 26/27 July, 27/28 July, 9/10 August, and 17/18 August. The Fifteenth Air Force raid on 15 April was a PFF one on Floesti town, but one in which further damage was inflicted on the oil installations. History of MAAF, 10 Dec 43-1 Sep 44, II, ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 31 Aug 44; ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 76, 1 May 44; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-369), 6 May 44, (Ref. No. AI-307), 19 May 44 (Ref. No. AI-357), 1 Jun 44, (Ref. No. AI-315), 7 Jun 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 104, 5 Apr 44, No. 134, 5 May 44, No. 147, 18 May 44, No. 160, 31 May 44, No. 166, 6 Jun 44; Fifteenth Air Force, Tactical Mission Report, 5 May 44; Capt. W. A. Salant, R&R, Hq, 2677th Regt, OSS to Brig. Gen. W. J. Donovan, Director, OSS, "Report on Bombardment of Floesti Oil Refineries," 26 Sep 44; MAAF, Air Power in the Mediterranean, November 1942-February 1945, 11, 40-41; MASA, Floesti: Summary of Operations and Results and Tactical Problems Involved in 24 Attacks Between 5 April-19 August 1944; USSTAF, Semi-Monthly Record of Results, 1 Apr 44-30 Jun 44; USSTAF, Air Intelligence Summary, No. 31, week ending 11 June 44, in A-2 Lib.; CM-IN-5768 (8-5-44), Spaatz to Arnold, #U-61850, 8 May 44; CM-IN-14840 (20-5-44), Spaatz to Arnold, #U-62359, 19 May 44.
8. MAAF, Preliminary Statistics on Results of Attacks Against Roumanian Oil Refineries by Ninth and Fifteenth Air Forces, 14 Oct 44; History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-377), 7 May 44 (Ref. No. AI-375), 16 May 44 (Ref. No. AI-326), 20 May 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 135, 6 May 44, No. 144, 15 May 44, No. 148, 19 May 44, No. 154, 25 May 44.
9. Eighth Air Force, Target Priorities of the Eighth Air Force, 15 May 45, in A-2 Lib.; USSTAF, Semi-Monthly Record of Results, 16-31 May 44; USSTAF, Air Intelligence Summary, No. 32, week ending 18 Jun 44, in A-2 Lib.
10. Eighth Air Force, Air Operations Report, Mission 298, 11 Apr 44; Eighth Air Force, Interpretation Report No. S.A. 1341, 13 Apr 44; CM-IN-13692 (19-4-44), Spaatz to Arnold, #U-61065, 18 Apr 44; CM-IN-15352 (21-4-44), Spaatz to Arnold, #U-61187, 21 Apr 44; CM-IN-15683 (21-4-44), Spaatz to Arnold, #U-61212, 21 Apr 44.
11. Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44; U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 41-42; U. S. Strategic Bombing Survey, Oil, Chemicals and Rubber Division, Team 46, Plant Report No. 1, Ammoniakwerke, Merseberg, Leuna, Germany; CM-IN-12681 (17-5-44), Spaatz to Arnold, #U-62213, 16 May 44.

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12. Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44; CM-IN-12681 (17-5-44), Spaatz to Arnold, #U-62213, 16 May 44; MAAF, Air Power in the Mediterranean, November 1942-February 1945, 73. Brax had been bombed as a target of opportunity on 7 May by one plane which dropped two and a half tons of bombs.
13. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 41-42; U. S. Strategic Bombing Survey, Oil Division Final Report, 29; U. S. Strategic Bombing Survey, Oil, Chemicals and Rubber Division, Team 46, Plant Report No. 1, Ammoniakwerke, Merseburg, Leuna, Germany.
14. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 41-42; Eighth Air Force Statistical Control, Monthly Summary of Operations, May 44; USSTAF, Semi-Monthly Record of Results, 16-31 May 44, 1-30 Jun 44. For tonnages dropped by USSTAF and the RAF from January to June 1944, see Table 22. For attacks made on oil from January to June 1944, see App. 9, this study.
15. AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 50-51. Nitrogen, methanol, and ethylene were used in making explosives; calcium carbide for synthetic rubber; sodium cyanide for aircraft Plexiglas and case hardening; tetraethyl lead for aviation gasoline; and sulphuric acid, caustic soda, chlorine, and sodium carbonate for various industrial purposes.
16. AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 50-51; U. S. Strategic Bombing Survey, Oil Division Final Report, 42. For list of attacks on the chemical and powder industries, see App. 10, this study.
17. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 36, 46; U. S. Strategic Bombing Survey, Oil Division Final Report, 50, 52. For a list of major and medium processors, see ibid., App., Table C-1.
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20. U. S. Strategic Bombing Survey, Oil Division Final Report, 1-2; AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); Hq, MAAF, POW Intel. Sec., "Interview of Kapitän zur See von Kutzleben," 28 Jun 45, KO-18418.
21. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 42; AC/AS Intel., Analysis Div., "Report on German Oil Position as of 24 June 1944," in WP-III-D-8, Germany, Jan 43-Dec 44 (AC/AS Plans Office); Captured Personnel and Material Br., MID, WD, Report, "Information Obtained from the Former German Minister of Armaments and War Production, Albert Speer . . .," 11 Jul 45, KO-21120; Captured Personnel and Material Br., MID, WD, Report, "Information on GAF Policies and Experience . . . Obtained from a Field Marshal of the GAF /Milch/," 3 Jun 45, KO-18936.
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24. U. S. Strategic Bombing Survey, Interview No. 55, Field Marshal Wilhelm Keitel, 27 Jun 45, KO-18991; U. S. Strategic Bombing Survey, Oil Division Final Report, 60; U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 51-53.
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NOTES

Chapter I

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4. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 65, 66, 68; AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); Captured Personnel and Material Br., MID, WD, Report, "Information Obtained from the Former German Minister of Armaments and War Production, Albert Speer . . .," 11 Jul 45, KO-21120. For a list of major tank, M/T, and AFV factories damaged in the first half of 1944, see App. 13, this study.
5. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 81. For a list of some of the armament and miscellaneous engineering factories damaged by aerial attacks from January to May 1944, see App. 14, this study.
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9. U. S. Strategic Bombing Survey, Over-all Report (European War), September 30, 1945, 38, 95; Captured Personnel and Material Br., MID, WD, Report, "Observations on the Allied Air Offensive . . . from a German General of Infantry captured 1 April 1945 near Eisenach, Germany," 11 Apr 45, KO-6897; Captured Personnel and Material Br., MID, WD, Report, "Information Obtained from the Former German Minister of Armaments and War Production, Albert Speer . . .," 11 Jul 45, KO-21120; History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 63, 31 Jan 44.
10. Captured Personnel and Material Br., MID, WD, Report, "Information Obtained from . . . Albert Speer . . .," 11 July 45, KO-21120; Captured Personnel and Material Br., MID, WD, Report, "Opinions of . . . high ranking German Air Force officers on the effectiveness of U. S. strategic bombing on German industry," 26 May 45, KO-11423; U. S. Strategic Bombing Survey, Interview No. 55, Field Marshal Wilhelm Keitel, 27 Jun 45, KO-18991; Hq, Air POW Interrogation Det., MIS, 9th AF, Hermann Goering, 1 Jun 45, KO-13951; Hq, MAAF, POW Intel. Sec., Interview of Engineer Anderlie, Engineer with Rheinmetall Borsig, 28 Jun 45, KO-18418; Hq, MAAF, POW Intel. Sec., Interview of General Leutnant Linnarz, CG, 26 Panzer Div., 26 Jun 45, KO-17601.
11. Ibid.

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BIBLIOGRAPHICAL NOTE

The sources for this study are varied and voluminous, and although many volumes have been turned over in order to get a few ounces of information, no claim is made to having exhausted all sources. The following depositories have been more or less thoroughly searched:

- archives of the AAF Historical Office
- Office of the Cable Secretary, AAF
- AAF Classified Files
- C/AS Plans
- A-2 Library
- AAF Operational Research Section

In each of these, however, the different methods of filing and the lack of subject indexes have denied the assurance that all pertinent records have been covered.

The most valuable sources may be narrowed down to comparatively few. Among the histories prepared by the different air forces in the field and forwarded to the archives Section of the AAF Historical Office, the History of the Mediterranean Allied Air Forces, 10 December 1943-1 September 1944, prepared by Lt. Col. James Parton and his staff, proved to be very valuable. This history consists of one volume of narrative and 33 volumes of supporting documents. The latter constitute something of a gold mine for information from the Mediterranean Theater of Operations. The monthly histories of the Eighth Air Force, although not so complete in supporting documents, were useful for the ETO theater. The final over-all histories of the Eighth Air Force and the Fifteenth Air Force are not yet complete. To date, no integrated history of the United States Strategic Air Forces in Europe has been prepared.

For the operations performed in connection with the strategic bombing of Europe, USSTAF Semi-Monthly Record of Results and USSTAF Air Intelligence Summaries were extremely valuable. The same can be said for the MAAF Central Mediterranean Operational Summaries, MAAF Air Intelligence Weekly Summaries, and special MAAF studies, such as "A Record Week of Strategic Bombing" and "Notes on MAAF Counter-Air Program," all of which are found among the supporting documents of the above-mentioned History of MAAF.

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To these, the Tactical Mission Reports of the Fifteenth Air Force and the Eighth Air Force Air Operations Reports and Interpretation Reports should be added.

The results of the bombing program are well discussed in the U. S. Strategic Bombing Survey Over-all Report (European War), September 30, 1945 and the Survey's reports on individual industries, such as the Aircraft Division Industry Report (November 1945) or The German Anti-Friction Bearings Industry (November 1945). There are several objections to the use of these reports for this study, however, because they tend to discuss the whole war as an entity rather than by smaller chronological divisions. It is difficult, therefore, always to use the Survey for an evaluation of the success of the Combined Bomber Offensive for the period covered here. The Survey reports, however, have been supplemented by the various Intelligence Summaries, reports of Statistical Control Units, and special studies such as the "Strategic Bombing of Axis Europe, January 1943-September 1944," prepared by AG/AS Intelligence, Analysis Division, European Branch, in December 1944. The aforementioned sources, however, must be used with caution, since their evaluations are of the moment, and are often based on such things as photographs and sometimes on not fully tested ground reports. In this respect, the Survey reports are more reliable. They were based on examination of plants and production records by field teams and on interrogations of factory managers and other responsible persons, and could thereby arrive at sounder conclusions. A disadvantage of the Survey material, on the other hand, is that all reports are not yet completed. For example, there is at present no over-all report on the bombing of transportation and only two studies on two German rail divisions are available. An aid to interpretation are the various prisoner of war interrogations made by the U. S. Strategic Bombing Survey; the Captured Personnel and Material Branch, CID, U. S. War Department; MAAF; and other agencies.

Various correspondence files in AAF Classified Files, in AG/AS Plans, and among the supporting documents of the Eighth Air Force and MAAF histories have helped to fill in gaps. Other sources of value have been the cable files in both the Office of the AAF Cable Secretary and the Archives of the AAF Historical Office, and the reports in the files of the Operational Research Section. Information on the Royal Air Force has been gleaned from all the above-named sources in addition to the RAF Mediterranean Review and the RAF Bomber Command Review.

