

THE STRATEGIC BOMBING OF THE GERMAN RAILWAYS
IN WORLD WAR II

by 1264

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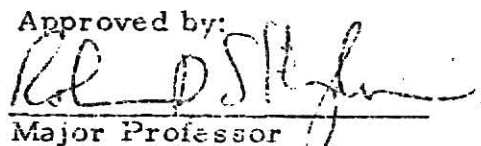
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1. Introduction

The purpose of this thesis is to consider the effectiveness of the Allied attrition strategy directed against the German transportation system by the strategic air forces in World War II. It examines the results of the air attacks as they effected railway operations within the Third Reich, and the dislocation within the economy emanating from the disruption of railway performance.

Although this work will scrutinize the railway system, it must be noted that Germany also relied heavily on her inland waterways, canals and highways to move raw materials and finished products to industry and consumer. By 1939 these secondary modes of transport were becoming increasingly keen competitors of the railways. Much of their success was a result of the financial support they received from the new leaders of Germany who were interested more in the novel than practical means of transport. Due to its lack of use during the war the huge outlays for the construction of the Autobahn stands as an example of Hitler's shortsightedness as a warlord and economist.

The railway administration's lack of preparation for the contingencies which would result from an air attack against the system was dissipated by the inability of the Allies to perfect the instrument of destruction - the strategic bomber. Controversy developed within the Allied camp over the correct strategy of attrition to be employed. Doubts about the accuracy of bombing soon began to develop and was more than confirmed through photo-reconnaissance. It was not until the spring of 1944 that the strategic bomber, through improvements in tactics and technology, was able to become a creditable weapon

against Germany. Even then it suffered from poor economic intelligence and a controversy over priorities which led to the dissipation of its effectiveness.

Opportunities to disrupt rail transportation occurred during the winter of 1941-1942 when a large proportion of locomotive and cars were moved to the Russian front. The British Royal Air Force, however, continued to focus its attention on the area bombing of cities. Until the spring of 1944 the percentage of bombs dropped on transportation targets formed only a negligible proportion of the total dropped on Germany. The results were anything but heartening.

The second phase of the attack on the European railways system came when General Eisenhower demanded the use of the heavy bombers to assist in knocking out the French railways as a prerequisite to a successful cross-Channel attack. The strategy was formulated in the Transportation Plan which was adopted by Air Chief Marshal Tedder. The success achieved under this plan encouraged Tedder to propose a similar formula for Germany. Hence, the origin of the strategic bombing of the German railways owed its birth to the tactical success achieved in France.

The complexity of the Reichsbahn proved to be its best defense against the strategic air offensive which was directed against it after June 1944. Decline set in very slowly even when the rate of repair could no longer overcome that of destruction. The Reichsbahn resorted to every ingenious device known to curtail the encroaching destruction from the air. Bombed tracks were restored to operating condition within 48 hours. Even up to April 1945

Military traffic was at best only delayed. The stockpiles for the Ardennes offensive in December 1944 were amassed by the Reichsbahn in a last supreme effort. The decline in movement, when it did become noticeable was clearly evident in the coal supply situation. When the Reichsbahn was incapable of coal movements from the Ruhr the death knell had sounded for the German war economy.

Allied concepts in regards to the strategic air offensive against German railroads were based on the illusion of operations in the strategical sphere and the harsh necessity of tactical operations whose results were always much more easily identifiable and readily forthcoming. The greatest successes against the railways were always achieved when the strategic bombers were assigned tactical missions, an anthem which was opposed by the bomber barons, but enforced by General Eisenhower.

II. Condition of German transportation prior to 1939

Germany began World War II with a transportation system superior to that of any European country. A complex system of railways, waterways and canals served to move raw materials to industry and the finished products to the consumer. In addition to the system of railways and canals, the National Socialist government undertook an ambitious road construction program to improve highway facilities.

In 1937, the Reichsbahn, totaled 33,804 miles and formed the keystone in the transportation system. The Reichsbahn handled 73 percent of all freight, as compared to 21 1/2 percent by inland waterways and only 2 1/2 percent by highway vehicles. A small system of privately owned railroad lines moved the remaining 3 percent of the freight traffic. These lines, which were scattered throughout Germany and totaled only 4,485 miles, generally served as feeder lines for the Reichsbahn.¹

Passenger travel was also dominated by the Reichsbahn which accounted for 70 percent of the total. Private railways moved 3 percent of the passengers. Motor vehicles, however, were making successful inroads into the Reichsbahn's monopoly by absorbing the remaining 27 percent of the passenger business by 1937.²

Although the railways were able to provide dependable performance in peacetime, divisive policies emanating from the leadership in Berlin failed to ensure a strengthening in the depth of the system for the strain of wartime operations. Shortsightedness in planning and in the allocation of resources

for improvements within the transportation field were less than beneficial to the railways.

Railway management and decision making within Germany was subject to political as well as economic considerations. After World War I the victorious powers demanded and received as reparations 5,000 locomotives, 15,000 passenger cars and 135,000 freight cars.³ Much of the equipment was overage and in questionable operating condition due to its intensive use throughout the war. The loss of this equipment in the early 1920's forced the state to initiate a series of heavy replacement purchases. The trend of increased sums spent upon rolling stock continued until the formation of the German Reichsbahn Company in 1924. The company reduced new purchases drastically when it realized that the rolling stock was becoming excessive. It chose not to keep a reserve of rolling stock on hand, but to purchase new stock according to increased demand. Hence, the Reichsbahn's policy was to increase purchases during the boom years of 1927-1929 and follow through with sharp reductions for the depression years 1930-1932.⁴

Expenditures for Rolling Stock
of the Reichsbahn and its Predessors⁵

(millions of RM: up to 1923 millions of gold mark)

| <u>Year</u> | <u>R. M.</u> | <u>Year</u> | <u>R. M.</u> | <u>Year</u> | <u>R. M.</u> |
|-------------|-----------------|-------------|-----------------|-------------|------------------|
| 1918 | 349.5 | 1925 | <u>2</u> / 75.7 | 1932 | 69.6 |
| 1919 | 170.2 | 1926 | 64.1 | 1933 | 88.5 |
| 1920 | 456.3 | 1927 | 202.0 | 1934 | 126.5 |
| 1921 | 308.2 | 1928 | 212.4 | 1935 | 130.4 |
| 1922 | 261.7 | 1929 | 203.7 | 1936 | 125.1 |
| 1923 | 296.8 | 1930 | 172.8 | 1937 | 138.1 |
| 1924 | <u>1</u> / 70.2 | 1931 | 103.7 | 1938 | <u>3</u> / 213.4 |

1 / 6 months

2 / 15 months

3 / 187.1 in Germany, 26.3 in Austria.

The Reichsbahn encountered difficulty in recovering its financial stability because of the increased competition from inland shipping and the trucking industry. Freight and passenger revenue also suffered a decline during the years following the Depression. The Reichsbahn concentrated its energies upon increasing the efficiency of the system, rather than upon making new outlays for equipment. Hence, yearly purchases for rolling stock during the 1930's did not exceed the expenditures made during the boom years 1927-1929.

The stock of locomotives on hand between 1929 and 1937 declines by 9.4 percent. Emphasis was placed upon the construction of midget locomotives, used mainly for shunting purposes and electric locomotives. Of the 21,278 steam locomotives in 1938 only 18,533 were available for traffic, the remainder were undergoing repair.⁶ Between 1929 and 1937 the freight car fleet decreased by 10.3 percent and the number of passenger cars fell by 4.7 percent.

| | Rolling Stock of the Reichsbahn ⁷ | | | | | | | | Austria Greater | |
|-------------------|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------|-----------------|
| | <u>1925</u> | <u>1929</u> | <u>1932</u> | <u>1934</u> | <u>1936</u> | <u>1937</u> | <u>1938</u> | <u>1938</u> | ONLY | Germany Greater |
| Locomotives | 27,620 | 24,091 | 21,489 | 21,105 | 21,792 | 21,838 | 23,050 | 2,159 | 25,209 | 27,669 |
| Steam | 27,373 | 23,698 | 21,002 | 19,887 | 20,187 | 20,166 | 21,278 | 1,910 | 23,188 | 23,379 |
| Midget | ----- | 2 | 85 | 754 | 1,082 | 1,127 | 1,200 | 3 | 1,203 | 1,218 |
| Electric | 246 | 388 | 400 | 461 | 521 | 543 | 571 | 241 | 812 | 828 |
| Self-Powered Cars | 490 | 1,151 | 1,255 | 1,384 | 1,688 | 1,762 | 2,059 | 111 | 2,170 | 2,239 |
| Passenger Cars | 63,829 | 63,641 | 64,413 | 59,925 | 60,339 | 60,629 | 63,093 | 5,849 | 68,942 | 68,965 |
| Baggage Cars | 21,831 | 20,990 | 21,063 | 20,407 | 20,045 | 19,969 | 20,473 | 1,555 | 22,042 | 21,990 |
| Freight Cars | 688,810 | 660,748 | 641,515 | 594,128 | 595,360 | 593,088 | 617,979 | 32,250 | 650,229 | 656,622 |
| Box Cars | 231,291 | 229,950 | 226,124 | 212,470 | 211,192 | 209,420 | 218,047 | 13,135 | 231,182 | 232,577 |
| Open Cars | 450,175 | 417,580 | 400,824 | 365,914 | 367,130 | 365,516 | 380,993 | 18,144 | 399,137 | 403,951 |
| Company | | | | | | | | | | |
| Service Cars | 7,344 | 13,218 | 14,567 | 15,744 | 17,038 | 18,092 | 18,939 | 971 | 19,910 | 20,032 |

The Reichsbahn's tight financial situation was also reflected in the amount of locomotive tons purchased and exported. Locomotive production was halved in 1924 and 1925. The greater percentage of locomotive tons built were for the export market. During the National Socialist period the total of locomotive tons exported averaged 35 percent. In 1938, one year prior to the outbreak of war, 68 percent of all locomotive tons built left the country.

German Output of Steam Locomotives 1918-1938⁸

| <u>Year</u> | <u>Total Output (tons)</u> | <u>Output for Home Market</u> | <u>Exports</u> | <u>% of Total Exported</u> |
|-------------|--------------------------------|-----------------------------------|----------------|--------------------------------|
| 1918 | 100,000 | 98,000 | 2,000 | 2 |
| 1919 | 100,000 | 94,000 | 6,000 | 6 |
| 1920 | 215,000 | 200,000 | 15,000 | 7 |
| 1921 | 254,000 | 203,000 | 51,000 | 20 |
| 1922 | 260,000 | 130,000 | 130,000 | 50 |
| 1923 | 137,000 | 111,000 | 26,000 | 19 |
| 1924 | 80,000 | 64,000 | 16,600 | 20 |
| 1925 | 35,400 | 12,900 | 22,500 | 63 |
| 1926 | 25,000 | 10,000 | 15,000 | 60 |
| 1927 | 26,600 | 10,600 | 16,000 | 60 |
| 1928 | 44,300 | 24,300 | 20,000 | 45 |
| 1929 | 30,600 | 6,100 | 24,500 | 80 |
| 1930 | 49,000 | 7,000 | 42,000 | 86 |
| 1931 | 27,200 | 12,200 | 15,000 | 85 |
| 1932 | 15,000 | 13,500 | 1,500 | 10 |
| 1933 | 13,400 | 11,400 | 2,000 | 15 |
| 1934 | 17,900 | 15,400 | 3,500 | 14 |
| 1935 | 20,000 | 12,400 | 8,000 | 40 |
| 1936 | 28,500 | 18,000 | 10,000 | 35 |
| 1937 | 33,600 | 20,100 | 13,500 | 40 |
| 1938 | 53,100 | 17,100 | 36,000 | 68 |

The inability of the Reichsbahn to plan for an increase in its rolling stock to satisfy the growing demands in transportation resulted from the difficulties incurred in balancing income and expenses. Dwindling revenue, which characterized operations in the 1930's, forced management to curtail new purchases and attempt to mobilize existing reserves of equipment. Governmental policies compelled the Reichsbahn to make unnecessary investments in public works projects such as the Autobahn, and the reconstruction of large cities. These policies were less than beneficial to the Reichsbahn's finances, already strained by the loss of revenue from passenger and freight traffic.

Revenue from passenger traffic declines after reaching a high point in 1931. The major cause of the loss can be attributed to the reduced rates enjoyed. In 1929 fifty-six percent of all passengers traveling by rail benefited from reduced rates. By 1937 this figure had reached 72 percent. Revenue per passenger kilometer dropped 3.3 percent from 1929 to 1932. The decrease continued after the National Socialists took over the reins of government. Much of the shrinkage in revenue during the National Socialist period was accounted for by the 'Strength through Joy' trips of the German labor front, group journeys to the gala performances of the Third Reich and the increase in troop movements and furlough traffic of the Wehrmacht.⁹

Freight revenue declined 12 percent over the period 1929-1932. By 1937 ton kilometers had declined 19.6 percent. In 1929 fifty-seven percent of the goods shipped by rail moved under exceptional rates. The loss in freight revenue per ton kilometer was occasioned by the numerous tariff cuts invoked in the competition with the trucking and inland shipping industries. Added to

this was the growing proportion of military goods and low-rated mass products such as construction materials.¹⁰

Reichsbahn Revenues in Reich Pfennig¹¹

| <u>Year</u> | <u>Per Passenger Kilometer</u> | <u>Per Ton Kilometer</u> |
|-----------------|------------------------------------|------------------------------|
| 1928 | 3.03 | 4.93 |
| 1929 | 3.02 | 5.05 |
| 1930 | 3.11 | 5.19 |
| 1931 | 3.12 | 5.07 |
| 1932 | 2.92 | 4.44 |
| 1933 | 2.81 | 4.36 |
| 1934 | 2.63 | 4.27 |
| 1935 | 2.50 | 4.08 |
| 1936 | 2.46 | 4.15 |
| 1937 | 2.37 | 4.06 |
| 1938 <u>1</u> / | 2.37 | 3.90 |

1 / Without Austria, but including Sudeten
Area. Plus Austria 2.43 and 3.94 Rpf.

Loss of revenue, coupled with compulsory investment in areas not deemed profitable by the Reichsbahn's management, prompted them to adopt a deeply pessimistic view of future railroad operations. The Reichsbahn had been obliged to contribute personnel and funds for the construction of the

Autobahn, which would serve to benefit its competitors rather than themselves. Adolf Hitler seemed preoccupied with the motorization of the German Wehrmacht and the civilian population as well. Although Reichsbahn officials were assured that expenditures for highways and canals were designed with the intention of relieving some of the transportation burden from the railways, they remained skeptical of expenditures on these projects. The Reichsbahn also had little desire to be so relieved of its freight and passenger business and fought to defend its interests. Competition in terms of rising tariffs with riverboats and long-haul trucking intensified. The Reichsbahn's fleet of trucks competed against long-haul truckers. That the Reichsbahn sought to eliminate the competition and insisted upon bearing the brunt of the transportation load appeared advantageous in the short run, but proved inimical to both the Reichsbahn and Germany in the long. The Reichsbahn's leadership cannot be accused of lack of foresight, but of capital. The Third Reich chose to squander its resources upon the periphery of the transportation problem rather than striking at the heart of the matter.

The National Socialists duplicated their error of neglecting to expand railroad rolling stock when they attempted to improve the conditions of Germany's inland waterways. The fleet of vessels plying the inland waters were to a great extent unorganized. Most companies were a family concern and consisted of one or two vessels with the owner and his family living on board. Proper expansion of the inland fleet was the necessary action to take in relieving the burden on the railways. However, National Socialist

policymakers choose to improve the locks and canals rather than concentrate energies upon shipbuilding.

River traffic was in great need of governmental assistance if it was to recover from the disastrous consequences of the Depression. Total freight carried on the rivers declined from 140,669,000 tons in 1929 to 73,774,000 tons in 1932. By 1937 recovery had been only to the extent of 133,080,000 tons.¹²

Policy makers in Berlin were well aware of the difficulties of inland shipping, however, they confused existing reality with grandiose visions of the future and failed to concentrate their energies upon the problem at hand. Although the inland rivers offered a cheap means of transporting bulk items, this advantage was dissipated due to slow movement. Competition with the fast service of the Reichsbahn was keen. By 1937 inroads into the Reichsbahn's dominance of transportation had not exceeded the level reached in 1929. The crucial key to the success of inland shipping lay in the expansion of the fleet itself. Motor ships were especially lacking, as well as were all other types. Powered vessels numbered 4,872 in 1929, but fell to 4,841 in 1932 and then climbed slowly upwards to 5,440 by 1937. Those rivercraft lacking motor power declined only from 14,557 in 1929 to 12,441 in 1937.¹³

With the surplus of unemployed labor the National Socialist government could move along two avenues of approach to solve the problems plaguing inland shipping. The government could increase the size of the fleet by floating loans for ship construction, or construct new locks and canals while improving

existing facilities. Given the resources available they chose the second course of action. The Midland Canal was rushed to completion to provide an easy access route for coal being shipped to industries in central and eastern Germany. Construction of locks and canals helped to solve the unemployment problem, but did nothing in the short term for the improvement of inland shipping. Canals and locks usually took decades to complete. However, Germany would have accrued a much greater short-term advantage by increasing the size of her fleet. Inadequate expansion of rivercraft imparted that inland shipping would be unable to significantly reduce the pressure wartime traffic would place on the railroads. This would serve to frustrate any attempt to allieviate the strain placed upon the transportation network by a wartime economy.

Road construction was the only really original and novel idea brought home to Germany by the Nazi regime. Its proponent was none other than Hitler himself. Hitler's interest in the motor car, and fascination with high-speed vehicles led him to support the development of mechanization in the new German Wehrmacht.

Hitler wanted to construct the Autobahn because he wished to be known in history as a great builder of roads. Fritz Todt expressed Hitler's dream that, "at all times the roads have been the expression of the culture and state of a people. The highways of ancient Rome, of Napoleon, of the Chinese Empire and of the Incas bear witness to this fact."¹⁴ After the invasion of the Soviet Union in 1941 Hitler wanted to extend the Autobahn to Riga, Tallin

and Novgorod in the north and to the Ukraine and Caucasus in the south.

Hitler became so infatuated with the idea that he designed the plans for the width of the roadbed and traffic regulations on the new superhighways.¹⁵

The Autobahn like the thousand year Reich was a missionary plan for the future, but it had little practical value for a nation about to embark on a course which would lead to World War. The Autobahn served Germany best as a public-works project to reduce unemployment. Although it had relatively little military or commercial utility, the Autobahn was enthusiastically pursued by the top leaders of the Reich. Economically the new superhighways avoided all major cities thus making them useless to both long and short haul truckers who preferred the convenience of secondary roads. Militarily the roads should have given Germany the advantage of interior lines. However, this was dissipated by the policy of expansion and the critical petroleum situation. For Germany rationing of oil and gasoline was automatic with the outbreak of any European conflict. The ability of the railroads to entrain and move entire divisions made this form of transport much more economical than road marches. Deterioration of motor vehicles, which then had a short life, was great. Vehicles and men arrived at their destination with their combat efficiency intact. When the mechanized forces were experiencing their teething troubles during the Anschluss many vehicles and units were moved into Austria by rail, otherwise they never would have made Hitler's triumphant entry parade.

Expenditures of the Autobahn began in 1934 and reached 900 million Reichmarks by 1938. Construction continued rapidly until the war years when

it gradually slowed. However, due to the backing received from the high-ranking party members the idea of the Autobahn died slowly. By 1943-44 a decision was reached to discontinue road building and expenditures fell to almost nothing. In 1944 the planned expenditure for road building of all types, including normal repair, did not exceed 60 million reichmarks. This was not more than 3 percent of the 1938 total.¹⁶

Efforts to improve transportation by the National Socialists were misguided and resulted in the employment of valuable resources on projects of little return. Energies expended on the Autobahn proved fruitless in the prosecution of the war. The railroads were generally neglected by those in high office after Hitler's intentions to motorize the Reich became known. As a result, expansion of the rolling stock, necessary to handle the increased traffic of a wartime economy, never came about. Efforts to relieve the railroads' burden by shifting it to inland shipping were frustrated by the lack of a sufficient fleet of rivercraft. Resources had been expended upon locks and canals, rather than on the needed expansion of the number of vessels. World War II broke unexpectedly on the Reichsbahn and forced it to improvise in handling the increased traffic. What the German General Staff affectionately regarded as the fourth branch of the armed forces was soon to become one of the first victims of the theory of short war.

III. Transportation and the Nazi concept of war

The concept of war evolved by the Nazi state reflected a strong distaste for a repetition of the long drawn out struggle of World War I. For the First World War had played upon German's economic weakness and into Allied economic superiority. Since the armies were so blunted by the opening battles that they were unable to achieve a decision, the conflict resolved itself into an economic struggle. Numbers of weapons and corpses become a substitute for effective leadership.

That Hitler's strategical thinking was a reaction to World War I should come as no surprise. The trenches conditioned his mind against another titantic struggle. Hitler sought to minimize the economic superiority of future opponents such as Britain, the United States and Russia. Hitler decided upon the short war as his instrument of success.¹⁷

The idea of blitzkrieg, however, should not be restricted to the concept of motorization within the German Wehrmacht, but extended to include the entire pre-war German economic preparations. For contrary to the reports published by the news media and leading economists, Germany had not made long-term preparations for placing the entire economy upon a war basis. The German propaganda machine did much to foster the illusion of total war activity within the state. Bellicose statements by Hitler, the emphasis on uniforms and the constant display of military units also served to promote the idea of fervent preparation for war.¹⁸

The blitzkrieg idea fitted in rather nicely with Hitler's concept of ad hoc committees and administrators to divide the power he did not or could

not humanly possess within the state. Hitler refused to be restricted by a strict war plan, but chose to give the German people butter, in the form of a thriving domestic economy and guns, in the guise of a quick striking Wehrmacht and Luftwaffe. The domestic economy would be carried over into the war years until Albert Speer became the leading architect of German armament production. Until the advent of Speer the armaments industry was run on a demand basis only. What was required by the armed forces for victory was produced, then production was surrendered to items of civilian consumption. Once it became evident that victory would not be achieved in the short term, industry was fully mobilized to produce the implements of war. The total mobilization of industry marked the abandonment of the blitzkrieg strategy and the beginning of preparations for a long war.¹⁹

The conversion of the German economy to a war footing was so influenced by Hitler's strategical concept of blitzkrieg that the term can also be applied to the German economy prior to 1939.²⁰ Blitzkrieg economics meant that the German economy would be expanded in 'width' rather than in 'depth'. Expansion in width signified that the existing equipment and the material base of the economy was to be accepted as it stood. Expanded munitions production would be on the basis of available capacity only. By expanding armament production in width the Germans would have a high degree of ready armaments with which to fight a short war, but would be under a handicap if they were forced into a prolonged struggle. By adopting a short war blitzkrieg strategy Germany rejected the idea of armament in 'depth'. This would have laid the foundation of a war economy by concentrating upon the expansion of the basic industries

and by building up equipment for the mass production of munitions. Such a policy would have better prepared Germany to endure a prolonged struggle.²¹

The unwillingness of Germany to make capital investments in the basic industries prior to 1939 reflects the adoption of an expansion in width strategy. The following table divides the German economy into three main categories of investment. The first grouping consists of armament factories and military facilities. The second grouping includes the important basic industries which would indicate in 'depth' expansion of armament capacity. The third category is composed of civilian and governmental investment directed towards non-war activity.

TOTAL INVESTMENT CLASSIFIED BY PURPOSE²²

| (Billions of RM) | | | | | | | |
|---|-------------|------------|------------|-------------|-------------|-------------|-------------|
| | 1928 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 |
| <u>GROUP I (total)</u> | <u>0.8</u> | <u>0.2</u> | <u>0.4</u> | <u>1.9</u> | <u>3.3</u> | <u>4.0</u> | <u>5.3</u> |
| Armaments plants ^a | 0.8 | 0.2 | 0.4 | 0.6 | 0.9 | 1.2 | 1.6 |
| Military facilities ^b | | | | 1.3 | 2.4 | 2.8 | 3.7 |
| <u>GROUP II (total)</u> | <u>4.2</u> | <u>1.5</u> | <u>2.1</u> | <u>2.6</u> | <u>3.0</u> | <u>3.7</u> | <u>4.5</u> |
| Heavy Industry ^c | 0.9 | 0.1 | 0.3 | 0.6 | 0.8 | 1.0 | 1.3 |
| Railroad & other transportation equip. | 1.3 | 0.6 | 0.8 | 0.8 | 0.8 | 1.1 | 1.5 |
| Agriculture | 0.9 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 | 1.1 |
| Public Utilities | 1.0 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 |
| <u>GROUP III (total)</u> | <u>8.6</u> | <u>3.3</u> | <u>5.4</u> | <u>6.6</u> | <u>8.0</u> | <u>7.8</u> | <u>8.6</u> |
| Other Industry ^d | 0.9 | 0.3 | 0.3 | 0.4 | 0.5 | 0.6 | 0.8 |
| Residential Construction | 2.8 | 0.9 | 1.4 | 1.6 | 2.2 | 2.0 | 2.5 |
| Commercial, Handicraft, Miscellaneous | 1.7 | 0.7 | 0.7 | 0.8 | 0.9 | 1.0 | 1.0 |
| Roads | 0.5 | 0.3 | 0.6 | 0.9 | 1.2 | 1.2 | 1.8 |
| Other Government ^e | 2.7 | 1.1 | 2.4 | 2.5 | 3.3 | 2.9 | 2.9 |
| <u>TOTAL</u> | <u>13.7</u> | <u>5.1</u> | <u>8.3</u> | <u>11.2</u> | <u>14.3</u> | <u>15.5</u> | <u>18.8</u> |

a. Electrical machinery, vehicle, locomotive, naval, metal-working, optical and chemical industries.

b. Barracks, airfields, fortifications, etc. (more than 2 billion RM were spent on fortifications in 1938 & 1939.)

c. Steel, coal construction materials and rubber industries.

d. Clothing, food printing and publishing, linoleum, paper, and musical instrument industries.

e. Postal system, trams and subways, waterways, government and party buildings, municipal improvements, etc.

Prior to 1939 investment in the German economy indicated preparations for a short war based on the blitzkrieg concept. These were moderate increases in armament plants and military facilities as the armed forces expanded in numbers and units. Emphasis was placed upon the quality of the weaponry rather than the quantity. New barracks and training facilities were established to meet the requirements of the swollen Wehrmacht. Expenditures in the Group I sector generally reflected the demands of a growing military establishment. Investment in Group I, however, never exceeded outlays for civilian non-war projects prior to 1938.

By 1938 investment in Group II industries, which signify the armament in depth concept, barely surpassed the amount spent in the same area for the year 1929. It was not until 1938 that the 4.2 billion figure was eclipsed, and only then by .3 billion reichsmarks. The Group II sector represented iron and steel plants, coal mines, railroads and public utilities all vital to the prosecution of a long-term conflict. Expenditures in this area were exceeded every year by the totals spent on road construction and party buildings. Heavy investment in the Group II sector would have indicated an in-depth preparation for war. This, however, did not occur.