Unless otherwise noted, all citations are to materials in the Archives Section of the AAF Historical Office except in the case of cablegrams. For security reasons there is no notation as to whether the cable referred to is to be found in the Cable Secretary's Office or in the AFSHO files. In the case of prisoner of war interrogations the A-2 Library KO number has been added.

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Appendix 1

UNUSED OR UNKNOWN ACTIVITY OF CRUDE OIL REFINERIES*

A. Major Refineries

<u>Refinery</u>	<u>Capacity</u> (In thousands of tons per annum)	<u>Remarks</u>
Confrayville, France	1,600	Believed destroyed
Port Jérôme, France	1,100	Believed destroyed
Wartigues, France	900	Unused, inconveniently located
Petit-Couronne, France	300	Believed destroyed
Étang de Berre, France	500	Unused, incon. located
Rotterdam-Fernis	500	Very slight activity
Pauillac	500	Believed destroyed
Venice, Italy	450	Activity unknown, incon. located
Dunkirk, France	410	Believed destroyed
L'Avera, France	400	Unused, incon. located
Aquila, Trieste, Italy	350	Activity unknown, incon. located
Eec d'Ambes, France	250	Unused, incon. located
La Spezia, Italy	310	Unused, incon. located
Ebeno, Hamburg, Germany	300	Unused
Courchelettes, France	250	Activity unknown
Cravenchon, France	250	Believed destroyed
Frontignan (Sète)	200	Unused, incon. located
Leghorn, Italy	185	Believed destroyed
Donges, France (2 plants)	320	Unused, incon. located
Ostermoor, Hamburg, Germany	150	Unused
Ramsa, Fiume, Italy	120	Believed destroyed
SIAP, Trieste, Italy	120	Activity unknown, incon. located
Antwerp (Redeventza), Belgium	120	Believed destroyed
Limanowa, Poland	90	Used for storage
Ghent, Iangerbrugge (Shell), Belgium	85	Activity unknown
Kovy Bohumin (Oderberg), Czechoslovakia	65	Activity unknown

Total capacity excluding refineries destroyed or inconveniently located, 940,000 tons.

* Plan for the Completion of the Combined Bomber Offensive, 5 Mar 44, Sup. No. 10.

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Appendix 1 (Cont'd.)

B. Minor Refineries

<u>Refinery</u>	<u>Capacity (In thousands of tons per annum)</u>	<u>Remarks</u>
Rumania		
Noris	50	Activity unknown
Brasov-Vacuum	35	Partial operation
Austria		
Schwechat	50	Capacity operation
Kornenberg	45	Capacity operation
Wösendorf	40	Capacity operation
Drösing	35	Activity unknown
Hungary		
Fanto Budapest	50	Capacity operation
Hazafi	50	Capacity operation
Munkacs	25	Major portion in use
Petfurdo	20	Major portion in use
Nyirbogaány	15	Major portion in use
Szöreg	10	Major portion in use
Czechoslovakia		
Dubové	60	Major portion in use
Frvoz (Moravská-Ostrava)	55	Activity unknown
Kralup	40	Activity unknown
Yugoslavia		
Smederevo	50	Activity unknown
Osijek (Ipoil)	25	Activity unknown
Poland		
Meglowice (Jeślo)	60	
Glińnik-Mariampolski	60	Major portion in use
Drohóbyez (Kafta)	35	Major portion in use
Krosno	30	Used for storage
Lwów	30	Major portion in use
Italy		
Fornovo di Taro	50	Activity unknown, inconveniently located
Germany		
Düsseldorf	25	Activity unknown
Regensburg (4 targets)	80	Activity unknown
Schönberg	18	Activity unknown
Templehof	15	Activity unknown
France		
Autun	15	Shale oil operation
Norway		
Vallo-Toneberg	50	Activity unknown, inconveniently located

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Appendix 1 (Cont'd.)

Belgium		
Antwerp-Kiel	50	Believed destroyed
Ghent Langerbrugge	20	Activity unknown
Hoboken (Socony)	20	Believed destrcyed
Antwerp-Darse	20	Activity unknown
Holland		
Flushing asphalt	40 (?)	Activity unknown

Total, excluding the few
believed destroyed or in-
conveniently located 1,253

Percentage of total
usable capacity
suitably located 9%

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Appendix 2

SUPPORT OF GROUND OPERATIONS BY MASAF, FEBRUARY-MARCH 1944*

1-29 February

<u>Target</u>	<u>Date</u>	<u>Target</u>	<u>Date</u>
Sulmona M/Y	3	Ferrara M/Y	14
Stimigliano M/Y	3	Verona & Mantua M/Y	14
Antheor viaduct	4	Vicenza RR	14
Padua M/Y	7/8	Pontedera A/D	14
Verona M/Y	8	Brescia	14
Prato M/Y	8	Modena M/Y	14
Piombino M/Y	8	Verona M/Y	14
Orvieto A/D	8	Albano/Cecina &	
Tarquinia A/D	8	Cecina/Canpoleone roads	14/15
Viterbo A/D	8	Poggibonsi M/Y	15
Rimini M/Y	8/9	Monte Cassino Monastery	15
Albano town	10	Grottaferrata/Albano/	
Tivoli & Vicovaro towns	10	Velletri roads	15/16
Manteratonde road junction	10	Pontassieve M/Y	16
& RR	10	Pontassieve T/O's	16
Campoleone M/Y	10	Certaldo	16
Velletri town	10	Poggibonsi M/Y	16
Cecina town & RR	10	Rieti road & RR	16
Cisterna town	10	Siena M/Y	16
Troop concentrations		Cecina bridge	16
(Anzio)	12	San Stefano harbor	16/17
Cisterna, Velletri & Cori		Anzio area	16/17
towns	12/13	Anzio area	17
Campoleone/Cecina roads	12/13	Anzio area	17/18
Campoleone/Cecina roads	13/14	Anzio area	18/19
Albano/Cecina roads	13/14	Sante Marie/Tagliacozzo	
Arezzo M/Y	14	area	20
Pisa A/D & M/Y	14		
Prato M/Y	14		
Pontedera A/D	14		

1-15 March

Anzio area	1/2	Castelfiorentino M/Y	7
Anzio area	2	N. Central Italy T/O's	7
Montalto di Castro	2/3	Viterbo A/D	7
San Stefano	2/3	Fabrica di Rome A/D	7
Orbetello M/Y	2/3	Orvieto A/D	7
Viterbo A/D	3	San Stefano	7/8
Camino L/G	3	Prato M/Y	11
Fabrica di Roma A/D	3	Pontassieve M/Y	11
Littorio and Tiburtina M/Y	3	Iesi A/D	11
Pontassieve M/Y	7	Padua M/Y	11
Prato M/Y	7	Cassino and area	15
Poggibonsi M/Y	7		

*USSTAF, Semi-Monthly Record of Results, 1 Feb-15 Mar 44.

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Appendix 3

ATTACKS ON AIRFRAMES
1 JANUARY-6 JUNE 1944*

<u>Plant</u>	<u>Location</u>	<u>Product</u>	<u>Date</u>	<u>Air Force</u>
Erla	Leipzig/Trockau	Me-109 assembly	19/20 Feb 20 Feb 29 May	RAF EC 8th 8th
Erla	Leipzig/Heiterblick	Me-109 fuselage	19/20 Feb 20 Feb 29 May	RAF BC 8th 8th
Messerschmitt	Regensburg/Fröhenling	Me-109 components	22 Feb 25 Feb	15th 15th & 8th
Messerschmitt	Regensburg/Obertraubling	Me-109 components	22 Feb 25 Feb	15th & 8th
Daimler-Puch	Steyr	Me-109 components and components for engines AFV and small arms	23 Feb 24 Feb	15th 15th
Messerschmitt	Klagenfurt	Me-109 wing tips and ailerons	24/25 Feb 16 Jan	205th GP, RAF 15th
Wiener Neustadter Werke I	Wiener Neustadt	Me-109 assembly	12 Apr 23 Apr 10 May 29 May	15th 15th 15th 15th
Wiener Neustadter Werke II	Wiener Neustadt	Me-109 components	12 Apr 10 May 12 Apr 12 Apr	15th 15th 15th 15th
Wiener Neustadter Werke I	Bad Vöslau	Me-109 assembly	23 Apr 12 Apr	15th 15th
Wiener Neustadter Werke I	Fischamend/Markt Neudorf	Me-109 components	30 May 24 May 29 May	15th 15th 15th
Amme-Luther-Seck	Atzgersdorf	Me-109 components		

* AC/AS Intel, Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); USSTAF, Semi-Monthly Record of Results, Jan-Jun 44; U. S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45; MAJF, Central Mediterranean Operational Summary, No. 10, 1 Jan 44-No. 166, 6 Jun 44.

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Appendix 3 (Cont'd.)

<u>Plant</u>	<u>Location</u>	<u>Product</u>	<u>Date</u>	<u>Air Force</u>
Rogozarski	Belgrade	Me-109 assembly	16 Apr	15th
Ikarus	Belgrade	Me-109 assembly	17 Apr	15th
Robrbach	Neunkirchen	Me-109 components	17 Apr	15th
Pottendorfer Spinnererei	Pottendorf	Me-109 components	24 Apr	15th
Hungarian Wagon Works	Gyor	Me-109 components	30 May	15th
I.A.R.	Brasov	Me-109 assembly	30 May	15th
Wiener Neustadter	Ebreichsdorf	Me-109 components	13 Apr	15th
SNCA	Meulan/Les Mureaux	Me-109 assembly and repair	16 Apr	15th
MIAG	Brunswick/Waggum	Me-110 assembly	6 May	15th
MIAG	Brunswick/Neupetritor	Me-110 components and tanks	30 May	RAF BC
MIAG	Brunswick/Wilhelmitor	Me-110 components	2/3 Mar	9th
Gothaer	Gotha	Me-110 assembly and Go-242 assembly	30 May	8th
Bachmann	Fürth	Me-110 components	11 Jan	8th
Messerschmitt	Augsburg	Me-410 assembly	8 Apr	8th
Dornier	Oberpfaffenhofen	Me-410 assembly and Do-217 assembly	20 Feb	8th
Duna Repülőgyar	Budapest/Szigetszentmiklos/Tokol	Me-410 assembly and components	21 Feb	8th
			29 Feb	8th
			29 Mar	8th
			30 Jan	8th
			20 Feb	8th
			21 Feb	8th
			29 Feb	8th
			29 Mar	8th
			29 Mar	8th
			30 Mar	8th
			8 Apr	8th
			19 May	8th
			20 Feb	8th
			24 Feb	8th
			25 Feb	8th
			25 Feb	8th
			25/26 Feb	RAF BC
			13 Apr	8th
			18 Mar	8th
			13 Apr & 24 Apr	8th
			3 Apr	15th
			13 Apr	15th

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<u>Plant</u>	<u>Location</u>	<u>Product</u>	<u>Date</u>	<u>Air Force</u>
Kjeller	Oslo	We airframe and DB engine repair	28/29 Apr	RAF BC
AGO	Oschersleben	FW-190 assembly and components	11 Jan 20 Feb 11 Apr 30 May 19 Apr	8th 8th 8th 8th 8th
Mieseler	Kassel/Haldau and Kassel/ Bettenhausen	FW-190 assembly and components	20 Feb	8th
Focke Wulf	Tutow	FW-190 assembly	9 Apr 13 May 29 May	8th 8th 8th
Focke Wulf	Marienburg	FW-190 assembly	9 Apr	8th
Focke Wulf	Cottbus	FW-190 assembly	11 Apr	8th
Focke Wulf	Sorau	FW-190 assembly	29 May	8th
Focke Wulf	Arzesinski	FW-190 components	11 Apr	8th
Focke Wulf	Posen	FW-190 components	29 May	8th
Arado	Wormünde	FW-190 components	9 Apr	8th
Karlsruhe	Gdynia/Sakmel	FW-190 assembly and repair	9 Apr	8th
Dornier	Friedrichshafen/Wanzell	FW-190 components and Do-217 assembly	16 Mar 18 Mar 24 Apr 27/28 Apr	8th 8th 8th RAF BC
SNCA	Villacoublay	FW-190 repairs and Ju-52 assembly	5 Feb	8th
Liotard	Tours/Usine	FW-190 repairs	20 May	8th
G. Bresser	Zwickau	FW-190 repairs	27 Mar	8th
SNCA	Bordeaux/Merignac	FW-189 assembly and FW-200 repair base	12 May 28 May	8th 8th
Focke Wulf	Berlin/Treptow	FW-200 components	5 Jan 27 Mar 1/2 Jan 2/3 Jan 20/21 Jan 15/16 Feb	8th 8th RAF BC RAF BC RAF BC RAF BC

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<u>Plant</u>	<u>Location</u>	<u>Product</u>	<u>Date</u>	<u>Air Force</u>
Junkers	Bernburg	Ju-86, Ju-188, Ju-52 assembly	20 Feb	8th
Junkers	Halberstadt	Ju-88 wings	11 Apr	8th
			11 Jan	8th
			22 Feb	8th
			11 Apr	8th
			30 May	8th
Junkers	Aschersleben	Ju-88 and Ju-52 fuselages	22 Feb	8th
ATAG	Leipzig/Föckau	Ju-88 and Ju-52 assembly	20 Feb	8th
A/C Factory Fildex	Wels	Ju-87 assembly	29 May	8th
	Budapest/Vecses	Ju-52 assembly and Me storage	30 May	15th
Junkers	Dessau	Ju-88 and Ju-52 assembly	13 Apr	8th
			28 May	8th
			30 May	8th
Heinkel	Rostock/Marienehe	He-111 and He-219 assembly	20 Feb	8th
Heinkel	Kostock/Barnsdorf	He-111 components	20 Feb	8th
Heinkel	Rostock/Sleicher Str.	He-111 components	11 Apr	8th
Heinkel	Oranienburg/Annahof	He-111 and He-177 assembly	18 Apr	8th
Ivere	Brussels/Lvere	He-111 repair	10 Apr	8th
heinkel	Oranienburg/Germendorf	He-177 components	18 Apr	8th
Arado	Brandenburg	He-177 assembly	18 Apr	8th
			29 Apr	8th
			8 May	8th
Arado	Rathenow	He-177 components	18 Apr	8th
Heinkel	Schwechat	He-219 assembly	23 Apr	15th
A.I.A.	Toulouse	He repairs	5/6 Apr	RAF BC
Henschel	Berlin/Johannisthal	Hs-126 assembly	1/2 Jan	RAF FC
			2/3 Jan	RAF FC
			15/16 Feb	RAF BC
Peggiane	Reggio Emilia	Re-2005 and SM-79 assembly	7/8 Jan	205th GP, RAF
			8 Jan	15th
			30 Apr	15th
Breda	Milan/Bresso	Fighter assembly	30 Apr	15th
Piaggio	Pontedera	PI-108 and G-55 assembly	14 Feb	15th
FIAT	Turin/Aeritalia	Fighter assembly	25 Apr	15th

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<u>Plant</u>	<u>Location</u>	<u>Product</u>	<u>Date</u>	<u>Air Force</u>
Fiat Macchi	Marina di Pisa Varese	Fiat airframes Mc-205 assembly	12 May 1/2 Apr 11/12 Apr 30 Apr	15th 205th GP, RAF 205th GP, RAF 15th
Cent	Monfalcone	Z-1007 (3-engine bomber)	19/20 Mar 25 May	205th GP, RAF 15th
Dornier	Friedrichshafen/Lowenthal	Do-217 assembly and Fw-190 tools	18 Mar 24 Apr	8th 8th
SNCA	Bourges	Se-204 assembly and components	10 Apr 23 May 4 Jun	8th 8th 8th
S.A. Ateliers D'Aviation	Toulouse	Latecoere-298 and jet experimentation	5/6 Apr	RAF BC
SNCA	Toulouse	Dewoitine trainers	5/6 Apr	RAF BC
Messerschmitt	Leipheim A/F	Me-262 assembly	24 Apr	8th
Messerschmitt	Lechfeld A/F	Me-262 training and assembly	13 Apr	8th
Dornier Flettner	Friedrichshafen/Lowenthal Berlin/Treptow	Jet a/c production assembly and repair of trainers and gliders	27/28 Apr 1/2 Jan 2/3 Jan 20/21 Jan 15/16 Feb 1/2 Jan 2/3 Jan	RAF DC RAF BC RAF BC RAF BC RAF BC RAF BC RAF BC
Deutsche Versuchen anstalt	Berlin/Treptow	A/C research	20/21 Jan 15/16 Feb 1/2 Jan 2/3 Jan	RAF BC RAF BC RAF BC RAF BC
Aulnat	Clermont/Ferrand Diepholz	A/C repair A/C stores depot	20/21 Jan 29/30 Apr 30 May	RAF BC RAF BC 8th

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Appendix 4

**ATTACKS ON AERO-ENGINES,
1 JANUARY-9 JUNE 1944***

<u>Plant</u>	<u>Location</u>	<u>Type of Engine</u>	<u>Date</u>	<u>Air Force Attacking</u>
Daimler-Benz	Maribor, Yugoslavia	DB	7 Jan	15th
Daimler-Benz	Stuttgart/Unter Urkheim	DB-601	23/24 Jan	205th Gp, RAF
Wiedersachliche Motoren werke	Brunswick/Quernum	DB-601, 605, 606, 610	1/2 Feb	205th Gp, RAF
Daimler-Fuch	Steyr	DL components	20/21 Feb	RAF BC
			1/2 Mar	RAF BC
Kjeller	Oslo	DB repairs	21 Feb	8th
Daimler-Benz	Berlin/Geushagen	DB-603	23 Feb	15th
Manfred Weiss	Eudepest/Tsepel/Szietszent- miklos	DB components	24 Feb	15th
Henschel	Kassel/Altenbeuna	DB-603	2 Apr	15th
Bayerische Motoren werke	Berlin/Spandau	DB-603	24/25 Feb	205th Gp, RAF
Bayerische Motoren werke	Brandenburg	DB-603	28/29 Apr	RAF DC
Bayerische Motoren werke	Eisenach	DB-603	6 Mar	8th
			3/4 Apr	205th Gp, RAF
			19 Apr	8th
			1/2 Jan	RAF BC
			2/3 Jan	RAF BC
			20/21 Jan	RAF BC
			15/16 Feb	RAF BC
			24 Feb	8th

AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944,"
1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); USJAF, Semi-Monthly Record of Results, Jan-Jun 44;
U. S. Strategic Bombing Survey, Aircraft Division Industry Report, Nov 45; IAAF, Central Mediterranean
Operational Summary, No. 10, 1 Jan 44--No. 169, 9 Jun 44.

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Appendix 4 (Cont'd.)

<u>Plant</u>	<u>Location</u>	<u>Type of Engine</u>	<u>Date</u>	<u>Air Force Attacking</u>
Ateliers Industriels d'Air	Clermont/Ferrand	BMW assembly and repair	10/11 Mar	RAF EC
Gnome and Rhone	Le Mans	BMW assembly	29/30 Apr	RAF EC
Cie Mecanique d'Albert	Albert	BMW assembly and repair	13/14 Mar	RAF EC
			2/3 Mar	RAF EC
Bayerische Motoren werke	Munich/Allach	BMW	9 Jun	15th
Kothensee	Magdeburg	Jumo	21/22 Jan	RAF EC
Fischer A.G.	Frankfurt/Oberrod	Jumo carburetors	29 Jan	8th
			4 Feb	8th
ATAG	Leipzig/Grosszschocher	Jumo	19/20 Feb	RAF EC
Junkers	Brussels/Vilvorde	Jumo repair	10 Apr	8th
Pommerische Motorenbau	Stettin/Arminswalde	Jumo	11 Apr	8th
Junkers Flugzeug u. Motoren werke (formerly Katford)	Strasbourg/Leinau	Jumo repair	27 May	8th
Hobas werke	Noirvy	Jumo components and repair	27 May	8th
Mitteldeutsche Junkers Flugzeug u. Motoren werke	Leipzig/Taucha	Jumo	28 May	8th
Alfred Teves	Dessau	Jumo jet experiment	28 May	8th
			30 May	8th
	Frankfurt	Jet experiment	2 Mar	8th
			18/19 Mar	RAF EC
			20 Mar	8th
			22/23 Mar	RAF EC
			24 Mar	8th
	Liroges	14N and 14R assembly	8/9 Feb	RAF EC
Gnome and Rhone	Turin/Lingotto	Fiat	29 Mar	15th
	Lyon	Gnome and Rhone components	29/30 Mar	RAF EC

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Appendix 5

DISPOSITION OF GAF OPERATIONAL FIGHTER STRENGTH FOR ALL FRONTS
JANUARY-MAY 1944***

Month	Total	Western Front	South German Front	Mediterranean and Balkan Front	Russian Front
January	2,638	60.0%	10.6%	13.9%	15.5%
February	2,607	61.0%	14.4%	8.9%	15.7%
March	2,613	62.8%	12.2%	8.7%	16.1%
April	2,646	58.6%	13.0%	8.6%	19.7%
May	2,721	23.1%*	49.3%**	7.7%#	19.8%##

* Excluding Germany
 ** Changed to German and Central European Front
 # Including Bulgaria
 ## Including East Hungary, Rumania, Bessarabia
 *** USSTAF, Semi-Monthly Record of Results, January-May 1944

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PRE-ATTACK SOURCES OF GERMAN SUPPLY OF BALL BEARINGS*

<u>Plant</u>	<u>Location</u>	<u>Per Cent of Pre- attack Supply</u>
Germany		
Kugelfischer	Schweinfurt	19.7
VKF	Schweinfurt	18.0
Dichtel and Sachs	Schweinfurt	.9
Norma (VKF)	Stuttgart	5.1
VKF	Berlin/Orkner	4.3
VKF	Berlin/Neukölln	3.4
NDK	Berlin/Lichtenberg	.9
DKF	Leipzig	3.4
Jaeger	Wuppertal	2.6
Muller	Muenzburg	1.7
Robert Kling	Wetzlar	.9
Gebaur and Moller	Fulda	.9
Geb. Heller	Marienthal	.8
All others		1.7
Austria-Poland-Czechoslovakia		
Steyrwaffen Walzlager Werke	Steyr	9.4
SEF	Pürnstern	.9
All others		.8
Italy		
RIV	Turin	5.5
RIV	Villar-Perosa	1.4
IMI	Ferrara	.9
All others		.8
France		
CAN	Paris/Blois Colombes	2.6
CAN	Paris/Ivry-sur Seine	2.6
SFO	Annecy	1.7
All others		.8
Total Axis Europe		91.7

* Memo, Col. John E. Turner, Executive AC/AS Intel. to Col. G. M. Taylor, AC/AS Plans, Axis Europe Anti-friction Bearing Supply, 6 Mar 44, in 384.5--
Special attacks (Classified Files).