Observing the prewar pattern of investment it is obvious that the Germans were not concentrating investment in those activities associated with economic preparation for war.²³ The German government was more interested in satisfying consumer demand for more residential construction and its own ambitious building projects for the edification of the Reich.

Extended improvements of the railroads, which were classified under the basic industries, would have contradicted the blitzkrieg concept of a short war. The railroads, however, received little attention in pre-war planning. The possible effects of air attacks upon the system were never seriously evaluated by planning committees. Railroad leaders themselves believed that the system which had served Germany so well in the previous war was crisis-proof.

Little thought had been given to the transportation problems arising from the relocation of industry to the interior of the country prior to the war. New industrial sidings had to be constructed in many areas to accommodate the relocated plants. Efforts were made to move the industry into unoccupied plants which were strongly integrated within the transportation network.

Since the Reichsbahn had been unable to float major loans, the construction of by-passes around critical bottlenecks such as bridges and viaducts was generally neglected. Construction of new lines around important railroad centers, with a view towards lessening the vulnerability of through lines, encountered difficulty through shortsightedness and the lack of funds. In the city of Munich, for instance, a 'Northern Ring' around the city was constructed to facilitate the movement of through trains.²⁴ Although this tactic proved to be exceptionally successful many German cities had no facilities for the rerouting of through traffic.

Aside from the detrimental economic effects of the blitzkrieg strategy upon the railroads, the military implications of the term must be put into

perspective in regard to transportation.

Prior to and during the First World War the railroads earned their reputation as the fourth branch of the armed forces. The German General staff set up a rigid timetable to be followed by all railroads once war broke out. The cumbersome units of the army of the day had to report to railway stations to be moved to their respective places in the front lines. Supply of the advancing army depended upon the ability of repair crews to get the enemy lines into operating condition. Heavy demands were made upon the railroads to make timely deliveries of munitions, men and material to the army.

The detailed planning, which was so characteristic of World War I operations, was almost entirely lacking in 1939. The blitzkrieg strategy made the railroads look like forlorn and forgotten partners in the war effort. The lack of a stringent mobilization plan meant that the railroads would not have to adhere to a strict military timetable. Peacetime operations were to be continued, only at an accelerated pace.

The railroad's role had changed with the passage of time because of the blitzkrieg strategy which called for quick rapier thrusts aimed at an opponent apparently diplomatically off balance. The new Wehrmacht was fully motorized to carry out this new strategy. Each division moved as a self-contained fighting unit. Logistical support needed during an operation was to be provided by aircraft and motor convoy which could reach the most advanced units. Since the initiative would always be held by the Germans the time and place of each confrontation would be decided in Berlin. Stockpiling of munitions could be accomplished in a leisurely manner by the railroads well in

advance of the jumping off date for the attack. Normal civilian traffic throughout Germany would not be disrupted. Civilian traffic in the immediate area of operations would be curtailed and this for only a short period.

It had become evident that the adoption of a blitzkrieg strategy would confine the activities of the railroads to insuring the smooth operation of the economy. The degree of participation as the fourth branch of the armed forces had been minimized.

IV. Allied bombing policy: Design vs. Reality

If the Germans were of the opinion that the complexity of their transportation system would shield it from Allied air attacks, they were sadly mistaken. However, it was only after much disagreement and procrastination among the Allied air commanders that the transportation network gained a ranking position in the strategic air offensive. The establishment of transportation as an alternate target with oil and area bombardment represented a hard won victory for Air Marshall Tedder and his scientific advisor, Sir Solly Zuckerman. Thus, the problems inherent in the attacks on the Reichsbahn were intricately interwoven with the priorities and personalities of the strategic air forces, the capabilities and limitation of strategic bombing and the advances in technology.

The ability of the bomber to penetrate deeply into Germany led to the application of the sea blockade psychology to air warfare. Prior to this time ships at sea performed blockade duties with the intention of depriving the German war economy of vital raw materials from abroad. Now the airplane was given a similar mission. Various interdependent segments of the German economy were to be isolated from one another through air bombardment. Hence raw materials were to be prevented from reaching industry and the finished products were to be denied the German armed forces.

To some members of the Allied supreme command an attack directed against transportation seemed a feasible objective in fulfilling the blockade strategy. It appeared logical to them that by preventing the movement of raw

materials and semi-finished goods would bring war production to a grinding halt.

The application of the blockade strategy failed to take into consideration the inability of the airplane to remain over the target area long enough to insure that the damage would not be repaired. For unlike the ships at sea, which could remain on station for weeks on end, the airplane was limited to a few minutes over the target. While the attacking force was withdrawn Germany's great recuperative powers were employed to reconstruct the injured facilities. Thus destruction would only be temporary, since it would be subject to intensive repair activity. The Reichsbahn was able to reconstruct damaged lines within 24 to 48 hours after even the heaviest attacks. It was only when the power to destroy outran the ability to repair that any recognizable damage could be achieved.

From the very beginning of the war the air commanders found themselves in the unenviable position of possessing a weapon for which only a theoretical doctrine of employment had been developed. They themselves had received their education in the old school of land and naval warfare, which had never experienced the war of strategic bombing as a weapon to be employed against an enemy economy gearing for war production. Since no tested method of employment could be applied to their situation it was inevitable that the air commanders should look to the old practice of naval blockade and attempt to apply its major premise to air warfare. The civilian leadership could only provide the guidelines for the strategic air offensive.

They accomplished this at the Casablanca Conference, in January 1943. The directive issued to the air commanders was sufficiently vague in operational detail to permit them considerable freedom of action. However, it also provided them with plenty of opportunity to bicker among themselves as to the proper strategy to be employed in the air offensive against Germany.

Early employment of the air force had been a belated attempt to strike at the rear of the German advance into France and the Low Countries with the intention of disrupting supply lines. The lightning pace of the German advance, however, nullified the small gains which might have been achieved from striking the unproductive target.

Once the occupation of the continent by the Germans was an accomplished fact the British directed their efforts at oil, industrial and transportation targets in northwestern Germany and the Ruhr. The basis of these attacks were the pre-war economic studies of Germany known as the Western Air Plans.²⁵ Transportation attacks were generally aimed at inland marshalling yards and were usually carried out when the primary target could not be located. The frequency of the attacks made upon the sprawling marshalling yards at Hamm in the early years of the war, attests to the inability of the air force to locate their primary objectives.

After sustaining mounting air losses in daylight operations over Germany it soon became apparent to the members of the Air Ministry that Bomber Command would cease to be a fighting force. Economic raids against target systems proved to be disappointing. Photo-reconnaissance showed many of

the buildings considered destroyed still intact. German armaments production did not reach its peak in 1942 as was expected, but continued its expansion. Bomber Command was forced to switch to night attacks against large German cities. The bombs were to be directed against the German worker with the intention of reducing his morale and thus his ability to produce. Despite civilian casualty figures which reached 530,000 killed, 780,000 wounded and 5,000,000 evacuated, the Germans were able to withstand city bombing.²⁶ Area bombing at night, however, became official British doctrine and was embraced after 1942 by Air Chief Marshal Sir Arthur Harris and Bomber Command.

Air operations against rail targets in Italy during the campaign in the Mediterranean in 1943 provided the impetus for the listing of transportation as a priority item in France and later Germany. The proposal to strangle rail movements in Italy by attacks upon key railroad marshalling yards and installations came from Air Marshal Tedder's scientific advisor, Sir Solly Zuckerman. Zuckerman believed that 14,000 tons of bombs dropped on key areas of the railway could render it inoperable, and prevent German military traffic from proceeding south. The apparent success achieved in Italy prompted Tedder to propose a similar operation to be carried out prior to a landing in Europe. Not all air commanders and civilian analysts working for the Air Ministry were as elated or as convinced of the Italian victory as Tedder and Zuckerman. They remained skeptical, pointing out that only a small percentage of the rail traffic was directed towards the military end. This

usually received a high priority and was moved before civilian and freight traffic.

Tedder's suggestion for a transportation plan for Northern France and Belgium, similar to the Italian rail attack, encountered immediate opposition from Harris of Bomber Command and General Carl Spaatz of the U. S. Eighth Air Force. Both Harris and Spaatz were heavily engaged in offensives against area and oil target in Germany. The approval of the Transportation Plan would necessitate an interruption of their attacks. Both men felt this to be disastrous to their plans since decisive results were expected soon. Harris and Spaatz argued that the best way to assist the Overlord operation was to continue the air attack against Germany without respite.

The Transportation Plan was rescued from obscurity by the impasse which had been reached between General Eisenhower and the air commanders over the exercise of operational control of the heavy bombers. Prior to 1944 the strategic air forces had conducted independent operations against the Axis powers. Cooperation with the ground and naval forces had been minimal. Harris and other air leaders resented the idea of having General Eisenhower, who was primarily grounded in land operations, in operation control of the heavies. Once they had relinquished their independence the air leaders felt they would never be able to regain it again. Eisenhower who was about to assume the role of Supreme Commander of all Allied forces in the European theater, disliked the idea of permitting the bomber commanders to conduct their own battle against the Germans in flagrant disregard of the necessary

contributions which could be made during the critical phase of the landings in France. No alternative plan presented to Eisenhower would utilize the total available resources for the success of a landing attempt so effectively as the Transportation Plan.

The opposition to the Transportation Plan coalesced around Harris and Spaatz, who objected to the use of the heavy bomber in what they considered a tactical exercise. Casualty figures, which would result from an attack upon French and Belgian railroads, were circulated by the British Ministry for Home Security. Its estimated civilian casualty figures at anywhere from 80,000 to 100,000. This so alarmed Prime Minister Churchill that he voiced his misgivings about the Transportation Plan to President Roosevelt.²⁷

Tedder received the crucial backing he needed from the Transportation Plan from Eisenhower, because the plan appeared to be the only solution to problems of operational control of the heavy bombers and the concentration of all available resources for Overlord. Tedder also marshalled the support of the scientists under Zuckerman, and when it became apparent that civilian casualty figures would hamper acceptance of the plan he received the support of the Free French leaders who were willing to accept the highest casualty figures so long as the Germans were removed from French soil.

The attack aimed at the railroads of Northern France and Belgium began ninety days prior to D-Day. The heavy bombers were assigned the task of reducing marshalling yards and repair centers in a campaign of attrition. The light bomber and fighter aircraft of the tactical air forces were to carry out

the interdiction of the rail net by line cuts and strafing attacks against locomotives and trains.

Like the Reichsbahn, the French railway system had been weakened before the war by a series of financial crises which resulting in economy measures in the areas of maintenance and repair. During the campaign of 1940 five hundred way structures and 1,200 railway buildings were destroyed. By 1944 only the important facilities had been reconstructed. French railways suffered heavily during the winter of 1941-42 when the Germans began the leasing of locomotives and cars for use on the Eastern Front. Of the 18,000 locomotive in France, 4,000 especially heavy-duty types, were removed to Germany. More than a third of the rolling stock which totaled 31,000 passenger cars and 480,000 freight cars were withdrawn to Germany.²⁸

In addition to the loss of facilities and equipment the French railway system was burdened with Franco-German management. Personnel of the French National railways was reduced by twenty percent and the remaining quality diluted by the hiring of unskilled workers and the recalling of retired personnel.²⁹ Passive resistance was common among the French railway workers and acts of sabotage increased as the date of the invasion approached.

The heavy bombers repeatedly attacked railroad facilities one hundred miles to the rear of the potential battle area in order to reduce the capabilities of the railroad system as a whole. Bridges, viaducts and tunnels were subjected to constant attack until the German gave up all hopes of repair. Twin and single-engined aircraft attempted to eliminate traffic which reached

the combat areas. These tactics were used to create a traffic desert in the Seine-Loire triangle of Northern France which paralyzed all rail and road movement in the immediate battle area.³⁰

From the tenth of June until August 11th 1944, when the Allies conquered it, only five trains a day were able to enter this triangle. This was only 3.5 percent of the April figure. Trains originating in the Seine-Loire triangle numbered only four daily, making a total of nine trains daily which might reach the front lines if they successfully evaded the fighter-bombers flying patrol over the area. Total Wehrmacht trains required in the area was estimated to have been 36 trains daily or four times the amount moving through the triangle.³¹

Ninety-eight percent of the military traffic which entered France did so through the railroad regions Nord and Est. This traffic declined around D-Day to 50 percent of the January/February level for the regions. However, recovery was swift although only temporary. The German general staff pushed through divisions from the east, increasing the percentage of recovery to 80 in the last three weeks in June with a high of 105 percent in the week of 30 June. Despite the interdiction attempt at the French border the Wehrmacht was able to recover. In July, however, divisional moves from the east were only 39 percent of the January/February level.³²

Wehrmacht trains operating within France declined at the beginning of June, but showed signs of recovery towards the end of the month due to the increase in troop movements. Only troop trains showed any signs of recovery

after D-Day with supply and leave trains well below the January/February average. Troop traffic fell from 435,000,000 kilometer tons at the end of March to 120,000,000 kilometer tons around D-Day. By the end of June recovery had been to the extent of 260,000,000 kilometer-tons. A leveling to 170,000,000 kilometer-tons or 39 percent of the March peak was recorded for July.³³

German rail traffic crossing the second line of interdiction east of Paris was reduced from 1,000 trains a week in April to 400 per week in June and July, or a decline of 60 per cent. The second line of interdiction centered on the Seine River in the north and the Loire River to the south. In the Seine section of the line traffic fell from 213 trains in the first week in April to 53 in the last week of May. After D-Day only one train from the north crossed the Seine during the entire campaign. In the Loire section traffic fell from 400 trains in the first week in April to 200 in the week of 2 June. In the entire period of the French campaign an average of only 4 1/2 trains daily crossed the Loire into the tactical area.³⁴

The service rendered by the air forces to the Overlord operation was in delaying the arrival of important military units at the front. German military railheads were pushed back 150 miles from the battle area. Troops were forced to disembark and hazard a road march to their staging area. Motor transport proved inadequate and was only able to operate at night or in poor weather conditions. In daylight, troops on the move were subjected to strafing attacks by fighters of the Allied Tactical Air Force. Attrition in men and vehicles

mounted rapidly and greatly reduced the number fit for combat. The survivors arrived in dribblets in the battle area, were committed to battle piecemeal and usually achieved poor results. Although the air forces could not completely isolate the battle area they did prevent the Germans from building up reinforcements quicker than the Allies could get men ashore. This was Eisenhower's objective in using the strategic and tactical air forces to render the railroads inoperable.