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Appendix 6 (Cont'd.)

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	<u>Plant</u>	<u>Location</u>	<u>Per Cent of Pre- attack Supply</u>
Imports			
	Sweden		7.9
	Switzerland		.4
	Total		100.0

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Appendix 7

ATTACKS ON GENERAL ANTI-FRICTION BEARING INDUSTRY
JANUARY-MAY 1944*

<u>Plant</u>	<u>Location</u>	<u>Date</u>	<u>Air Force</u>
RIV	Villar-Perosa	3 Jan	15th
Kugelfischer	Elberfeld	30/31 Jan 2/3 Feb 4/5 Feb 7/8 Feb 8/9 Feb 9/10 Feb 11/12 Feb 12/13 Feb	RAF
DEF	Leipzig (area)	20 Feb	8th
VKF	Stuttgart	21 Feb 25 Feb	8th
Steyrmaschinen- und Werkzeugmaschinenfabrik	Steyr	23 Feb 2 Apr	15th
Kugelfischer	Schweinfurt	24 Feb	8th
RAF, Werke I and Werke II		24/25 Feb	RAF
Deutsche Star Kugellager		25/26 Feb	RAF
Richtel and Sachs		24 Mar	8th
		30/31 Mar	RAF
		13 Apr 26/27 Apr	8th RAF
VKF	Berlin/Erkner	8 Mar	8th
Macella	La Ricamarie	10/11 Mar	RAF
RIV	Turin	29 Mar	15th
SRC	Annecy	9/10 May	RAF

* AC/AS Intel., Analysis Div., European Dr., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files). U. S. Strategic Bombing Survey, The German Anti-Friction Bearings Industry, Nov 45, Exhibit E.

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GERMAN DIFFICULTIES WITH RUMANIAN RAILROADS
as Told by POW Oberst Han Hoeffner*

P/W has had a long and varied experience with the Wehrmacht which opens many corridors of information not probed into in this report. He served in Southern Russia, Italy and Rumania in charge of transportation and incidental remarks made during the interrogation show that there is an ample field in his experiences in these regions for further interrogation.

Throughout these times P/W made the observation that blueprints and actual performances remained far apart. In Italy, in Russia, and in the Balkans the German general staff had not figured with certain imponderables.

For example, there is the affair of the bored buffaloes. The Herr Oberst had faced and resolved many transport problems before he came to Rumania, but the shunting of freight cars by means of buffaloes who nudged the cars into place along the switch-tracks on the banks of the Danube was a bit of a poser. Rumanian railways were not noted for their efficiency at their best, and the impatient Germans sought means of vitalizing these services. With mere human beings, this was a simple problem, for the German methods of stimulating greater exertions in their behalf were by this time well if not favorably known. The buffalo-drivers were readily convinced that their interest lay on the side of faster freight car marshalling for the Germans. They belabored the buffaloes mightily with iron goads.

But the buffaloes, secure in a dignity quite superhuman, were not having any. They simply walked off the job, and plumped themselves down in the riverbed in a sort of lie-down strike. Threats, cajolery, goads, were all tried in vain, the buffaloes lay in the riverbed indifferent to the problems of any living space but their own. Not for two days, when hunger at last presented the winning argument, did they emerge to resume their former task under their vastly relieved drivers.

However, notes the Herr Oberst with a shrug, they did precisely as much work as previously, no more and no less, thus recording one of the earliest of the now culminating series of triumphs over the Wehrmacht.

* AAF Evaluation Board in EPO, Effectiveness of Air Attack against Rail Transportation in the Battle of France, Jun 75, p. 151.

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Appendix 9

ATTACKS ON OIL TANKERS, JANUARY-JULY 1944*

Plant	Location	Product or Type of Installation	Date	Air Force
Astra Romana	Floesti	Refinery	27 Apr, 5, 18, 31 May	15th
Steaua Romana	Gampina	Refinery	5/6 May	205th Cg, IIF
Concordia Vega	Floesti	Refinery	6 May	15th
Romana Americana	Floesti	Refinery	6 Jun	15th
Phoenix Orion	Floesti	Refinery	5, 27 Apr	15th
Standard Columbia Aquila	Floesti	Refinery	31 May	15th
Phoenix Unirea	Floesti	Refinery	6 Jun	15th
Yenia	Floesti	Refinery	21 May, 6, 10, 23, 24 Jun	15th
Lumina Petrolmina	Floesti	Refinery	24 Apr, 5 May	15th
Dacia Romana	Floesti	Refinery	5 May	15th
Redeventza	Floesti	Refinery	5 May, 6 Jun	15th
	Floesti	Refinery	31 May	15th
	Floesti	Refinery	5 May	15th
	Floesti	Refinery	6 Jun	15th
	Floesti	Refinery	31 May	15th
	Floesti	Refinery	5 May	15th
	Floesti	Refinery	6 Jun	15th
	Floesti	Refinery	31 May, 6, 23 Jun	15th

* AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1942-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files); USSFAP, Semi-Monthly Record of Results, Jan-Jun 44.

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Appendix 9 (Cont'd.)

Plant	Location	Product or Type of Installation	Date	Air Force
Prahova Petrolul	Bucharest	Refinery	4 Apr	15th
Titan	Bucharest	Refinery	28 Jun	15th
Vacuum	Brasov	Refinery	16 Apr	15th
Pagyar Shell Koolaz	Budapest	Refinery	3 Apr	15th
			17 Jun	15th
Vacuum	Almasfuzito, Hungary	Refinery	25/26 Jun	205th Gp, PAF
Apollo	Bratislava	Refinery	12/13 Jun	205th Gp, PAF
Magyar Olajfinorito	Szobny, Hungary	Refinery	16 Jun	15th
Standard-Vacuum	Erod Rosanski, Yugoslavia	Refinery	14 Jun	15th
			10/11 Jun	205th Gp, PAF
Smederevo	Smederevo, Yugoslavia	Refinery	11 Jun	15th
Shell	Caprag, Yugoslavia	Refinery	14 Jun	15th
Shell	Vienna/Floridsdorf	Refinery	16, 26 Jun	15th
Vacuum	Vienna/Vagren	Refinery	16, 26 Jun	15th
Nova Cel u. Brennstoff s.G.	Vienna/Nova Schwechat	Refinery	16, 26 Jun	15th
Creditul Miner	Korneuburg, Austria	Refinery	26 Jun	15th
Donau Chemie	Wosbierbaum, Austria	Refinery	26 Jun	15th
AGIP	Fiune	Refinery	21/22 Jan	205th Gp, PAF
			24, 25 Feb	15th
AGIF	Porto Marghera	Refinery	14/15 May	205th Gp, PAF
			19, 25 May	15th
			9, 10, 13 Jun	15th
Shell	La Spezia	Refinery	19, 22 May	15th
Aquila	Trieste	Refinery	31 Jan/1 Feb	205th Gp, PAF
			9/10 Jun	205th Gp, PAF
			10 Jun	15th
SIAP	Trieste	Refinery	26/27 Jun	205th Gp, PAF
			10 Jun	15th

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Appendix 9 (Cont'd.)

Plant	Location	Product or Type of Installation	Date	Air Force
Deutsche Gasolin A.G. and Olwerke Loury u. Van der Lande	Emmerich, Germany	Refinery	14 Jun	8th
Gewerkschaft Deutsche Erdolraffinerie	Hannover/Histburg	Refinery	15, 18, 20 Jun	8th
Deutsche Vacuum Oil A.G.	Bremen/Gellebshausen	Refinery	13, 20 Jun	8th
Kuropaische Tanklager u. Transport A.G.	Hamburg	Refinery	13 Jun	8th
Lithuania-Ossag Mineralwerke	Hamburg	Refinery	18, 20 Jun	8th
Olwerke Julius Schindler GmbH and Deutsche Erdol A.G.	Hamburg	Refinery	18, 20 Jun	8th
Mineralolwerke Albrecht and Ernst Schliemann Olwerke	Hamburg	Refinery	20 Jun	8th
Maschinol-Import GmbH	Hamburg	Refinery	18 Jun	8th
Lbano Asphalt-Werke A.G.	Ortenoc	Refinery	20 Jun	8th
Mineralol u. Asphaltwerke	Nersburg/Leuna	Synthetic	12, 28 May	8th
Ammoniakwerke	Laby, Czechoslovakia	Synthetic	12 May	8th
S.D. Treibstoffwerke	Pillitz	Synthetic	11 Apr, 29 May, 20 Jun	8th
Hydrierwerke	Pillitz	Synthetic	12 May, 29 Jun	8th
Braunkohle Benzol	Ehlen	Synthetic	12, 28 May	8th
Braunkohle Benzin	Zeit	Synthetic	28 May, 21 Jun	8th
Braunkohle Benzin	Fuhland/Schwartzheise	Synthetic	12, 28 May	8th
Wintershall	Lutzendorf	Synthetic	21/22 Jan	PAF EC
Braunkohle Benzin	Magdeburg/Rothensee	Synthetic	23 May, 20 Jun	8th
Fuhrchemie A.G.	Sterrade/Wolten	Synthetic	16/17 Jun	RAF BC
Hydrierwerke Schaluen	Gelsenkirchen	Synthetic	12/13 Jun, 21/22 Jun	RAF BC
Union Rheinsche Braunkohle	Wesseling	Synthetic	21/22 Jun	RAF BC
Gewerkschaft Rheinprussen	Homburg/Meerbeck	Synthetic	21/22 Jun	RAF BC
Poblis	Leipzig	Low-temp, carbonization, and coal-tar treatment	25/26 Jun	RAF BC
			28 May	8th

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Appendix 9 (Cont'd.)

Plant	Location	Product or Type of Installation	Date	Air Force
Zeer Sohne	Dortmund	Tar distillation	22/23 May	RAF DG
Gelsenkirchen Bergwerke	Euisburg	Coke and tar distillates	21/22 May	RAF 8G
Sprematuna Trieste	Trieste	Vegetable oil	10 Jun	15th
	Osijek, Yugoslavia	Refinery	14 Jun	15th
	Petfordo, Hungary	Refinery	17 Jun	15th
	Vienna/Lobau	Refinery	16, 26 Jun	15th
	Lrohobycz, Poland	Refinery	26 Jun	8th
	Fornovo di Taro, Italy	Refinery	22 Jun	15th
	Savona/Vado Ligure, Italy	Refinery	22/23 Jun	205th Gp, RAF
	Balaruc, France	Refinery	25 Jun	15th
	Constanta, Rumania	Oil storage	11 Jun	15th
	Giurgiu, Rumania	Oil storage	2/3 Jun	205th Gp, RAF
	Vienna/Innterhafen	Oil storage	11, 23 Jun	15th
	Sète, France	Oil storage	28/29 Jun	205th Gp, RAF
		Oil storage	16, 26 Jun	15th
		Oil storage	25 Jun	15th

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Appendix 10

ATTACKS ON CHEMICAL AND EXPLOSIVE INDUSTRIES, JANUARY-MAY 1944*

<u>Plant</u>	<u>Location</u>	<u>Product</u>	<u>Date</u>	<u>Air Force</u>
I.G. Farben	Ludwigshafen	Dyestuffs, synthetic oil, and rubber	7 Jan 11 Feb 22/23, 26/27, 28/29 May	8th 8th PAF BC
Karstig	Ludwigshafen	Synthetic phenols	7 Jan 11 Feb 27 May 27 May 6/7 May	8th 8th RAF BC RAF BC
Knoll	Ludwigshafen	Pharmaceuticals		
I.G. Farben	Leverkuren	Chemicals		
Griesheim Elektron	Frankfurt	Chemicals, acids, and fertilizers		
I.G. Farben	Frankfurt	Heavy chemicals	22/23 Mar 29 Jan 4 Feb (?) Jan (?) Jan	PAF BC 8th RAF BC RAF BC RAF BC
Schering	Berlin/Köpenick	Chemicals		
Spinnstoff Fabrik	Berlin/Steglitz	Synthetic silk and wool		
Bakelite	Berlin/Birkner	Raw materials for plastics	6 Mar	8th
Rütgerswerke	Berlin/Birkner	Tar, chemicals, explosives	6 Mar	8th
Kiesel and De Haen	Berlin/Neukölln	Chemicals	(?) Jan	RAF BC
Gherische Grunau	Berlin/Köpenick	Chemicals	(?) Jan	RAF BC
Kemmlerwerke	Berlin/Treptow	Chemicals	(?) Jan	RAF BC
Henkel	Düsseldorf/Reisholz	Soap, hydrogen peroxide	20/21 May	PLF BC
Lignose Sprengstoffwerke	Schönebeck	Dynamite and mining explosives	21/22 Jan	RAF BC
Kurmarkische Zellwolle	Wittenberg	Viscose staple fiber	6 Mar, 18 Apr	8th
Spinnfaser	Kassel	Textile yarns from staple fibers		
I.G. Farben	Döberitz	Tetraethyl lead	19 Apr 18 Apr	8th 8th
Bollig and Kemper	Cologne	Dyestuffs	20/21 Apr	PAF BC
Schultz	Leipzig	Chemicals	19/20 Feb	PAF BC
Didier Werke	Stettin	Catalysts	5/6 Jan	PAF BC

VAC/AS Intel., Analysis Div., European Gr., "Strategic Bombing of Axis Europe, January 1943-September 1944," I Jec 44, in 353.41--Bombing, Bulk (Classified Files); USSAF, Semi-Monthly Record of Results, Jan-May 44.

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Appendix 10 (Cont'd.)

<u>Plant</u>	<u>Location</u>	<u>Product</u>	<u>Date</u>	<u>Air Force</u>
Augshurger Kuchtharz	Augsburg	Synthetic resin	25/26 Feb	RAF EC
Poudrierie Nationale	Angoulême	Explosives	20/21 Mar	RAF EC
Poudrierie Nationale	Bergotte	Explosives	18/19 Mar	RAF EC
Poudrierie Nationale	Salbris	Explosives	7/8 May	RAF EC
Poudrierie Nationale	St. Leger en Jailles	Explosives	29/30 Apr	RAF EC
Poudrierie Nationale	Toulouse	Nitrocellulose	1/2 May	RAF EC

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MAJOR RUBBER FABRICATING PLANTS DAMAGED BY AREA RAIDS,
JANUARY-MAY 1944*

<u>Plant</u>	<u>Location</u>	<u>Date</u>	<u>Air Force</u>
Continental Gummiwerke	Hannover	31 Jan	8th
Michelin	Clermont-Ferrand	16/17 Mar	RAF BC
Clouth	Cologne	20/21 Apr	RAF BC
Cologne Gummifadin Fabrik	Cologne	20/21 Apr	RAF BC
Paguag	Düsseldorf	22/23 Apr	RAF BC
Metzler	Munich	24/25 Apr	RAF BC
Wilhelm Pahl	Dortmund	22/23 May	RAF BC
Semperit	Neunkirchen	24 May	15th
Englebert	Aachen	24/25 May 27/28 May	RAF BC

* U. S. Strategic Bombing Survey, Oil Division Final Report, App. Table C-9;
USSTAF, Semi-Monthly Record of Results, Jan-Jun 44.

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MAJOR STEEL AND NONFERROUS PLANTS DAMAGED, JANUARY-MAY 1944*

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Appendix 12

Plant	Location	Product or Type of Installation	Date	Air Force
Thyssen Hutte	Duisburg/Hamborn	Steel	(?) Jan	RAF EC
Krupp	Duisburg/Pheinhausen	Steel	21/22 May	RAF BC
Mannesmann	Duisburg/Huckingen	Steel	21/22 May	RAF BC
Verein Stahlwerke	Duisburg/Huckingen	Steel	21/22 May	RAF BC
Verein Stahlwerke	Duisburg/Hochfeld	Steel	21/22 May	RAF BC
Vereinigte Deutsche Metallwerke	Duisburg/Hochfeld	Brass, cooper rolling mill	21/22 May	RAF BC
Kupferhutte	Duisburg/Hochfeld	Copper, zinc, and lead refinery	21/22 May	RAF BC
Verein Stahlwerke	Duisburg/Wilhelm	Steel	(?) Mar	RAF BC
Verein Stahlwerke	Duisburg/Ruhrort	Steel	21/22 May	RAF BC
Berzelius	Duisburg	Zinc refinery	21/22 May	RAF BC
Verein Stahlwerke	Dortmund/West	Steel	22/23 May	RAF BC
Hoesch A.G.	Dortmund	Steel	22/23 May	RAF BC
Gutehoffnungs	Oberhausen	Steel	(?) Jan	RAF BC
Vereinigte Huttenwerke	Saarbrücken	Steel	23 May	8th
Klocknerwerke	Osnabrück	Steel	13, 31 May	8th
Kupfer u. Drahtwerke	Osnabrück	Copper refinery	12/13 Apr	RAF BC
Deutsche Rohrenwerke	Düsseldorf	Steel	22/23 Apr	RAF BC
Huttenwerke	Berlin/Köpenick	Copper foundry	22/23 Apr	RAF BC
Altenburgs für Bergbau	Essen	Zinc refinery	26/27 Mar	RAF BC
Goldschmidt	Essen	Lead, tin smelting	26/27 Mar	RAF BC
Deutscher Gold u. Silber Scheideanstalt	Frankfurt	Precious metal refinery	22/23 Mar	RAF BC
Knoevengel	Hannover	Iron foundry	31 Jan	8th
Manfred Weiss	Budapest	Steel	3/4 Apr	205th Gp, RAF
Piombino	Piombino	Iron and steel	10/11 Jan	205th Gp, RAF

* AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files).

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Appendix 13

MAJOR MOTOR TRUCK, TANK, AND ARMORED VEHICLE FACTORIES DAMAGED, JANUARY-MAY 1944*

Plant	Location	Product or Type of Installation	Date	Air Force
Rheinmetall Borsig	Berlin/Weinickendorf	Tanks, AFV, munitions, armaments	(?) Jan	RAF BC
Daimler-Benz	Berlin/Marienfelde	Tanks and aero-engines	(?) Jan-Feb	RAF BC
Bussing NAG	Berlin/Köpenick	Lorry, AFV, wireless	(?) Jan	RAF BC
Ami-Budd	Berlin/Treptow	Press work for tanks	(?) Jan	RAF BC
Auto Union	Berlin/Spandau	Military vehicles	(?) Jan	RAF BC
MIAG	Brunswick/Neupetritor	Tanks and A/C components	20 Feb, 8 Apr	8th
Krupp Crusonwerke	Magdeburg	Medium tanks	21/22 Jan	RAF BC
Maybach Motoren	Friedrichshafen	Tanks, AFV, and A/C engines	16, 18 Mar	8th
Zahnradfabrik	Friedrichshafen	Gears and gear boxes	27/28 Apr	RAF BC
Adler Werke	Frankfurt	AFV and components	27/28 Apr	RAF BC
Alfred Teves	Frankfurt	M/T and A/C components	22/23 Mar	RAF BC
Gothaer Waggonfabrik	Gotha	Locomotives, trucks, AFV	20 Mar	8th
Klockner Humboldt Dentz	Ulm	Heavy trucks and AFV	20, 24 Feb	8th
Daimler-Benz	Stuttgart/Unter Turkeim	Light trucks, personnel carriers, aero-engines	16 Mar	8th
Volkswagenwerke	Hallersleben	M/T and A/C components	20/21 Feb	RAF BC
Daimler-Puch	Steyr	Trucks, small arms bearings	8 Apr	8th
Fichtel and Sachs	Schweinfurt	A/C components	24 Feb	15th
NSU Werke	Neckarsulm	Motorcycles, small motors	24 Feb	8th
Perl Automobil Fabrik	Atzgersdorf	Motorcycles	24 Apr	8th
General Motors	Antwerp	Motor vehicles	29 May	15th
Berliet	Lyon	Trucks	24/25 May	RAF BC
	Königsborn	Truck assembly	1/2 May	RAF BC
		Ordnance depot	28 May	8th

* AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files).

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Appendix 14

MAJOR ARMAMENT AND MISCELLANEOUS ENGINEERING ESTABLISHMENTS
DAMAGED, JANUARY-JAY 1944*

Plant	Location	Product or Type of Installation	Date	Air Force
Krupp	Essen	Armaments, shells, fuzes	26/27 Mar	RAF BC
Rheinmetall Borsig	Düsseldorf	Guns, shells, forgings	26/27 Apr	RAF BC
Press u. Walzwerke	Düsseldorf	Pressed and rolled steel	22/23 Apr	RAF BC
Mannesmann	Düsseldorf	Tubes, munitions	22/23 Apr	RAF BC
Deutsche Delta	Düsseldorf	Steel and brass	22/23 Apr	RAF BC
MAN	Augsburg	AA artillery	25/26 Feb	RAF BC
Gebr Bayer	Augsburg	Engineering	25/26 Feb	RAF BC
Masch Kleindienst	Augsburg	Engineering	25/26 Feb	RAF BC
Maschinenfabrik Duchsau	Magdeburg	Steam and Diesel engines	21/22 Jan	RAF BC
Otto Gruson	Magdeburg	Steel for AFV gears	21/22 Jan	RAF BC
Berliner Maschinenbau	Berlin/Wildau	Torpedo and submarine components	8 Mar	8th
Deutsche Eisenhandel	Berlin/Templehof	Heavy engineering	(?) Jan	RAF BC
Strebelwerke	Berlin/Templehof	Heating engineering	(?) Jan	RAF BC
Feldbahn	Berlin/Templehof	Steel pipes	(?) Jan	RAF BC
Deutsche Timken	Berlin/Templehof	Engineering	(?) Jan	RAF BC
Jürst & Co.	Berlin/Treptow	Metal works	(?) Jan	RAF BC
H. Eckert	Berlin/Lichtenberg	Agricultural machinery	(?) Jan	RAF BC
Neue Effzet	Berlin/Lichtenberg	Motors	(?) Jan	RAF BC
Danneburg-Quandt	Berlin/Lichtenberg	Engineering	(?) Jan	RAF BC
Iahr Gawron	Berlin/Neukölln	Light engineering	(?) Jan	RAF BC

* AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," I Dec 44, in 353.41--Bombing, Bulk (Classified Files).