The success achieved in France prompted Air Marshal Tedder to advocate the same type of attack for the remainder of the war against German transportation. Although the strategic bombers were called upon to aid Patton's Third Army by bombing transportation targets in the Metz area and the assault upon Aachen there was no overall coordinated plan in effect for the attack on the German transportation system until November 1944, when the working Committee (Communications) of the Combined Strategic Target Committee was formed.³⁵

The Working Committee was set up to provide some guidance for the strategic air offensive in choosing worthwhile targets in Germany. The Committee was to prevent the bickering by air commanders as to what should be the primary objectives. For Harris had continued the area attacks against large industrial cities with the belief that this would cause general dislocation throughout the entire German economy. He disdained those who sought out 'target systems' as peddlers of 'panaceas'. Spaatz believed that the common denominator of any industrial state was oil. Spaatz directed his energies at

the elimination of all refineries developing crude oil into petroleum products. Tedder sought to elevate transportation on the priority list after the success achieved in France. The one beneficial point possessed by an attack upon transportation which the above objectives lacked was its direct effect upon the course of the land battles in progress on the continent. The disruption of transportation in the rear of the Wehrmacht greatly assisted the advancing Allied armies. Coordination between land and air forces was essential if victory was to be achieved.

The Strategic Targets Committee put communications second on the priority list in November 1944. A line was drawn between the Rhine and Longitude 10 E (which ran through Hamburg - Hannover - Wurzburg - Ulm) to provide the boundaries for a systematic attack on railroad marshalling yards, bridges, viaducts which would hamper the supply of German forces west of the Rhine. The area was further subdivided by the number of targets to be hit in each zone. The barge traffic on the system of inland waterways was to be attacked to prevent the easing of pressure in the already overburdened railroads.³⁶

The failure of the Communications Plan was due to the inability of the air forces to cover the various zones with enough bomb tonnage to effectively stop the flow of rail traffic. The plan entailed too large an area and would require at least eight months of bombing before any strategic effects on the war economy would result. The Communications plan also failed because the Germans switched from the defensive to a surprise offense in the Ardennes region in December 1944. The German land offensive was enough to force the air forces

to assume a defensive role in protecting the land forces. The heavy bombers had to be concentrated against the railheads and army depots supplying the offensive. By concentrating their efforts in a small area the Allies were able to disrupt transportation and eventually starve the German army of fuel and reinforcements. The Communications Plan was thoroughly disrupted, but the lesson of concentration of resources was applied to the isolation of the Ruhr.

With the reduction of the Bulge, the strategic air forces were deployed to isolate the Ruhr from the remainder of Germany. The plan called for the disruption of transportation within the Ruhr area itself and the destruction of bridges and viaducts leading to the rest of Germany. A selected list of rail centers and marshalling yards were concentrated upon. The attack began in February and by March the isolation of the Ruhr was virtually an accomplished fact. Internal communications were thoroughly disrupted. In fact the internal communications suffered greater than the lines leading to the remainder of Germany.³⁷ This suggests that the lines leading out of the Ruhr would have been a much more worthwhile target than internal transportation since whatever would have been produced in the Ruhr area would not have been able to leave. The internal destruction served no strategic purpose whatsoever and was not commensurate with the outline of the plan which was the denial of raw materials and finished products to the remainder of Germany.

After the encirclement of the Ruhr the strategic air force had eliminated its last major target. Russian troops moving west and the advance of the Allied armies to the east had diminished the amount of territory held by the Third Reich. In February the air forces were so pressed for a worthwhile target

system that they thought up Operation Clarion, calling for a widespread attack upon the remaining rail and water transportation available to the Germans. The objective of the operation was to overwhelm the normal repair system and force the Germans to use up their remaining oil products by switching to motor transport for high priority movements. A crisis among German railway workers was also expected. None of the hoped for results ever materialized although a considerable amount of rolling stock was destroyed and some temporary disruption caused to railroad transportation. Repair facilities continued to remain unsaturated and the railway workers performed their assigned tasks. Because of insufficient evidence that any of the objective had even been partially accomplished Clarion was never repeated. ³⁸

A multiplicity of priorities and conflicting views of air warfare among the leaders of the Allied air forces, which was not confined to national lines prevented them from achieving a concentration of effort and decisive results early in the war. The strategic bombing of German transportation targets was never a top priority item until the war was a foregone conclusion. No study of the attack upon the railroads can be complete without examining the accuracy achieved against this type of target system by the strategic bombers.

The standard of accuracy achieved by the strategic bombers was limited by meteorological conditions over the target area, German fighter plane and flak defenses, useful intelligence as to the nature of the target and the technological advances in bombing techniques.

The most important factor in the success of any bombing mission was the

weather. Cloud cover, fog, smoke and haze all served to obscure the target from the bombardier and reduced the accuracy of the drop. In many instances weather conditions forced the bombers to their secondary targets after they failed to locate the primary objective. The Eighth Air force found that 30 percent of the bombs dropped in good to fair visibility fell within 1,000 feet of the aiming point. With poor visibility only 9.4 percent of the bombs landed within 1,000 feet of the aiming point.³⁹

The German Air Force was also an effective instrument in reducing the accuracy of the raiding bombers as well as their freedom of action in the skies above Germany. The activity of the fighter planes forced the RAF into night raids. Visual location of a target at night increased the chance of error greatly. The British, using pre-World-War-II bombing studies, estimated the daylight bombing error at 300 yards from the aiming point. When they went over to night attacks the bombing error was never revised. Air Ministry studies with night photographic equipment placed the error closer to 1,000 yards.⁴⁰ Precision bombing with this error was nonexistent. Air Marshal Saundly disgustedly remarked that if this was the case, all the RAF could say it was doing was exporting bombs in the direction of Germany.⁴¹

It was only after the disaster of the Schweinfurt raid that air force strategists realized that the old axiom of Douhet, that the bombers would always get through, was false. A concentrated effort was made to eliminate the German Air Force. In the early months of 1944 air superiority was finally established. German flak defenses served to keep the bombers at a respectable

altitude although their value was negligible. The B-17's attacked from an altitude of 21,242 feet and B-24's from an altitude of 19,880 feet.⁴² A change in altitude of a few thousand feet near the altitude of 12,000 feet does not seriously effect accuracy. Whereas at 26,000 feet a change in altitude will have a definite effect upon accuracy.⁴³

The size of the attacking force also has an importance as the accuracy of the bombing. The attacking force flew in a definite formation and contained smaller units known as boxes. The boxes varied from three to eighteen. After May 1943 the Eighth Air Force was able to launch attacks of over 200 bombers. It soon became apparant that the accuracy of latter boxes over the target seriously declined because of haze, smoke and obstruction caused by the attack of the first boxes.⁴⁴ German fighter defenses prompted the air commanders to keep the boxes large for the all around protection of the aircraft within them. Once fighter escorts became available, and the elimination of the German fighters a fact, the size of the boxes decreased. The following table indicates the order of accuracy in a major attack.⁴⁵

| <u>Order of Boxes over Target</u> | <u>Percent of Boxes Placing at least 10 percent of their bombs within 1,000 feet of the aiming point</u> |
|---------------------------------------|--|
| 1 | 82% |
| 2 | 60% |
| 3 | 48% |
| 4 | 47% |
| 5 | 30% |

Allied economic intelligence suffered serious shortcomings from the very beginning of the war. The British Ministry of Economic Warfare was convinced, even as late as 1942, that the peak of German armament production had been reached in 1941. As post-war investigations revealed, nothing could have been further from the truth.⁴⁶

Allied intelligence failed to comprehend the relationship between the German oil, chemical and rubber industries. Accidental damages inflicted upon methanol and nitrogen plants proved to be critical to the production of synthetic rubber and explosives. If the five plants which produced ethyl fuel had been hit Germany's fuel situation would have been catastrophic.⁴⁷

Even with area attacks upon industrial complexes the problem of determining damage remained elusive. Solly Zuckerman complained of the so-called 'operational factor' which was constantly being introduced into the planning picture in the wake of realistic calculations. Zuckerman humorously refers to the mystical operational factor of two, used by planners to multiply their answers to account for the undefined variables which they assumed to exist, but which had not been considered.⁴⁸

Although World War II saw technological improvements in navigation and bombing techniques, there was still no substitute for accurate navigation and visual bombing. But weather proved to be a distinct handicap to both. Winter storms formed early over Europe and produced a cloud cover which made it difficult to locate the objective. The Eighth Air Force found it almost impossible to do any bombing if the cloud cover exceeded 5/10 or half the sky covered with clouds.⁴⁹

The H_2S was perhaps the most useful aid to wartime navigation and blind bombing. The H_2S system was predicated on the basis that a radar echo returning from a ground target would have distinctive characteristics depending upon the target. Thus cities could be distinguished from open areas. Coastlines, rivers and even railway tracks could be identified by the navigator.⁵⁰

The Eighth Air Force Operations Analysis Section published a report on H_2X (the American code name for H_2S) covering the period September through December 1944. It found that the accuracy obtained with H_2X through 10/10 cloud cover areas was .02 percent of the bombs within 1,000 feet of the aiming point. Whereas 30 percent of the bombs dropped under visual conditions generally fell within 1,000 feet of the aiming point. The report concluded that H_2X was the least effective bombing method. However, the use of H_2X resulted in an increase in accuracy with the decrease in cloud cover. This indicated that H_2X had its chief value as an aid to visual bombing. Visually assisted bombing with a 4/10 to 5/10 cloud cover produced 1/6 as many bombs within 1,000 feet of the aiming point. The major value of H_2X was as a navigation aid, rather than as a precision bombing instrument.⁵¹

The bombing which occurred during the Second World War can hardly be described as precision. For the Strategic air forces were never to become precise instruments for carrying out the destruction of the German economy. The British admitted the inaccuracy of their bombing when they went over to area attacks against large cities. The Mark XIV bombsight could only place a bomb within 150 feet of the aiming point, even with the best of crew training.⁵²

The United States chose to stick with selective bombing of key areas of the economy, although the degree of bomb wastage was enormous. In three major oil producing plants studied by the Strategic Bombing Survey only three percent of all bombs dropped struck damageable targets.⁵³ This can hardly be called precision.

In the attack against the marshalling yards of the Reichsbahn the weather was a key factor in the success or failure of a mission. Marshalling yards were very rarely protected by the Luftwaffe. The air forces encountered only weak opposition fighters in the skies above their objective. The German defenders could only offer moderate flak opposition which was often inaccurate. This left meteorological conditions as the only hindrance to the big bombers. It became especially true in the later stages of the war when the Luftwaffe had been eliminated as an effective opponent. Examination of the Catalogue of Attacks found in the Bombing Accuracy USAAF Heavy and Medium Bombers in the ETO, reveals that when visibility was limited by haze, fog, industrial smoke or a 5/10 cloud cover, attacks against marshalling yards usually achieved a circular error greater than the average. The Eighth Air Force for example, generally attacked from an altitude of 21,000 feet. The average circular error for six attacking boxes of aircraft would be around 955 feet.⁵⁴ The following list of attacks against marshalling yards examines the circular error in the light of enemy aircraft, flak, and weather conditions.