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Appendix 14.(Cont'd.)

Plant	Location	Product or Type of Installation	Date	Air Force
Piechatzek	Berlin/Wedding	Lifts and cranes	(?) Jan	RAF BC
Pfeiffer	Berlin/Mitte	Coaches	(?) Jan	RAF PC
A. Meyer	Berlin/Horst Wessel	Machinery repairs	(?) Jan	RAF BC
Henning u. Orth	Berlin/Kreuzberg	Valve taps and wire	(?) Jan	RAF BC
A. Salinger	Berlin/Kreuzberg	Castings	(?) Jan	RAF BC
Gara Autogaragen	Berlin/Schöneberg	M/T repairs	(?) Feb	RAF BC
Esslinger Maschinen	Stuttgart	Locomotives, boilers, pumps	1/2 Mar	RAF BC
J. M. Weisemann	Stuttgart	Piston rings	25 Feb	8th
Kreidles Metall	Stuttgart	Press and drawn rods	20/21 Feb	RAF BC
Hesser Maschinenfabrik	Stuttgart	Submarine components	20/21 Feb	RAF BC
Zahnradfabrik	Stuttgart	Gears	1/2 Mar	RAF BC
Zarges	Stuttgart	Light metal products	1/2 Mar	RAF BC
Demag Werke I and II	Duisburg	Pumps, steam engines	21/22 May	RAF BC
Kabelwerke	Duisburg	Torpedo nets and cables	21/22 May	RAF BC
Berninghaus	Duisburg	Boilers	21/22 May	RAF BC
Gutehoffnung	Duisburg/Sterkrade	Engineering	(?) Jan	RAF BC
Milke Werke	Brunswick	Boilers, pipes	20/21 Feb	RAF BC
			29 Feb, 15, 23, 29 Mar, 8 Apr	8th
Karges	Brunswick	Canning machinery	20/21 Feb	RAF BC
Durlak	Karlsruhe	Small arms and ammunition	24/25 Apr	RAF BC
Wolfartsweiler	Karlsruhe	Small arms and ammunition	24/25 Apr	RAF BC
Nahmaschinen	Karlsruhe	Armaments	24/25 Apr	RAF BC
Deutsche Waffen	Karlsruhe	Munitions	24/25 Apr	RAF BC
Hartmann u. Braun	Frankfurt	Firing apparatus for sub-marine mines	22/23 Mar	RAF BC
VDM	Cologne	Detonators, shell casings	20/21 Apr	RAF BC
Waggonfabrik	Cologne	Railroad cars	20/21 Apr	RAF BC
Singer	Wittenburg	Field kitchens, petrol tanks	18 Apr	8th

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Appendix 14 (Cont'd.)

Plant	Location	Product or Type of Installation	Date	Air Force
Verein Stahlwerke	Hamm	Engineering products	23 Mar	8th
Knoevenagel	Hannover	Machine foundry	31 Jan	8th
Henschel u. Sohn	Wiener Neustadt	Heavy engineering	10, 29 May	15th
Manfred Weiss	Budapest	Heavy engineering, shells, artillery	3/4 Apr	205th Gp, RAF
Hungarian Wagon Works	Gyor	Armaments, RP cars	13 Apr	15th
Astra	Brasov	RR equipment, armaments	18 May	15th
Ausaldo	Genoa	Armaments	4 Jun	15th
Vickers-Terni	La Spezia	Armaments	10, 13 Apr	15th
Torpedo Factory	Fiume	Torpedoes	24, 25 Feb	15th
Officine Meccaniche	Modena	Armaments	13 May	15th
Cie de Fives	Lille	Heavy engineering	10/11 May	RAF BC
Gnome and Rhone	Paris/Gennevilliers	Foundry and stamping	9/10 May	RAF BC

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MAJOR MACHINE-TOOL FACTORIES DAMAGED, JANUARY-MAY 1944*

REF ID: A66222

Appendix 15

<u>Plant</u>	<u>Location</u>	<u>Product</u>	<u>Date</u>	<u>Air Force</u>
Schiess	Dusseldorf	Machine tools, magnetic mills	22/23 Apr	RAF BC
Deutsche Industrie	Berlin/Spandau	Machine tools, castings	(?) Jan	RAF BC
Deutsche Miles	Berlin/Weissensee	Machine tools	(?) Jan	RAF BC
Rabome Maschinen	Berlin/Reinickendorf	Drilling machines	(?) Jan	RAF BC
L. Lowe	Berlin/Tiergarten	Machine tools, fire- control equipment	(?) Jan	RAF BC
Zeiss Ikon	Berlin/Steglitz	Optical instruments	(?) Jan, (?) Mar	RAF BC
Naxos Union	Frankfurt	Grinding wheels	29 Jan	RAF BC
Leier u. Weichelt	Leipzig	Tools and abrasives	4 Feb	8th
Fortuna Werke	Stuttgart	Grinding wheels and measuring instruments	19/20 Feb	8th RAF BC
J.C. Eckhardt	Stuttgart	Measuring instruments	25 Feb	8th
Elektronmetall Fortuna	Stuttgart	Grinding machines and gauges	20/21 Feb	RAF BC
Bauer u. Schaurte	Neuss	Machine tools	1/2 Mar 5 Jan	RAF BC 8th

* AC/AS Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, January 1943-September 1944," 1 Dec 44, in 353.41--Bombing, Bulk (Classified Files).

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MAAF OPERATIONS IN SHINGLE, CASSINO, AND DIADEN

The Anzio beachhead campaign was divided into three phases as far as the air forces were concerned. The first phase, 2-13 January, was a cover operation consisting of attacks in northern Italy to divert enemy attention from the proposed landing site. The second phase, 13-22 January when the beachhead was established, was devoted to disrupting communications and isolating the battle area. The third phase, 22 January-25 May when the Anzio forces were united with the main body of the Fifth Army, concerned aerial cover for the landing and subsequent necessary protection.¹

During the first period, the Fifteenth attacked the marshalling yards in northern Italy, striking such railroad centers as Colzano, Vicenza, Padua, Ferrara, and Turin.² It also gave direct support to the Eighth Army by hitting the tracks at Pescara, the nearest point to the front lines yet to be bombed by four-engine aircraft,³ although except in cases of emergency, the general line of demarcation for the strategic and tactical air forces was Pisa-Rimini.⁴

In the second and third phases, the heavy bombers kept up their attacks on marshalling yards.⁵ For the most part a line roughly from Pisa to Rimini still marked the boundary for normal operations of the Fifteenth and Twelfth Air Forces, although the former did occasionally employ its forces south of this line in a role usually played by the light bombers of the tactical air forces. During the last week of January, for example, Fortresses and Liberators were used to bomb enemy motor transports on the way to Anzio and to create road blocks by destroying bridges and railroad junctions between Rome and the beachhead.⁶

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1. History of MAAF, 10 Dec 43-1 Sep 44, I, 155.
 2. Ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 59, 3 Jan 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 12, 3 Jan 44; Fifteenth Air Force, "Villar-Perosa Ball Bearing Factory and Turin-Lingotto Marshalling Yards Operation of 3 January 1944."
 3. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary No. 59, 3 Jan 44.
 4. MAAF, Air Power in the Mediterranean, November 1942-February 1945, 49.
 5. The following marshalling yards were attacked by the Fifteenth Air Force and the 205th Group, MAF in the last half of January in support of Anzio and the general Italian campaign: Empoli, Arezzo, Ferrara, Verona, Foligno, Bologna, Siena, Fabriano, Rimini, and Ancona. USSTAF, Semi-Monthly Record of Results, 16-31 Jan 44.
 6. History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 63, 31 Jan 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 30, 22 Jan 44.

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In addition to assaults against the railroads, large-scale attacks were started on the airdromes and landing grounds furnishing fighter and bomber bases to the enemy for launching air assaults against Anzio and the rest of the battle line. This part of the program, although designed to support the Italian campaign, also served to carry out the intermediate objective of POINT-BLANK, which was the destruction of the GAF wherever it could be found. The airfields affected were located in Italy, southern France, and southern Germany.⁷

In the remaining months before the junction of the Fifth Army and Anzio, the Fifteenth Air Force continued to support the beachhead and general land operations, and as late as May was still engaged in such tactical operations.⁸ The bulk of continuous close support by MAAF, however, was done by the 205th Group, PAF in its night work. In the critical month following the landing, the planes of this organization were dispatched almost every night to bomb troop concentrations, roads, and towns in the beachhead area.⁹

Since the CCS had given top theater priority to the Italian battle in the MTO, there was generally no objection to the use of the Fifteenth to push this campaign except when it came in conflict with POINTBLANK.¹⁰ In the latter part of February the bad weather which had slowed up POINTBLANK operations gave promise of clearing. Spaatz was extremely anxious to take advantage of the opportunity thus offered to stage a series of concentrated and heavy attacks which would vitally cripple the enemy's remaining aircraft-production facilities. He therefore planned a number of missions, several of which were to be joint or coordinated attacks by the Eighth and Fifteenth Air Forces. One such mission was planned for 20 February, but on 19 February the ground situation and overriding priority of the Italian campaign threatened to interfere. Eaker notified Spaatz that both Clark and Cannon believed that

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7. The airdromes and landing grounds attacked by the Fifteenth during the last half of January were: Ciampino, Centocelle, Montpellier/Frejorgues, Istres Le Tube, Salon-de Provence, Aviano, Maniago, Villaorba, Lavariano, Udine/Campoformido, Klagenfurt, Osoppo, Perugia, Guidonia, Rieti, and Aquila. USSTAF, Semi-Monthly Record of Results, 16-31 Jan 44; History of MAAF, 10 Dec 43-1 Sep 44, XIII, MAAF, Operational Summary No. 24, 16 Jan 44, No. 27, 19 Jan 44, No. 28, 20 Jan 44; *ibid.*, VII, Opsum, Eaker to Arnold, Portal, Spaatz, 21 Jan 44.
 8. For example, in the first half of February operations were confined chiefly to hitting marshaling yards, roads, airfields, and bridges in support of the ground effort. Between 12 February and 2 March the Fifteenth dispatched 799 planes and dropped 1,457 tons of bombs against troop concentrations, motor transport parks, stores depots, and bivouac areas. On 5 May, 116 B-24's attacked the Podgorica troop concentration, dropping 276 tons of bombs. History of MAAF, 10 Dec 43-1 Sep 44, X, Fifteenth Air Force, "Operations in Close Support of Ground Forces, 12 February-15 August 1944"; *ibid.*, XII, Opsum, Eaker to Arnold, Spaatz, Portal, DeFord (Ref. No. AI-369), 6 May 44; USSTAF, Semi-Monthly Record of Results, 1-15 Feb. 44.
 9. History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Eaker to Spaatz, Arnold, Portal, 13, 14, 16, 17, 19, 20, 21 Feb. 44.
 10. For examples of the targets hit by MAAF during February and the first half of March in support of the ground armies, see App. II, this study.