Bombing Accuracy

Type target: Marshalling yards

Catalogue of Attack Examined

| Type target: Marshalling yards | Circular Error Bigger(+) or smaller(-) than average. | Location | Depth of Penetration(miles) | Enemy A/C | Opposition FLAK | Weather Cloud Cover | Other | Misc. | Type A/C |
|--------------------------------|---|----------------|--------------------------------|--------------|--------------------|------------------------|-----------|--------------|-------------|
| | | | | | | | | | |
| + | | Liege | 240 | None | Mod-Acc | Breaks | Haze | Smoke | B-24 |
| + | | Mulhouse | 440 | Weak | Int-Acc | 5/10 | | | B-24 |
| + | | Liege | 240 | Weak | Int-Acc | Heavy | | | B-24 |
| | | | | | | GroundHaze | | | |
| + | | Osnabruck | 300 | Strong | Int-Acc | 2-3/10 Dense | | Contrails | B-17 |
| + | | Montignies | 320 | Weak | Mod-Acc | Clear | | | B-17 |
| + | | Belfort | 440 | Weak | Meagre-Acc | | | Haze | B-24 |
| - | | Karlsruhe | 400 | None | Int-Acc | | | | B-17 |
| + | | Saarbrucken | 350 | None | Int-Acc | | | Haze | B-24 |
| + | | Konz Karthaus | 340 | None | Int-Acc | | | Haze | B-24 |
| + | | Le Mans | 310 | Weak | Mod-Acc | cover 10/10 | | | B-24 |
| - | | Ruhland | 560 | None | Meagre-Acc | Clear | | Good Fighter | |
| | | | | | | | | Escort | B-17 |
| + | | Belfort | 550 | None | Meagre-Inacc | 3/10 | | | B-24 |
| - | | Poullons | 600 | None | Meagre-Inacc | Clear | | | B-24 |
| + | | Saarbrucken | 340 | Weak | Meagre-Inacc | Clear | Haze | Ind. | |
| + | | Ehrang | 310 | None | Int-Acc | 4/10 | | Smoke | B-24 |
| - | | Magdeburg | 460 | oil | Int-Acc | Clear | Haze | Smoke | B-24 |
| + | | Ehrang | 310 | None | Mod-Acc | 2/10 | Int. Grd. | | B-24 |
| | | | | | | | Haze | | B-17 |
| + | | Rower | 350 | None | Mod-Acc | Clear | | | B-24 |
| + | | Kblnza | 340 | None | Mod-Acc | Clear | Haze | | B-17 |
| + | | Andernach | 320 | None | Meagre-Inacc | Clear | Fog | Haze | B-17 |
| + | | Bingen | 360 | None | Meagre-Acc | 5/10 | | | B-17 |
| + | | Cottigen | 400 | Mod | Mod-Acc | 5/10 | | | B-17 |
| + | | Kaiserslautern | 360 | None | Mod-Acc | 3/10 | | | B-17 |

Exhibit B (continued)

| Circular Error Bigger(+)or smaller(-)than average. | Location | Depth of Penetration(miles) | Enemy A/C | Opposition FLAK | Weather Cloud Cover | Other | Misc. | Type A/C |
|---|---------------|--------------------------------|--------------|--------------------|------------------------|-----------------|-------|-------------|
| | | | | | | | | |
| + | Koln | 280 | None | Mod-Acc | 8/10 | | | B-17 |
| + | Karlsruhe | | None | Mod-Acc | 8/10 | | | B-17 |
| + | Pforzeim | 420 | Light | Int-Acc | Clear | Haze | | B-17 |
| - | Gottingen | 400 | None | In-Acc | Clear | | | B-24 |
| + | Celle | 390 | None | Mod-Inacc | | Haze | | B-24 |
| - | Vienenburg | 420 | None | None | Clear | | | B-24 |
| + | Hafingen | | Weak | Meagre-Inacc | 8/10 | Haze | | B-17 |
| - | Winterhausen | | None | Meagre-Inacc | Clear | | | B-17 |
| + | Ottingen | | None | Meagre-Inacc | 10/10 | | | B-17 |
| - | Ansbach | 480 | None | None | Clear | | | B-24 |
| - | Gutersich | 320 | None | None | Clear | | | B-24 |
| + | Oranienburg | 540 | None | Int-Acc | | Heavy Grd. Haze | | B-17 |
| + | Garcelgen | 440 | None | Int-Acc | | Heavy Grd. Haze | | B-24 |
| - | Wurzburger | 440 | None | None | Clear | | | B-24 |
| - | Osnabruck | 300 | None | Mod-Acc | Clear | | | B-24 |
| + | Uizen | 240 | Weak | Meagre-Acc | 5/10 | | | B-17 |
| + | Neumunster | 400 | Strong | None | 4/10 | | | B-17 |
| - | Halberstadt | 440 | None | None | 2/10 | | | B-17 |
| - | Hof | 520 | None | Meagre-Acc | Clear | | | B-17 |
| + | Treuchtlingen | 520 | None | Meagre-Inacc | Clear | | | B-17 |
| - | Landshut | 560 | None | None | Clear | | | B-17 |
| - | Elstewerde | 560 | None | Meagre-Inacc | Clear | high cirrus | | B-17 |
| - | Falkenburg | 540 | None | Meagre-Inacc | Clear | high cirrus | | B-17 |
| - | Karlsbad | 540 | None | None | Clear | | | B-17 |
| + | Klatory | 590 | None | None | 3/10 | Haze | | B-24 |

The Strategic Bombing Survey conducted an examination of the effects of strategic bombing on three interrelated railroad divisions, Regensburg, Nuremburg and Munich, from which the accuracy of the bombing can be examined. The Survey reports the number of bombs dropped and gives the number of hits from the German bomb plot for the individual yards. Unfortunately on many of the raids either the number of bombs dropped or the number of hits was missing. The raids for which the number of bombs dropped and corresponding hits were recorded for the three divisions are given below. The hits consist of the bombs which landed in the marshalling yards. On several occasions the Survey reports a yard heavily blanketed or a few scattered hits. These cases are not included because they would only serve to lengthen the list without serving any useful purpose. Although the figures cannot be used inclusively for all marshalling yard attacks they give a fair estimation of the accuracy of the bombers in these three divisions. Of the total number of bombs dropped only 13.3 percent hit their intended targets. Although this figure is poor indeed, it still remains a considerable improvement over the accuracy achieved against oil refineries and synthetic oil plants. The raiding giants remained erratic until the very end of the war. The list reveals their inconsistency with a raid on Plattling on the 26th of April scoring with 28 percent of the bombs, followed two days later with a raid on Freising landing only 9 percent of the bombs on target.

Attacks on Regensburg, Nuremburg and Munich Divisions⁵⁶

Regensburg Division

| <u>Date of Attack</u> | <u>Objective</u> | <u>Bombs Dropped</u> | <u>Hits</u> | <u>%</u> |
|-----------------------|------------------|----------------------|-------------|----------|
| 4 Nov. 1944 | Regensburg | 1200 | 60 | 5 |
| 28 Dec. 1944 | Regensburg | 629 | 51 | 8 |
| 29 Dec. 1944 | Landshut | 612 | 40 | 6.5 |
| 13 Mar. 1945 | Regensburg | 5024 | 202 | 4 |
| 19 Mar. 1945 | Landshut | 7722 | 3000 | 3.9 |
| 19 Mar. 1945 | Passau | 75 | 10 | 13.3 |
| 24 Mar. 1945 | Plattling | 126 | 31 | 24. |
| 8 April 1945 | Hof | 1569 | 300 | 19 |
| 16 April 1945 | Plattling | 1084 | 300 | 28 |

Nuremberg Division

| | | | | |
|--------------|---------------|------|----|---|
| 21 Nov. 1944 | Aschaffenberg | 4116 | 75 | 2 |
|--------------|---------------|------|----|---|

Munich Division

| | | | | |
|---------------|------------|------|----|----|
| 9 June 1944 | Munich | 617 | 23 | 4 |
| 19 July 1944 | Munich | 645 | 50 | 8 |
| 16 Nov. 1944 | Munich | 3291 | 54 | 16 |
| 15 Dec. 1944 | Rosenheim | 454 | 48 | 11 |
| 19 Dec. 1944 | Innsbruck | 155 | 4 | 3 |
| 25 Dec. 1944 | Innsbruck | 583 | 25 | 4 |
| 29 Dec. 1944 | Innsbruck | 781 | 14 | 2 |
| 16 Feb. 1945 | Rosenheim | 549 | 60 | 11 |
| 1 Mar. 1945 | Ingolstadt | 1762 | 27 | 2 |
| 18 April 1945 | Freising | 860 | 77 | 9 |
| 20 April 1945 | Muhldorf | 463 | 25 | 5 |
| 21 April 1945 | Munich | 1537 | 50 | 3 |

V. Air Offensive to 1944

Aside from the implications of an attack upon German military, rail and road targets found in the Western Air Plans there was little thought given to the disruption of the Reichsbahn, allowing for the limited capabilities and pressing requirements of the Royal Air Force at the beginning of the war. Although sporadic attacks were made upon the Reichsbahn until the middle of 1944, it was not until September of that year that heavier attacks were made against the transportation facilities of the Reich. No significant deterioration of the Reichsbahn resulted from these attacks. After Sir Arthur Harris assumed the leadership of Bomber Command interest in everything other than area targets deteriorated.

Thus the Reichsbahn encountered only minor annoyance from the strategic bombers in the early war years. It was not until the Eighth Air Force became operational in August 1943 that interest in the Reichsbahn as a target system increased. Reichsbahn repair crews were able to handle the destruction which resulted from aircraft which could not find their primary objective.

The greatest problem faced by the Reichsbahn with the outbreak of World War II was in adjusting to new operating conditions and its major customer, the military. Industrial relocation and the dispersal of industry to the interior added to the difficulties of the railroad. 'Transportation time' soon became a factor in production. The route of finished armaments from the factory to the front was lengthened due both to distances and the disruption in transportation.⁵⁷ Considerable construction of industrial track sidings and branch lines were necessary to accomodate the newly located industry.

Heavy military traffic served to disrupt the Reichbahn's timetables prior to the war with the construction of the Siegfried Line which required over 50,000 freight cars to move the men and material that went into its building.⁵⁸ Troop movements involved in the occupation of Austria, Czechoslovakia and the blitz campaigns in Poland, Norway, France and the Balkans increased the percentage of transportation which had to be devoted to the military. The Reichsbahn held up reasonably well under these increased demands with only minor regional disruptions as the major drawback to continued efficient service. The increased activity of the railways resulted in wear and tear on the tracks and rolling stock, however, this was replenished by the stocks available to Germany in the occupied countries.

The Allied sea blockade caused the concentration of rolling stock in certain regions of Germany in neglect of others. An example of this was the necessity to supply Italy with coal once war cut that nation off from its major supplier (England). The Italo-German coal agreement of March 13, 1940, guaranteed Italy the delivery of one million tons monthly to make up for imports lost from England. Because German coal cars usually were limited to 10 tons, and were only able to make two trips a month over the mountains into Italy, this meant the tie up of 50,000 cars.⁵⁹

The invasion of Russia in the summer of 1941 placed the heaviest burden to date on the Reichsbahn and precipitated a crisis in transportation. The Royal Air Force, had it been provided with accurate intelligence concerning the transportation situation, could have further exploited the situation by a concentrated effort against the Reichsbahn.

In contrast to previous campaigns in the West, the Russian Blitz produced very little booty of value to the railway. The Red army destroyed all bridges and roads and evacuated the rolling stock to the interior of Russia. The Wehrmacht proved incapable of solving the immense technical problems involved in the reconstruction of the Russian railways and had ultimately to share control of the construction and operation of the railways with the Reichsbahn. Construction was extensive since the Russian railway gauge was different from those of the European countries. The Reichsbahn took over the responsibility for the entire system up to the Wehrmacht's railheads.⁶⁰

The Wehrmacht required 120 trainloads of supplies every twenty-four hours. The railroads carrying capacity was only one hundred trains a day, and that was for only a brief period. Field Marshal Keitel records that there were days when as many as a hundred locomotives broke down because of their inability to operate in sub-zero temperatures. Freight cars were commandeered by the Wehrmacht and used as shelters against the cold. Railway performance from December 1941 to March 1942 was so disastrous that only the establishment of a special motor transport organization staved off complete disaster.⁶¹

We must now turn and examine what effort Bomber Command was making to compound the German transportation problems during this critical period. A study of the tonnage of bombs dropped by type of target for the period December 1941 to March 1942 reveals the following.

Tonnage of Bombs dropped on Axis Europe

by Strategic Air Forces by type of target

quarterly 1941-1942⁶²

| <u>Year & Quarter</u> | | <u>Area Raids</u> | <u>Sub. Pens.</u> | <u>Transp.</u> | <u>Misc.</u> | <u>Total</u> |
|---------------------------|-----|-------------------|-------------------|----------------|--------------|--------------|
| 1941 | 4th | 3,599 | 119 | 885 | 2,987 | 7,590 |
| 1942 | 1st | 3,782 | 44 | 21 | 2,906 | 6,753 |
| | 2nd | 11,502 | 13 | 149 | 3,330 | 14,994 |

During the critical fourth quarter of 1941 and first quarter of 1942 Bomber Command dropped a total of 906 tons on transportation targets. For the first three months of 1942 only 21 tons out of a total of 6,753 tons were aimed at transportation. Bomber Command missed an excellent opportunity to disrupt transportation in the West while the Russian winter played havoc with the railways in the East.

The Russian front absorbed at least 1/10 of the Reichsbahn's rolling stock.⁶³ This caused a shortage of both locomotives and rolling stock throughout Germany. This shortage was made up by the leasing of locomotives and cars from the West, and by the implimentation of a new construction program.

The temporary shortage of locomotives alarmed the government which initiated an ambitious locomotive-building program. Production in 1941 totaled only 116 units a month. The planning office ordered an increased in production under the Four Year Plan, which had called for the construction of six thousand locomotives, quantities of other railroad equipment and highway

vehicles. Monthly figures jumped to 217 in 1942 and 438 in 1943, when the Four Year Plan was superceeded. By 1943, idle locomotives everywhere in the system were causing embarrassment. Monthly production for 1944 was reduced to 307 units.⁶⁴

The continuation of an expanded building program after the 1941-1942 crisis convinced Allied Intelligence that the Reichsbahn was still experiencing difficulty with motive power in the system. Indirect measures were taken by Allied economic experts to further hamper Axis transport. In the Anglo-U.S. -Swedish War Trade Agreement of 1943 the Allied powers sought to maintain an excess of German railway trucks in Sweden while limiting the number of Swedish trucks operating in Axis held countries. Sweden was asked not to increase the number of her locomotive operating in Norway and under no circumstances to send any locomotives to Germany. The War Trade Agreement of 1943 displayed the futility of Allied efforts to wage economic warfare against the German railways.⁶⁵

VI. Air Offensive: September 1944 - April 1945

Until September 1944, the Reichsbahn suffered only moderate deterioration caused by extensive utilization of the equipment and sporadic air attacks. The massive assault upon French transportation did not extend itself to the borders of the Reich. In September 1944, however, transportation had achieved an equal priority with oil and area targets.

From September to November 1944 the strategic air forces carried out a series of transportation attacks against the Reichsbahn, the air forces tried to eliminate supply lines to the German armies on the west bank of the Rhine by working with the land armies. Twenty-five marshalling yards in western Germany were also subjected to attack.

It was not until November 1944 that a plan was devised to coordinate the efforts of the strategic bombers. The Communications Plan, as it became known, gave transportation a strategic priority second only to oil. The Rhineland area was divided into zones to be subjected to attack by the various air forces. It was hoped that such an attack would paralyze rail traffic within each zone. Key communications centers, marshalling yards, bridges and viaducts were singled out for special attention.

Reichsbahn traffic in the West declined in September with the impact of the first bombing of transportation targets. As the initial shock expended itself and repair measures and rerouting became organized, traffic recovered. After the Communications Plan went into effect in November traffic was again reduced. However, by the second week in November, traffic had again rebounded due to the buildup of supplies and men for the Ardennes counter-

offensive. This operation involved the assembly of twenty-two divisions and three brigades over a period of fifty days. In one week in November over 4,000 Wehrmacht trains moved into the west in anticipation of the assault. Bombing did not prevent, but merely delayed the concentration of these troops, the assembly of which at this time represented a considerable achievement for the Reichsbahn.⁶⁶

The German counteroffensive in the Ardennes disrupted the entire air offensive being directed against Germany. All target systems within Germany had to be abandoned in order to aid the ground forces. The Communications Plan itself had to be discarded as a total failure. Thus with one stroke the Germans forced the most offensive striking arm of the Allies into a defensive role. Attacks on the strategic objective in Germany had to be deferred until the situation on the ground had been rectified.

Railroad routes to the rear areas of the Bulge came under attack from December until mid-January. Railway supply lines ran to Hellenthal and Otzenrath which were only eight miles behind the front lines. In all, five lines supplied the Bulge with men and material. The effect of an air attack against these lines would only be felt in the area of resupply, since the buildup would accommodate the army for a time. The lines experienced an increase in traffic during the fourth week in December and a partial recovery in January despite the pounding of the air forces. Detraining points, however, were pushed back from the Bulge, but once again the air forces had only been able to temporarily reduce movement at a given point, but not eliminate it completely.⁶⁷

After the reduction of the Bulge the air forces concentrated on isolating the Ruhr area from the remainder of Germany. Efforts were made to disrupt the internal transportation, as well as, lines leading out of the Ruhr. The principle of rail saturation on a small scale which had been painfully learned in the Ardennes offensive and from the failure of the Communications Plan was now applied to the Ruhr. Both the tactical and strategic air forces participated. This was the last major effort of importance in the strategic air war against Germany. The air forces could claim to have heavily damaged twenty of the twenty-five rail centers within and on the fringe of the Ruhr. The tactical air forces claimed the destruction of 4,000 locomotives and 28,000 cars along with 113 bridges. By March 24 the army crossed the Rhine in the Wessel area and the isolation of the Ruhr was an accomplished fact.⁶⁶

The attack on the Ruhr was interrupted on February 22-23 for Operation Clarion, which was designed to disrupt rail movements throughout Germany for a limited period of time. Such a widespread attack violated the hard learned lesson of concentration. The attacks carried out under favorable weather conditions caused a drop of more than 272 trains daily or a loss of 57.66 percent of the average from February 1 to 22. With the cessation of the attacks recovery set in to 75 percent of the earlier levels. The recuperative powers of the Reichsbahn, although diminished after six years of war, still were present.⁶⁹

The heaviest bomb totals of the Second World War dropped on transportation targets came in the 4th quarter of 1944 and 1st quarter of 1945 with 115,684 and 152,968 tons respectively.⁷⁰ After March 1945 the Reichsbahn

found it impossible to keep any accurate statistical record of operations. The bombings and the occupation armies had so constricted the size of the Reich that had the statistics been available they would have had relatively little meaning whatsoever. By March 1945 railroad transportation was on a day-to-day, station-to-station basis.

VII. Effect of the Bombing on Railroad Traffic

The effects of the air attacks upon the German railways can be observed in passenger, freight and military traffic trends and operating procedures. The end result of the decline in movement throughout the system was an increase in the proportion of Wehrmacht goods as compared to all others. Through the use of priorities the Wehrmacht gradually took over control of the system.

The Reichsbahn had always allotted a considerable portion of its energy to passenger traffic. This was primarily due to the great degree of dependence placed upon the Reichsbahn by a heavy urban population.

Passenger traffic remained uninterrupted by the outbreak of war except in those areas where major military moves were taking place. After these movements were completed civilian traffic returned to normal.

Berlin began to impose restrictions upon civilian passengers after 1940. The distance any person could travel was limited to seventy-five miles unless a pass could be obtained from the mayor of the town where he lived. These became much harder to get as the war progressed. Cheap travel fares for the working man were eliminated. The only element of the civilian community which escaped travel restrictions were doctors and businessmen. In 1941 civilian travel was further restricted by the elimination of restaurant cars and limitations upon the number of sleeping cars. All unessential travel became a punishable offense.⁷¹

Another determining factor in the curtailment of civilian traffic appeared in the winter of 1941-1942. A shortage of locomotives developed during this

period, which forced the Reichsbahn to divert locomotives from passenger to freight and military traffic. The locomotive shortage eased enough after the winter of 1942 to permit the return of locomotives to passenger service.

Passenger train kilometers began to rise after February 1942 and continued to do so until June 1944 when a precipitous decline set in. Much of the passenger traffic towards the end of the war consisted of military personnel on furlough or in transit to their units.

Freight traffic, which had been of secondary importance to civilian passenger traffic, gained increased importance after the outbreak of World War II. The demand for rolling stock and freight service increased as Germany moved to a war economy. As she expanded beyond her original borders, the average haul demanded of the Reichsbahn increased considerably. In 1937 the average haul was only 199 miles. After March 1941 it had increased to 266 miles due to new political and military conquests. This growth in mileage effected the turn around time of cars by raising it from 4.6 days in March 1939 to 8.2 days in March 1950.⁷² With the imposition of air attacks on the average turn around time increased to 11.4 days in 1944.⁷³ Thus air attacks created an increase of only 3.2 days whereas territorial expansion accounted for 3.6 day increase. Despite the increase in turn around time, testimony of officials with ministerial rank bear out the conclusion that at no time after 1940 did a car shortage hamper the movement of traffic.⁷⁴

The administrative solution to the tight car situation was to load each car with a greater amount of freight. Foreign railway cars were to be over-

loaded by one, German by two tons. Competition among companies for various markets throughout Germany was regulated so as to economize on transport. A coke boundary was set up to force the Eastern and Western coal syndicates to stop competing for markets outside of their local areas.⁷⁵

A system of priorities was set up by Berlin to determine who was to have the controlling interest over car supply and the regulation of train movement. A working committee composed of civilian Reichsbahn officials and the military recognized Wehrmacht traffic as having first priority. Freight traffic received second priority. Priority within freight traffic was divided between railway coal and the armaments industry.

With the disruption of freight service resulting from the bombings, ministerial direction from Berlin became impractical and was discontinued after 1944 in favor of local on the spot decisions. However, Reichsminister of Armaments Albert Speer gained considerable influence over the railroads when reconstruction was needed to enable them to function. He attempted to reduce the burden of the railroads by increasing the direct delivery of armaments from the factory to the front lines, and by persuading the military services to give up much of their preliminary testing and modification of armaments already completed.⁷⁶ By 1945 the system of local directives was the only one which could be enforced due to the disruption of communications.

The problem confronting the freight traffic service can be seen in the decline in carloadings. In September 1944 carloadings on the Reichsbahn began a steep decline which continued until the end of the war. In September 1944, about 860,000 cars were loaded in Germany. By December 1944 this

total had declined to 530,000 carloadings. For February 1945 carloadings totaled only 300,000 cars.⁷⁷

Railway fuel declined rapidly after August 1944. The reserves in the closing months of the war were down to four to six days from the prewar norm of twenty-one days. The switch to brown coal proved to be very inefficient because of the increased amounts required to produce the power necessary to drive a locomotive.⁷⁸

With the outbreak of World War II it was inevitable that the army would view the operation of the railways with increased interest. The Wehrmacht was quick to gain traffic priority for its equipment at the outset of military operations. The Wehrmacht maintained a liason with the civilian railway officials through the Transportation Command. In occupied countries the Wehrmacht was generally responsible for railway operations. In Germany a 'transport commander' was appointed as a plenipotentiary in each of the railway divisions. That some friction would develop between the military and their civilian railway counterparts was inevitable, since the civilians regarded this field as their specialty.⁷⁹

Wehrmacht interest in railway operations went deeper than just traffic control and priorities. In an attempt to create some uniformity throughout occupied Europe, thereby promoting efficiency of operation, the military specified the length, number of axles, weight, proportion of cars which had to be equipped with air brakes, and the order in which the train had to be made up. The Wehrmacht saddled the Reichsbahn with the responsibility for living

conditions within the cars used as quarters for its men. Food, drinking and toilet facilities all had to be provided by the railway.⁸⁰

Wehrmacht traffic was divided into three types: (1) complete Wehrmacht trains, (2) regular freight traffic carrying Wehrmacht lots, and (3) military personnel moved on passenger trains. Wehrmacht trains enjoyed top priority except in the critical months of the movement of railway coal. For this reason there was usually only a small backlog of Wehrmacht traffic at any time.⁸¹

Military traffic on the railway tended to hold up especially well throughout the entire war. However, this result was achieved at the expense of regular freight and civilian passenger service. As the air offensive began to have a noticeable effect on railway traffic the Wehrmacht began to move its equipment and personnel on through military trains, rather than distributing them in freight and passenger trains. This tactic of through military trains also served to nullify the results achieved by the strategic bombers in their attacks on railroad marshalling yards by diminishing military freight traffic's dependence upon them.

The major effect of bombing on military transportation was that of delay caused by disruption. Line cuts, destroyed bridges and damaged marshalling yards forced the rerouting of many trains. Schedules could not be maintained. This resulted in preventing the timely employment of Wehrmacht personnel and equipment. Units were committed to battle piecemeal, and their effect upon the outcome dissipated. As late as November and December 1944 the Reichsbahn was able to move divisional size units up to 150 miles.⁸²

VIII. Economic Effect of the Bombing: Coal

The most clearly defined study of the economic effects of the air attacks against German transportation can be made from the production statistics of hard coal and coke, and its movement from the Ruhr Valley to industries in central and eastern Germany. Coal shipments represented a total of 39 percent of all railroad shipments in Germany.⁸³ Since coal was not regarded as marginal traffic, but given equal priority with military necessities, the statistics for its shipment and deliveries were closely tabulated. Coal was of immense importance to the war economy, since it represented a major source of power needed by industry for electricity and the smelting of pig iron in the steel mills.

Air attacks upon the Ruhr's transportation and industrial complex can be divided into three distinct phases. The first phase was from May-June to September 1944. During this period the air attacks reduced the car placement total by less than ten percent, and there was no cumulative decline in coal shipments. The ability of the German railway workers and the Todt laborers to repair the damaged lines was equal to the efforts of the bombers to render them inoperable. The losses which were incurred from the air attacks were quickly made up by drawing from the existing stocks of coal kept in reserve by the various industries. These reserve stocks generally ranged from a fifteen day supply to a three month's supply. This remained sufficient to cover the minor interruptions caused by the bombing of railway lines.⁸⁴

The second phase of the air attacks ranged from September 1944 to the beginning of 1945. The air war intensified throughout this period in the numbers of planes involved and the frequency of the attacks. Losses in the transportation of coal became cumulative. The Germans were unable to repair the lines faster than they were being disrupted. Each new attack added to the destruction and compounded the repair problems. The result was the simultaneous decline of coal consumption and reserve stocks at the industrial plants. Stocks soon became exhausted and many of the plants were forced to discontinue operations. Production of coal in the Ruhr was, however, maintained. Stocks of coal in the Ruhr grew due to the lack of transportation. Production then had to be slowed, since there was no place to stockpile the amounts being mined.⁸⁵

The third phase of what was now becoming a crisis in the transportation of coal began in early 1945. Statistics available for this period suffer from the general disorganization of mail-flow caused by the decline of the railways. Accountants soon fell behind in their tabulation of coal being shipped or received. During the final months of the war, coal and coke shipments declined to a fraction of the previous levels. The transportation problem became so critical that selective industries, usually in the finishing process of armaments production, were given priority in coal shipments. The remaining industries were forced to scratch around for undiscovered stocks, improvise with what they had, or close down.⁸⁶

Prior to the outbreak of World War II, the Ruhr produced 69.3 percent

of Germany's coal. The second major coal producing area was Upper Silesia, which contributed 13.9 percent of the total mined. By 1944 the ratio between the two areas was almost equal. The Ruhr was producing 46.0 percent, while Upper Silesia contributed 40.5 percent.⁸⁷

For the first eight months of 1944, the Ruhr's coal production average was around 10,500,000 tons a month. The first phase of the air offensive against the Ruhr (May-September 1944) did not cause any noticeable drop in the production figures for those months. The decline in production, however, begins to set in with the beginning of the second phase. The production for September being 9,381,000 tons. Previous lows had been registered during the months of April, May, and August of 1943. The third phase of the air offensive began in January. Consequently January's production figures are down to an all time low of 5,470,000 tons. The decline continues throughout the remaining months of the war with figures for the first seventeen days of March registering 1,876,000 tons. The estimated total production figures for March were placed at 2,800,000 tons.⁸⁸

Coal Statistics⁸⁹

Production

(Thousand Tons)

| <u>Year</u> | <u>Month</u> | | <u>Year - 1944</u> | <u>Year - 1945</u> |
|-------------|--------------|---------|--------------------|-----------------------|
| 1943 | Jan. | 11, 229 | 10, 482 | 5, 470 |
| | Feb. | 11, 231 | 11, 049 | 4, 678 |
| | Mar. | 11, 785 | 10, 037 | 1, 876 |
| | Apr. | 10, 899 | 10, 705 | 1, 876 |
| | May | 9, 848 | 10, 339 | * |
| | June | 9, 929 | 10, 143 | <u>March 17, 1945</u> |
| | July | 10, 420 | 10, 417 | Est. 2, 800 |
| | Aug. | 9, 964 | 9, 381 | |
| | Sept. | 10, 078 | 7, 167 | |
| | Oct. | 10, 375 | 7, 169 | |
| | Nov. | 10, 883 | 5, 203 | |
| | Dec. | 10, 893 | 5, 370 | |

Statistics for the period beginning September 1944 and ending March 1945, show that production of coal and coke declined throughout. However, due to transportation difficulties caused by the bombing of rail lines and canals, stocks of coal and coke at the mines increased.