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20 February would be a critical day at Anzio and that they had expressed hope that the Fifteenth would give full heavy-bomber support. Furthermore, the weather over southern Germany did not hold any promise for visual bombing, and area bombing, as suggested by Spaatz if such a condition existed, was out of the question since the Fifteenth lacked H2X equipment. Eaker asked if the Eighth needed the Fifteenth for diversionary purposes anyway. If so, he would split his forces, but he wished to avoid the formal declaration of a tactical emergency by Wilson. He did not want a precedent to be established.¹¹

Spaatz replied that he would leave the matter to Eaker's discretion, but that he was concerned over the possible development in Italy of a "continuous emergency" which would prevent the use of the strategic air forces for the purposes for which they were organized.¹² Eaker finally decided to divide his force and the next day 105 heavies operated over the beachhead and 126 attempted to reach Regensburg. The latter planes, however, were forced to return because of icing conditions over the Alps and never reached their target. But they did furnish diversion which allowed the Eighth to proceed as planned, and for this Spaatz was grateful.¹³ Although the mission to Regensburg was abortive, Eaker had been able to satisfy both of his superiors and prevent a formal declaration of an emergency. In the next few months there were several other instances when major heavy-bomber support was given to the ground forces, but each time it was done by request and Wilson never had to declare a tactical emergency.¹⁴

In at least one instance, however, the strategic forces were used, not only at the request of Wilson but also on the suggestion of General Arnold, to give very heavy support to the ground army. This was at Cassino. Arnold, worried because of the impasse which existed at this place and which held up the union with the Anzio forces, suggested that all available air power be concentrated in an attack which would blast this enemy anchor off the map and "break up every stone in the town behind which a German soldier might be hiding." As long as this stalemate existed, the part of MAAF in the CBO would be of limited value because of the diversions necessary to aid the land campaign. Once the ground armies were free to move, the strategic air forces could resume their primary mission without interruption. Because of the success of similar strategy used in the Desert and Tunisian campaigns--although, to be sure, Cassino

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11. History of MAAF, 10 Dec 43-1 Sep 44, XXII, GS IE, Eaker to Spaatz, #29, 19 Feb 44.
 12. Ibid., I, 145, Redline, Spaatz to Eaker, 19 Feb 44.
 13. Ibid., Redline, Spaatz to Eaker, 20 Feb 44.
 14. Ibid., for the method of requesting tactical aid of MAAF, see ibid., VIII, Operations Instructions, No. 11, 4 Mar 44.

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presented a different terrain--Arnold believed that such a maneuver would be successful.¹⁵

Eaker replied that the air and ground forces had already worked out a plan coinciding almost exactly with that proposed by Arnold, but weather had delayed its execution. At first it had been lack of suitable flying weather, but now the troops were so mired down that they were unable to move. Eaker warned Arnold not to be disappointed if the operation failed to connect the present line of battle with the Anzio beachhead. He himself did not think such bombing would shake the Germans from their current position or compel them to abandon their defensive role, particularly if they followed their orders to hold to the last man. As to whether or not the Italian campaign was likely to jeopardize PCI TSLM, Eaker pointed out that there had never been a day on which the heavies had participated in the land battle when weather would have allowed them to reach south German targets.¹⁶

For one month before the big raid, the Fifteenth had been aiding in the battle for Cassino. On 15 February, after giving the monks due warning, 142 planes dropped approximately 353 tons of bombs on the monastery, which the Germans were using for military purposes. On the morning of 15 March began the big air assault on the town itself. A force of 263 Fortresses and Liberators dropped 800 tons of bombs on Cassino, and including that dropped by the B-25's and L-20's the total tonnage was over 1,100 tons.¹⁷ As a result of these operations Cassino was reduced to rubble, but as Eaker had feared, the Germans were not dislodged, and it was not until some time later that the army was able to open a hole in the line and continue its advance.

For the most part, however, the aid given by the Fifteenth to the Italian campaign was strategic rather than tactical. It consisted largely of attacking important railroad centers through which supplies and men were being funnelled to the front. Although the Fifteenth did aid the Twelfth Air Force in interdiction,¹⁸

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15. Ibid., II, ltr, Gen. H. H. Arnold to Lt. Gen. Ira C. Eaker, undated.
 16. Ibid., II, ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold, 6 Mar 44.
 17. Ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 70, 20 Mar 44; ibid., 4, Fifteenth Air Force, "Operations in Close Support of Ground Forces, 12 February-15 August 1944"; ibid., XII, Opsum, Eaker to Arnold, Spaatz, Portal (Ref. No. AI-302), 16 Mar 44.
 18. AG/AS, Intel., Analysis Div., European Br., "Strategic Bombing of Axis Europe, Jan 43-Sep 44," 1 Dec 44, 353.41--Bombing, Dulk (Classified Files). For example, MAAF attacked the marshalling yards at Orbetello and the track at Montalto di Castro on the night of 2/3 March and Littorio and Tiburtina on 3 March in order to block traffic leading immediately into Rome and the battle front. The attack on Pontassieve, southeast of Florence, on 11 March cut all through tracks to the battle front except one, and on this one track derailed cars and debris temporarily blocked the line. USSTAF, Semi-Monthly Record of Results, 1-15 Mar 44; History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 69, 13 Mar 44.

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its primary interest was in the railroad centers of the Po Valley--the crossroads for Italian traffic to Germany and the Balkans.¹⁹ In the early part of 1944, the Germans were able to limit serious tie-ups to the area south of Rimini-Pisa where the Twelfth Air Force kept battering the roads leading to the battle front. The plans of the Fifteenth promulgated in early March called for concentrated attacks on the north Italian yards to complement those of the tactical air forces. The slowness of the ground advance, however, led Devers to suggest that the Fifteenth "thicken the bombings of the mediums" by striking Rimini, Bologna, Florence, and Pisa and thereby more quickly cut off the supplies to the Germans south of Rome. What he wanted was immediate rather than long-range results.²⁰

The hub of enemy communications was Florence, whose marshalling yards were important to the Germans for final handling of both troops and equipment to the battle fronts over the main lines to Rome. The Allies, however, were hindered in their efforts to choke off this traffic by their policy of not endangering or destroying cultural or historical sites unless absolutely necessary. The result was that the Allies left Florence alone and attempted to accomplish the same results by bombing the yards of numerous surrounding cities, such as Pontassieve, Prato, Poggibonsi, Castelfiorentino, Pontedera, and Arezzo.²¹ The attacks on these yards and the work of interdiction on the part of the tactical air forces south of Florence hard pressed the enemy, although traffic inched forward as the Germans repaired cuts in their lines. This traffic, however, was insufficient for the full battle needs. Prisoners of war taken from late March to June all reported that soldiers came by rail as far as Florence but from there were forced to go by foot or motor transport.²²

The fact that the rail lines to Florence were able to function without too much delay led the strategic forces to try to knock out the yards in the Po Valley and destroy the considerable amount of freight which had accumulated in them. For the most part MASAF used these targets as alternates when POINTBLANK operations were not feasible,²³ although during the last week of March it was

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19. After the withdrawal of Italy from the war in September 1943, the Germans organized an Army Transport Control (Wehrmacht Verkehrsdirektion) at Verona, the southern terminus of the Brenner line. This organization controlled all freight traffic entering Italy over the five main routes and by shifting the load from one line or marshalling yard to another was able to keep congestion down when bombing was not too heavy. U. S. Strategic Bombing Survey, Transportation Report No. 1, Nov 45, pp. 4-5, KO-33545.
 20. History of IMAAF, 10 Dec 43-1 Sep 44, II, memo, Eaker to Director of Operations, IMAAF, 11 Mar 44.
 21. For example, the following marshalling yards were attacked by MASAF during the first half of March: Orbetello on the night of 2/3 March; Littorio and Rome/Tiburina on the 3d; Pontassieve, Prato, Poggibonsi, and Castelfiorentino on the 7th; and Prato, Pontassieve, and Padua on the 11th. USSTAF, Semi-monthly Record of Results, 1-15 Mar 44.
 22. History of IMAAF, 10 Dec 43-1 Sep 44, VI, IMAAF, Air Intelligence Weekly Summary, No. 85, 3 Jul 44.
 23. Ibid., II, ltr, Lt. Gen. Ira C. Eaker to Gen. H. H. Arnold (Round-up Item No. 7), 7 Apr 44.

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able to mount some of its heaviest attacks on these northern yards. In two days alone, 28 and 29 March, 974 heavies and 344 fighters of the fifteenth loaded with 2,218 tons of bombs were airborne against enemy communications. They were aided at night by the 205th Group, RAF. Among the targets hit during that week, were important yards at Turin, Milan, Verona, Vicenza, Faenza, Bolzano, Bologna, Mestre, and Rimini. In the course of these operations some industrial targets also suffered. For example, the Fiat aero-engine factory at Turin was set afire and burned for 24 hours after the attack, and the Breda shipbuilding and armaments works, a benzine and petrol depot, and chemical plant, all at Mestre, were seriously damaged.²⁴ The intense attacks were carried on through April with all rail approaches to Italy from Trieste to Alessandria being harassed, and with traffic south of the Po Valley being backed up by repeated assaults on marshalling yards, rail junctions, and bridges.²⁵

After DIADIA was begun on the night of 11 May, much of the effort of the strategic air forces was directed to support this project. On D-day plus 1 the day bombers were instructed to employ their maximum number on the first mission. Double sorties would be flown and the force of the second mission was to be on a maximum sustained-operations basis. The targets to be attacked on D-day plus 1 were: enemy headquarters at Monte Soratto and enemy command posts; the harbors at San Stefano, Piombino, Porto Ferrajo, Leghorn, La Spezia, and Genoa; the Leghorn marshalling yards; and the Genoa-La Spezia rail line. The remainder of the bombing effort would be expended on the marshalling yards north of Rimini-Pisa. Subsequent operations would be against similar targets, but with the possibility of sudden new assignments depending upon the tactical situation. The night bombers were to bomb the harbors at Porto Ferrajo, Piombino, and San Stefano on the nights of D-day plus 1 and 2, and otherwise were subject to the same general regulations as the day bombers.²⁶

The strategic attack opened with an assault on the corps headquarters at Massa d'Albe, but for the next three days emphasis was put on the enemy's lines of communications. These consisted of raids on such places as Arezzo, Livorno, Bologna, Bolzano, Bronzolo, Borgo, Cesena, Castelmaggiore, Civitavecchia, Fidenza, Faenza, Ferrara, Genoa, Lodi, Mestre, Orbetello, Padua, Piacenza, Parma, La Spezia, Vicenza, and numerous other points.²⁷ Constant attacks, by day and night, on enemy communications were continued throughout the month and the first part of June. Railroad centers and harbors bore the brunt of these raids, although the 205th Group, RAF dropped considerable tonnage on highways

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24. Fifteenth Air Force, Tactical Mission Report, 28-29 Mar 44; History of MAAF, 10 Dec 43-1 Sep 44, VI, MAAF, Air Intelligence Weekly Summary, No. 71 (27 Mar 44), No. 72 (3 Apr 44); *ibid.*, VII, Opsum, Baker to Arnold, Spatz, Portal, (Ref. No. AI-370), 25 Mar 44, (Ref. No. AI-397), 28 Mar 44, (Ref. No. AI-305), 29 Mar 44, (Ref. No. AI-312), 30 Mar 44.
25. USSTAF, Semi-monthly record of results, 16-30 Apr 44.
26. History of MAAF, 10 Dec 43-1 Sep 44, VIII, MAAF, Operations Order No. 35, 12 May 44.
27. *Ibid.*, MAAF, Air Intelligence Weekly Summary, No. 79, 22 May 44.