Coal stocks could have been even higher for 1945, had not production been slowed. Three factors served to reduce the increasing stocks at the mines. The first was the interruption of transportation from the mine shafts to the stockpiles caused by the bombing. The second was the limited space available to stock the coal once it was mined. The third was the probability of internal combustion resulting from coal stocks piled too high. The slow-down in production was a direct violation of orders from above, which unrealistically demanded unlimited production of coal and coke.

Despite the attempts to limit the production of coal and coke, the stocks at the mine mouths increased from September 1944 to March 1945. This increase can be readily seen in the stock of coke which grew from 1,011,000 tons in September 1944 to 3,185,000 tons for the first seventeen days of March 1945.⁹⁰

On an individual industry basis this problem of the overproduction of coal and coke, together with the inability to move it, can be seen in the example of the Vereinigte Stahlwerke's subsidiaries, who had no blast furnaces.⁹¹ Coke production and stocks were directly related to the ability of the transportation net to move them. The increase in the stocks of coke remaining showed a notable increase for the month of October. The decrease

in production for October was also sharp. This trend of increasing stocks and decreasing production continued until the end of the war. As the table shows, the decline in transportation was directly responsible for the increasing spiral in stocks, despite the declines in production.

The effect of transportation difficulties was apparent in the case of the Ilseder Hütte plant, which produced pig iron. The plant was dependent upon the deliveries of coal and coke if it was to operate. Production difficulties at the plant began in October 1944.⁹² The plant's average production figure for pig iron prior to October had been 44,000 tons. However, from October 1944 on, a decline began in the number of deliveries which were being made to the plant. Reserves were drawn upon, and a decline occurred here also. The decline in the deliveries of coal and coke was directly related to the decline in pig iron production at the Ilseder Hütte plant.

Since mining operations and steel plants offer little to be destroyed by aerial attack, the way the disruption of both occurred was through the bombing of the transportation net which served as the central nervous system between the two. Mining shafts and blast furnaces were only slightly vulnerable to bombs. However, the Ruhr, with the connecting link between her mines and steel plants in transportation, was particularly susceptible to bomb damage. The decline in the production of pig iron was directly related to the transportation system's inability to deliver coal to industry due to disruption from air attack.

Coal and coke stocks in the Ruhr, end of month⁹³

(Thousand Tons)

| | Hard Coal | | | Coke | | |
|-----------|-----------|-------|-------|------|-------|-------|
| | 1943 | 1944 | 1945 | 1943 | 1944 | 1945 |
| January | 710 | 1,204 | 2,626 | 329 | 731 | 2,881 |
| February | 683 | 1,115 | 2,727 | 339 | 796 | 3,069 |
| March | 500 | 774 | 2,754 | 297 | 762 | 2,185 |
| April | 211 | 457 | ..... | 199 | 699 | ..... |
| May | 106 | 386 | ..... | 97 | 742 | ..... |
| June | 48 | 249 | ..... | 51 | 696 | ..... |
| July | 33 | 186 | ..... | 34 | 590 | ..... |
| August | 26 | 415 | ..... | 24 | 630 | ..... |
| September | 91 | 872 | ..... | 57 | 1,011 | ..... |
| October | 250 | 1,894 | ..... | 250 | 1,858 | ..... |
| November | 1,039 | 2,109 | ..... | 496 | 2,321 | ..... |
| December | 1,437 | 2,339 | ..... | 707 | 2,649 | ..... |

Vereinigte Stahlwerke⁹⁴

(Thousand Tons)

Coke

| <u>Year</u> | <u>Month</u> | <u>Production</u> | <u>Stocks at end of month</u> |
|-------------|--------------|-------------------|-------------------------------|
| 1944 | January | 760.5 | 106.5 |
| | February | 723.1 | 106.5 |
| | March | 761.7 | 111.8 |
| | April | 741.7 | 117.8 |
| | May | 768.6 | 125.4 |
| | June | 691.3 | 112.3 |
| | July | 740.9 | 101.5 |
| | August | 738.2 | 111.4 |
| | September | 698.4 | 170.1 |
| | October | 514.9 | 338.1 |
| | November | 382.2 | 468.7 |
| | December | 330.0 | 562.2 |
| 1945 | January | 299.8 | 618.8 |
| | February | 218.7 | 661.9 |
| | March | 58.3 | 673.2 |

Ilse der Hütte⁹⁵

| <u>Year</u> | <u>Month</u> | Month end stocks | | Deliveries | | Pig Iron Prod. |
|-------------|--------------|------------------|-------------|-------------|-------------|----------------|
| | | <u>Coal</u> | <u>Coke</u> | <u>Coal</u> | <u>Coke</u> | |
| 1943 | Dec. | 13,480 | 18,541 | 28,986 | 16,693 | 44,380 |
| 1944 | Jan. | 17,755 | 17,749 | 42,472 | 18,712 | 45,449 |
| | Feb. | 15,623 | 19,280 | 34,781 | 17,702 | 40,475 |
| | Mar. | 17,414 | 19,938 | 40,494 | 18,597 | 43,682 |
| | Apr. | 22,246 | 17,096 | 41,085 | 16,558 | 43,470 |
| | May | 21,808 | 14,701 | 37,312 | 17,812 | 45,830 |
| | June | 17,807 | 15,253 | 33,307 | 19,240 | 45,854 |
| | July | 21,029 | 14,480 | 41,751 | 19,084 | 45,968 |
| | Aug. | 16,778 | 16,040 | 32,240 | 20,354 | 44,308 |
| | Sept. | 14,132 | 15,551 | 34,066 | 18,515 | 42,120 |
| | Oct. | 9,230 | 4,118 | 18,733 | 5,910 | 34,714 |
| | Nov. | 14,129 | 5,324 | 30,299 | 9,301 | 24,017 |
| | Dec. | 16,418 | 8,284 | 28,722 | 8,500 | 19,899 |
| 1945 | Jan. | 14,441 | 6,124 | 27,867 | 8,037 | 27,443 |
| | Feb. | 7,272 | 3,532 | 17,103 | 8,424 | 23,656 |
| | Mar. | 3,993 | 4,372 | 9,609 | 4,547 | 7,519 |
| | Apr. | 3,115 | 2,475 | 800 | ----- | 2,756 |

IX. Effect of the bombing on the physical plant

The damages sustained by the Reichsbahn's physical plant was small in comparison to the entire system taken as a whole. The air forces were definitely limited in the number of targets they were capable of attacking. Almost all targets had to be hit repeatedly otherwise German repair efforts would nullify the resources expended upon destruction.

The heavy bombers were primarily used against marshalling yards and large rail centers. Occasionally they were employed to eliminate important bridges and viaducts, but this remained a side task.

The effectiveness of attacks upon marshalling yards varied with the types of goods shipped. Civilian goods shipped in mixed lots required the use of marshalling yard facilities and were heavily disrupted by the raids. Military goods and high-priority items usually travelled as a unit and were able to move through a destroyed yard so long as one track was operational. Usually a through line was restored in even the most heavily damaged yard within twenty-four to forty-eight hours.

Recuperative efforts remained high throughout the entire war. Generally a yard was able to handle traffic within four days after the first intensive attack. In a period of from two to four weeks after the initial attack it was able to handle eighty percent of its previous capacity. However, recuperative powers usually diminished after successive raids, as did the capacity to handle traffic. It generally took six successive raids to eliminate the classification capacity of a yard.

After the allied invasion of Normandy in June 1944 line cuts and bridge destruction was usually carried out by fighter bombers of the Ninth Air Force. The Ninth was responsible for tactical interdiction of the European battlefield and rarely participated in strategic bombing.

Line cuts and bridge destruction proved to be the most valuable means through which the interdiction of traffic might be accomplished. It was also the only effective way of disrupting the military and high priority traffic moving in complete trains. The attack on the Ruhr was an excellent example of the success of interdiction. Attacks by fighter bombers severed the Ruhr from the remainder of Germany, but attacks by the heavy bombers upon the internal railway system of the Ruhr proved to be economically wasteful, since no coal could leave the area.

German records for the repair of line cuts and bridges was limited. Bridges were regarded as cuts and only those cuts which remained unrepaired after twenty-four hours were noted as such. The size of the cuts were not recorded. The time for repair varies throughout.

There was a steady increase in the amount of rolling stock available to the Reichsbahn after the occupation of France and the Low Countries. By 1944 the number of cars on the line, including foreign ownership had increased 124.3 percent since January 1937, while carloadings had increased only 27.5 percent. After August 1944 certain yards became congested due to the number of cars for which there existed no service need. Turn around time increased as there was no need to unload quickly to free the cars. Freight car turn

around time increased from 10.4 days in August 1944 to 16.0 days in December 1944.⁹⁷

German production figures do not distinguish between freight and passenger car construction. It can be assumed that the construction of passenger cars was kept at a minimum throughout the entire war.

Production: All Cars⁹⁸

| <u>Year</u> | <u>Number</u> |
|-------------|---------------|
| 1940 | 28,200 |
| 1941 | 44,845 |
| 1942 | 60,892 |
| 1943 | 66,263 |
| 1944 | 45,289 |

The German Ministry of Transport lists serious damage or loss to 9,014 freight and passenger cars in 1943 and to 33,743 cars for 1944.⁹⁹ Consequently this did not reduce the number of cars available to the Reichsbahn, which increased right until the end of the war. This increase resulted from the evacuation of cars from the West and a steady stream of production.

Locomotive production carried a high priority rating throughout the war and was not revised until October 1944. Henschel and Sohn, with three plants located in Kassel, was the largest producer of locomotives in Europe. Henschel's maximum capacity was eighty to ninety units per month.¹⁰⁰ The Knupp works at Essen contributed twenty units a month.¹⁰¹ German locomotive

manufactures altogether produced 12,944 units during the war. The following chart breaks this figure down yearly.

| Locomotive Production ¹⁰² | |
|--------------------------------------|------------------------|
| <u>Year</u> | <u>Number of units</u> |
| 1939 | 704 |
| 1940 | 988 |
| 1941 | 1,394 |
| 1942 | 2,159 |
| 1943 | 4,535 |
| 1944 | 3,061 |
| 1945 | 103 |

The number of locomotives destroyed or seriously damaged by air attack, according to the Ministry of Transport, totaled 444 in 1943 and 6,086 in 1944.¹⁰³ These figures, when compared to those of locomotive production, explain why motive power was not seriously reduced by strafing attacks. Locomotive supply increased throughout the war.

The plants producing locomotives and cars were never seriously attacked during World War II. It was only when they were turned over to tank production that they came under air attack.

Repair facilities were also ignored by the air forces. This was due in part to their number, and the resiliency of the locomotives themselves. A locomotive only needed to visit a repair shop once every two years.

Destruction of repair facilities usually resulted from siplage of bombs from area attacks upon large cities. Thus, locomotives and cars were well maintained throughout the war.

X. Observations and Conclusions

Upon the conclusion of the Second World War all the major participants rushed to get the reasons for the Allied success or the causes of the German failure into prints. This has resulted in a superabundance of literature in this area. In many instances the Germans won the battle of publication deadline with their apologia for the war. Rival British and American publications surpassed each other in explaining the causes of Germany's defeat.

In addition to these unofficial explanations the United States government had, under the authorization of the President Roosevelt, launched the Strategic Bombing Survey to examine the effectiveness of the strategic bombing of Germany. By March 1944 the Survey's teams were already at work gathering information.

The British Bombing Survey got off to an inauspicious start when Prime Minister Churchill refused to sanction funds for what he regarded as a sterile and academic exercise. Thus the British investigation lacked the magnitude of the American effort and suffered severely from interdepartmental pressures. Everyone who had played a role in strategic bombing demanded a voice in the survey. Hence the British survey was largely directed by the men who played a major role in determining the strategy followed by the Chiefs of Staff and the Defense Committee. The conclusions inevitably reflected their interests and appreciations.

British academic scholarship sank to its lowest depths. Lengthy questionnaires were drawn up in London and submitted to the defeated Germans.

The accuracy of the answers received from factory managers whose records had been destroyed may be questioned. The British Survey depended a great deal upon statistics. Very little was attempted in the way of actual examination of the physical destruction. The conclusions of the British depend heavily on the evidence found by American investigators in the U. S. S. B. S. Unlike the American Survey the British Bombing Survey has not been made public.