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between Rome and the battle front.²⁸

Support of DIADÉM was not confined solely to Italian operations. After the Germans had attacked Tito's headquarters with the hope of capturing him and ending the Yugoslav Partisan activities, MAAF began a series of Balkan raids designed to aid the guerrillas and thus keep the Germans busy on another front. Although these raids were not primarily a MASAF project, the strategic forces aided the tactical and coastal commands in these Balkan forays. The Fifteenth made attacks on German troop concentrations on 26, 28, and 29 May, using 593 planes and dropping approximately 1,077 tons of bombs.²⁹

The scope of operations also extended to France. In order to disorganize the movement of reinforcements to Italy, the heavies began to hit the marshaling yards of southern France. On 25 May, the yards in the Lyon area and at Toulon were successfully attacked, leaving the through lines blocked, worksheds wrecked, and many cars destroyed.³⁰ The operations in southern France, however, were not only for aiding DIADÉM but also in preparation for the forthcoming DRAGOO. These attacks, combined with the increasingly heavy raids (for OVERLOAD) on communications in northern France by the England-based air forces, pounded the enemy until he was almost punch-drunk.

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28. In the last half of May the Fifteenth Air Force dropped 1,125 tons of bombs on nine Italian railroad centers. Some of the harbors attacked during this same period were: San Stefano, Piombino, Genoa, Leghorn, La Spezia, Porto Ferrajo, and Porto Marghera. The bombing of highways included the roads through and around such places as Frosinone, Valmonte, Terracina, Viterbo, Subiaco, and Rome environs. USSTAF, Semi-Monthly Record of Results, 16-31 May 44; History of MAAF, 10 Dec 43-1 Sep 44, VII, Opsum, Baker to Arnold, Spantz, Portal (Ref. No. AI-399), 18 May 44, (Ref. No. AI-307), 19 May 44, (Ref. No. AI-326), 20 May 44, (Ref. No. AI-351), 23 May 44, (Ref. No. AI-376), 25 May 44, (Ref. No. AI-385), 26 May 44, (Ref. No. AI-317), 28 May 44, (Ref. No. AI-327), 29 May 44, (Ref. No. AI-338), 30 May 44, (Ref. No. AI-357), 1 Jun 44, (Ref. No. AI-315), 5 Jun 44.
29. The places attacked were: Bihac, Nikšić, and Podorica. Ibid., X, Fifteenth Air Force, "Operations in Close Support of Ground Forces, 12 February-15 August 1944."
30. Ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 80, 20 May 44.

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COORDINATED ATTACKS BY USTAF, FEBRUARY-JUNE 1944

The first of USTAF's coordinated attacks was set for 9 February with the object of hitting LA targets, but the deterioration of the weather in the ITO made it necessary for the Fifteenth to cancel its part of the operation. The Eighth got 848 bombers in the air, but prior to departure from the English coast they were also recalled because of increasing cloud conditions over the target areas.¹ Another coordinated attack for 15 February was also canceled by the Fifteenth because of weather. A third such mission planned for 20 February conflicted with the request for Fifteenth Air Force support of the Anzio battle, but Taker split his force and sent part to the beachhead and dispatched the other to participate in the planned coordinated attack. The latter mission proved abortive for the ITO forces, however, since weather turned the planes back in the vicinity of Trieste.² Another joint mission for 21 February was also canceled by the Fifteenth because of weather.

The first successful coordinated attack took place on 22 February. The targets for the Fifteenth were the Regensburg aircraft factories. These had last been attacked by the Eighth Air Force in August 1943. The damage inflicted at that time had reduced the output of Me-109's from 200 to 250 a month to an estimated 50. Repairs were under way almost immediately and by the end of January 1944 the plants at Regensburg/Prüfening and Regensburg/Obertraubling apparently were in full operation again.³ It was, therefore, imperative that these factories be again put out of commission. Over Prüfening the bombers encountered solid overcast, but 65 B-17's dropped 153 tons of bombs with unobserved results. Fifteen aircraft returned their bombs to their bases, and 21 dropped 42 tons on the marshalling yards and town of Petershausen. At Obertraubling, 132 B-24's dropped 178 tons of general-purpose 500-pound bombs and 47 tons of incendiaries with good results. The bombers experienced heavy and accurate flak over Klagenfurt, Pola, and Trieste and encountered about 120 enemy fighters, some of which were rocket-firing twin-engine planes. The Fifteenth lost 19 bombers and two fighters and claimed a score of 42-17-6. As a diversion to the main force, freshman missions bombed Zagreb airdrome and Sibenik and Zara harbors, but in all of these there was no encounter with enemy aircraft nor any losses.⁴

The Eighth Air Force met with weather trouble which prevented six combat wings from assembling and necessitated recalling two more before they reached

1. CI-IN-6221 (9-2-44), Spaatz to Arnold, 4K-3578, 9 Feb 44; ktr, Maj. Gen. F. L. Anderson to Brig. Gen. L. C. Guter, 11 Feb 44, in 312.1--Operations Letters (Classified files).
2. History of MAAF, 10 Dec 43-1 Sep 44, XVII, MAAF, Central Mediterranean Operational Summary, No. 59, 20 Feb. 44.
3. Ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 67, 28 Feb 44.
4. Ibid., I, 149; ibid., II, Opsum, Taker to Spaatz, Arnold, Portal (Ref. No. AI-302), 23 Feb 44; ibid., XIII, MAAF, Central Mediterranean Operational Summary, No. 61, 22 Feb 44; ibid., XVI, MAAF, PRO Air Communique, 23 Feb 44.

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enemy home territory. The latter, however, dropped nearly 234 tons of bombs on Dutch targets of opportunity on their return to England after receiving their recall. Some 289 B-17's of the 1st Bombardment Division were able to proceed to their targets in central Germany and about 175 dropped 379 tons of bombs with good results on the aircraft factories at Aschersleben, Bernburg, ernigerode, Halberstadt, Magdeburg, Merburg, and Blunde. Here also, rocket-firing planes were encountered, and a total of about 200 enemy aircraft attacked, many being vicious and persistent. The Eighth lost 38 bombers and 11 fighters but claimed 91 enemy planes destroyed, 25 probable, and 43 damaged.⁵

The next coordinated attack was on 24 February. On this date 37 B-17's of the Fifteenth dropped 261 tons of bombs on the Daimler-Puch factory at Steyr, causing severe damage to the machine and assembly shops, foundry, offices, power plant, and transformer station. Again the Germans put up aggressive opposition, about 110 fighters meeting the bomber formations. Some of the enemy planes fired rockets or used aerial bombs. Sixteen bombers and three fighters were lost as against 35-12-5.⁶ The Eighth dispatched 809 bombers against Gotha, Schweinfurt, and Postock. The Messerschmitt factory at the first-named city felt the weight of 382 tons of bombs delivered by 169 bombers of the 2d Bombardment Division, and an additional 44 B-24's of the same division laid 78 tons on the town of Eisenach. A force of 236 B-17's of the 1st Bombardment Division reached Schweinfurt and dropped 573 tons on the Kugelfischer, WKF Werke I, and Fichtel and Sachs ball-bearing factories. At the city of Rostock, 255 B-17's plastered the shipbuilding and aircraft factories with about 604 tons of incendiaries and GP bombs. Again the enemy put up stiff opposition, which cost the U.S. forces 49 bombers and 10 fighters in exchange for 120-27-55.⁷

The next successfully completed coordinated attack was on the following day, 25 February. The previous night, Wellingtons of the 205th Group, RAF unloaded almost four tons of bombs on the Daimler-Puch factory at Steyr and nearly 53 tons on the Vels marshalling yards and vicinity. No respite was to be allowed the enemy. On 25 February, Regensburg was again the target, but this time for both the Eighth and Fifteenth. This was the first instance when both air forces were over the same target on the same day. The Fifteenth dispatched a force of 132 B-17's and 264 B-24's against this city, but only 46 B-17's and 103 B-24's were able to reach their objectives. Although aggressively attacked by approximately 200 fighters, the bombers were able to destroy their targets almost entirely. An hour later 266 B-17's of the

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5. Ibid., I, 129; Narrative History of Headquarters, Eighth Air Force, Feb 44; Eighth Air Force Operations Report.
 6. History of MAAF, 10 Dec 43-1 Sep 44, XII, Opsum, Baker to Spaatz, Arnold, Portal (Ref. No. AI-324), 25 Feb 44; ibid., VIII, MAAF, Central Mediterranean Operational Summary, No. 63, 24 Feb 44; ibid., VI, MAAF, Air Intelligence Weekly Summary, No. 67, 23 Feb 44.
 7. Narrative History of Headquarters, Eighth Air Force, Feb 44; ibid., Annex C.

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Eighth Air Force completed the destruction of Regensburg/Obertraubling and Regensburg/Prüfening with 640 tons of bombs. The earlier assault by the Fifteenth had taken some of the sting out of the opposition to the Eighth, only 35 to 50 fighters being encountered. The former air force lost 32 bombers while the latter lost only 12. The claims of the Fifteenth were 52-10-9 and those of the Eighth were 13-1-7. The MASAF forces which failed to reach Regensburg attacked Graz/Thalerhof and port installations at Tora, Fiume, and Pola as secondary targets and with good results.⁸

In addition to the attack on Regensburg, the Eighth also sent forces against the Bachmann von Blumenthal & Co. (Me-110 and Me-410 components and final assembly) factory at Würth near Luremburg; the Messerschmitt factory at Augsburg; and the ball-bearing center at Stuttgart. At the latter place bombs struck not only the Vereinigte Kugellager Fabrik (VKF), but also the Fortuna Werke Spezial Maschinen Fabrik, manufacturers of grinding machines, gauges, and measuring instruments, and the piston ring, submarine, and temperature-gauge plant of the J. F. Weisemann Co. Crippling damage was inflicted on all targets in the three cities.⁹

This was the last successfully completed coordinated attack until after D-day (6 June). In the period covered by this study 15 were proposed, all of them by the Eighth Air Force, and two were implied. Of this total of 17, 9 were canceled because of weather, 1 was declined, and 4 were abortive. The last proposed attack before D-day was on 12 April, but was canceled because of weather. After that date both air forces were busy with either OVERLORD preparations or the support of the Italian and Balkan campaigns, and POINTBLANK operations in general were uncoordinated except for the filing of daily bombing intentions. The next coordinated attack after April was proposed for 16 June, but again weather forced cancellation. The first coordinated attack to be completed after 25 February was on 7 July.¹⁰

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8. History of MAAF, 10 Dec 43-1 Sep 44, VIII, MAAF, Central Mediterranean Operational Summary, No. 64, 25 Feb 44; *ibid.*, XII, Opsum, Eaker to Spaatz, Arnold, Portal (Ref. No. AI-332), 26 Feb 44; *ibid.*, VI, MAAF, Air Intelligence Weekly Summary, No. 66, 6 Mar 44; Narrative History of Headquarters, Eighth Air Force, Feb 44, annex C; Eighth Air Force, Air Operations Report, Mission 235, 25 Feb 44.
 9. Narrative History of Headquarters, Eighth Air Force, Feb. 44; *ibid.*, Annex C; Eighth Air Force, Air Operations Report, Mission 235, 25 Feb 44; Eighth Air Force, Interpretation Report No. S.A. 1061, Mission 235, 25 Feb 44.
 10. For the list of proposed coordinated attacks, see Table 7, this study.

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