Just what the U. S. Strategic Bombing Survey was designed to prove or disprove can be the subject of considerable debate. The members of the Survey went to Germany with the intention of investigating the effects of strategic bombing, but discovered they lacked sufficient knowledge of the intricacies of the Nazi economy. Hence the survey devotes much of its time to an in depth examination of the German war economy. It was perhaps inevitable that the economists assigned to the survey should find this aspect of their study infinitely more intriguing than a determination of what was ineffective or effective bombing.

Critics of strategic bombing quote the Survey as an admission of the failure of this concept. The Army Air Force, seeking independence, looked to the Survey for justification of its separate existence. Many of the claims made by the Air Force were largely exaggerated. Nevertheless, the bomber was awarded the primary role in the American defense establishment, and formed the cornerstone of our post-war defenses against the Soviet Union. It was not until the explosion of the atomic bomb that A. F. claims were justified.

Now few could argue against the effectiveness of future strategic bombing when viewing the destruction wrought upon Hiroshima and Nagasaki. However, it is interesting to note that interruption of railroad service in both these cities was minimal. Through railroad service was possible in Hiroshima on August 8th, only two days after the attack.¹⁰⁵ At Nagasaki, where the scale of destruction was greater, rails buckled intermittently for distance of 5,000 to 7,500 feet from ground zero. Bridges and wooden ties suffered from fire. All stations in the area were destroyed and the electric signal equipment was damaged. Destruction to equipment, however, was not extensive and emergency repair work was able to permit the resumption of limited traffic within 48 hours after the attack.¹⁰⁵

The Strategic Bombing Survey, voluminous in size, stands as a bulwark to anyone arguing for the concept of strategic bombing. Advocates of this concept are hard pressed to enlist the Survey's findings to further their own theories. The accuracy of the bombers themselves, as well as the adequacy of the concept of strategic bombing, was subject to question by various reports filed by the Survey.

The Strategic Bombing Survey would lead one to believe that the German Reichsbahn was a model of efficiency, lavishly supported by an unlimited amount of funds. This, however, was not true of the Reichsbahn prior to W. W. II. Competition with other modes of transport for freight and passenger revenue was keen. The Reichsbahn received little assistance from the state as compared to the help given to highways and canals. The system of transportation was designed to be complementary, but the degree of cutthroat

competition between the three component parts increased. With revenue railing the Reichsbahn was forced to economize by withholding new purchases of rolling stock and permitting the renewal of trackage to wait for some future time. Little anticipation was given to the problems which would result from a systematic air attack against railway facilities. By-passes at strategic choke points in the system were never constructed.

The amount of energy expended on railway facilities was determined by the theory of the short war, which provided for an expansion of armaments in width rather than in depth. The Reichsbahn represented a capital industry which according to blitzkrieg economics would be sufficient in a short war. Thus investment was not directed into the railways. Since the time and place of the attack and the number of opponents could be determined, the Reichsbahn would have enough time to meet the requirements of the army.

In the early war years it appeared that the railway would be able adequately to perform its tasks despite the Allied Air Forces. The complexity of the system seemed to be sufficient to deter the threat from the air. Underground bunkers were constructed to protect railway employees and the construction of key by-passes begun. The system proved capable of bearing the burden of satisfying both the civilian and military sectors of the war economy. The attitude of railway officials remained complaisant, they continued to believe their system to be crisis proof.

Events after September 1944 proved them incorrect. Allied air power was beginning to exploit its undisputed supremacy in the skies by concentrating upon the German transportation system. This, together with the loss of

adjacent territories and the defeat of German armies in the East and West, culminated in the declining effectiveness of the system. By March 1945 carloadings totaled only 214,000. The decline from 573,000 cars in December 1944 cannot be solely attributed to the Allied Air Forces, but must consider the physical occupation of the Reich itself by Allied armies. The number of carloadings achieved from March 1945 represent a considerable accomplishment for the Reichsbahn.

A study of the transportation attacks reveals a lack of clarity about basic objectives among the higher echelon of Allied commanders. The aim of the offensive became blurred by the arguments over target priorities and target systems. The British preferred area raids against large cities, the Americans, key targets within the German war economy. The problem of an overall objective could never be resolved so the bombings were termed complimentary. In the end it amounted to a violation of the principle of concentration which was repeated time and again as the air leaders employed their weapon in a strategic or tactical role.

The failure to concentrate upon one target system led to economic overbombing. Various interrelated sectors of the German economy were repeatedly bombed after they had been rendered useless by attacks upon a related area. Attacks were made upon steel mills whose supply of coal had been halted due to the disruption of the railway service connecting it with the mines. Many of the industrial areas attacked had been idled due to the disruption of the supply of a component part without which the manufacturing

process could not proceed. Bombs dropped on these non-productive targets could have been usefully employed elsewhere. The continual pounding of steel mills paralyzed by the lack of coal pointed to the failure of accurate intelligence.

Those proponents who argue for a diversification of targets point out the fact that if the air attacks were concentrated upon a single objective the Germans could concentrate upon its repairs very rapidly. This assumption led Air Marshal Harris to argue for a general attack, aimed at hitting hard everywhere. This, Harris reasoned, would serve to keep the Germans off balance and guessing. Harris' argument against a concentration of effort does not stand when reviewing the evidence of the German reaction to the crisis manufactured by the bombing. Throughout the entire air war the Germans were slow to realize where the successive blows were going to be administered by the Allies. Once convinced of the new objective they were sluggish in the movement of anti-aircraft guns and repair units from formerly threatened segments of the economy. The lines of power and authority in the Nazi hierarchy did not help matters much. Goebbels was unwilling to move any anti-aircraft guns from the cities to more threatened points. In view of the extensive nature of the railway system of the Luftwaffe wanted no role in its defense.

It can be argued that the nature of the air attack against German transportation was not strategical at all. The Survey implied that since the attacks upon the railways were 'primarily economic' they were therefore 'broadly strategical'. However, the attacks themselves were not planned or executed for this purpose, for tactical considerations were usually paramount in the

choice of individual targets. Thus, there was no basic study of the flow of German economic traffic and its handling with a view towards devising a system of rail targets designed seriously to diminish significant traffic flows.¹⁰⁶

Instead of reverting to imagination and creative generalship the air commanders resorted to bludgeoning tactics to bring discord within the German transportation network. Creative generalship usually declined proportionally to the increase in the amount of force available to the commander.

The strongest evidence of the effectiveness of the transportation attack can be witnessed in examining the isolation of the Ruhr from the remainder of Germany. The coal mined in the Ruhr was essential to the industry of northern and eastern Germany. The advantages of industrial relocation depended heavily upon the strength and safety of the transportation net. Re-location worked well for the Germans until the isolation of the Ruhr. The decline in production of these industries can be traced to the disruption of coal coming from the Ruhr. The mines of upper Silesia did not produce the rich hard coal of the Ruhr, but an inferior brown coal. The loss of the Ruhr was felt throughout the entire German war economy, and its loss represents a tactical victory for the air forces.

Aerial warfare against the railway net effected the civilian sector of the economy first then spread to the industrial-military sector. Industries producing goods for civilian consumption generally got low priority rating and were moved last. A second problem for civilian consumption items was the fact they moved in mixed trainload lots and had to be sorted out in marshalling yards.

Goods and raw materials for the industrial-military users generally had top priority and traveled in complete through trains, which did not require marshalling yard facilities. The last item to be effected by aerial warfare would be military equipment.

The Reichsbahn was able to move military equipment and personnel until the very end of the war by reducing all freight and what little there remained of the passenger service. The railway surmounted innumerable difficulties in meeting the requirements of the Wehrmacht. The Ardennes offensive had to be postponed several times to allow the railway to accumulate the necessary supply. Even under the concentrated aerial onslaught after the ground attack began the Reichsbahn was able to send through a few trains.

The failure of air power to halt the movement of men and material into the war zone is not confined to World War II alone. World War II was the first recorded instance of the failure of air power to critically limit movement over a railway net. A second example of this inability can be seen in the Korean conflict, when the Chinese Communists, despite overwhelming United Nations air superiority and the ruggedness of the terrain, were able to supply by rail their troops fighting along the 38th Parallel. Today the Vietnam war offers another example of this pattern of failure. The North Vietnamese railway functions quite adequately in supplying the Ho Chi Minh Trail and the North Vietnamese regiments along the Demilitarized Zone despite the efforts of the most modern air force in the world.

Footnotes

1. United States Strategic Bombing Survey: (Herein after known as USSBS) Effects of Strategic Bombing on German Transportation, (November, 1945), p. 6.
2. Ibid., p. 6.
3. Hebert Block, German Transportation Policy During the War, (Library of Congress Typescript, 1944), p. 79.
4. Ibid., p. 79.
5. Ibid., Table XV, p. 16.
6. USSBS: German Locomotive Industry During the War, (January 1947), p. 2.
7. Block, Table IX, p. 16.
8. USSBS: German Locomotive Industry During the War, Table II, pp. 3-4.
9. Block, p. 80.
10. Ibid, p. 80.
11. Block, Table XVI, p. 81.
12. Maxine Y. Woolston, The Structure of the Nazi Economy, (New York, 1941), Table III, p. 57.
13. Ibid., Table III, p. 57.
14. Block, p. 86.
15. Alexander Dallin, German Rule in Russia 1941-1945, (London, 1957), p. 400.
16. USSBS: Effect of Strategic Bombing on the German War Economy, (October 31, 1945), p. 59.
17. Edward Mead Earle, ed., Maker of Modern Strategy, (Princeton, 1943), p. 504.
18. Alan S. Milward, The German Economy at War, (London, 1965), p. 8.

19. Ibid., p. 27.
20. Ibid. p. 8.
21. USSBS: Effects of Strategic Bombing on the German War Economy, p. 7.
22. Burton H. Klein, Germany's Economic Preparation for War, (Cambridge, 1959), p. 14.
23. Ibid., p. 15.
24. USSBS: Effects of Bombing on Railroad Installations in Regensburg, Nuremburg and Munich Divisions, (October 26, 1945), p. 2.
25. Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945, IV, Annexes and Appendices, (London, 1961), p. 99-102.
26. USSBS: Overall Report, European War (September 30, 1945) p. 95.
27. Forrest C. Pogue, The Supreme Command, (Washington, 1954), p. 127.
28. Gordon A. Harrison, Cross-Channel Attack, (Washington, 1951), p. 225.
29. Ibid., p. 225.
30. USSBS: Impact of the Allied Air Effort on German Logistics, (January, 1947), p. 5.
31. Ibid., p. 34.
32. Ibid., p. 44.
33. Ibid., p. 44.
34. Ibid., p. 45.
35. Ibid., p. 50.
36. Forrest C. Pogue, p. 127.
37. USSBS: Effects of Strategic Bombing on German Transportation, p. 15.
38. Ibid., p. 16.

39. USSBS: Bombing Accuracy, USAAF Heavy and Medium Bombers in the ETO, (January, 1947), Exhibit R.
40. Noble Frankland, The Strategic Bombing Offensive Against Germany, (London, 1964), p. 58.
41. Air Chief Marshal Robert Saundby, Air Bombardment, (New York, 1961), p. 98.
42. USSBS: Bombing Accuracy ETO, p. 10.
43. Ibid., p. 6.
44. Ibid., p. 3.
45. Ibid., p. 6.
46. Milward, p. 1.
47. Wesley T. Craven and James Lee Cate, The Army Air Forces in WW II, Europe: Argument to VE Day, (Chicago, 1951), p. 795.
48. Sir Solly Zuckerman, Scientists at War, (New York, 1966), p. 21.
49. USSBS: Bombing Accuracy ETO, p. 4.
50. Webster and Frankland, p. 11.
51. USSBS: Bombing Accuracy ETO., p. 14-15.
52. Webster and Frankland, p. 38.
53. Craven and Cate, p. 795.
54. USSBS: Bombing Accuracy ETO, Exhibit C.
55. Ibid., Exhibit B.
56. USSBS: Effects of Strategic Bombing on Railroad Installations in Regensburg, Nuremburg and Munich Divisions, p. 1-79.
57. USSBS: Impact of the Allied Air Effort on German Logistics, p. 26.
58. Hebert Block, p. 10.

59. Ibid., p. 11.
60. William Keital, The Memoirs of Field Marshal Keital, (New York, 1966), p. 177.
61. Ibid., p. 176.
62. USSBS: Effects of Strategic Bombing on the German War Economy, p. 2.
63. Block, p. 12.
64. USSBS: German Locomotive Industry During the War, (January, 1947), p. 11.
65. W. N. Medlicott, The Economic Blocade, II, (London, 1959), p. 473.
66. USSBS: Impact of Air Attacks on German Logistics, p. 51.
67. Ibid., p. 54.
68. USSBS: Effects of Strategic Bombing on German Transportation, p. 15.
69. USSBS: Impact of Air Attacks on German Logistics, p. 60.
70. USSBS: Effects of Strategic Bombing on the German War Economy, Table 4, p. 5.
71. Impact of Air Attack in World War II, (Stanford Research Institute, 1953), p. 288.
72. USSBS: Effect of Strategic Bombing on German Transportation, p. 42.
73. Ibid., p. 75.
74. Ibid., p. 75.
75. H. W. Singer, "The German War Economy in the Light of Economic Periodicals," The Economic Journal, LI, December 1941, p. 402.
76. Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany 1939-1945. VIII, Victory, (London, 1961), p. 222.
77. USSBS: Effects of Strategic Bombing on German Transportation, Exhibit 37, p. 45.

78. Impact of Air Attack in World War II, p. 283.
79. Ibid., p. 290.
80. Ibid., p. 290.
81. USSBS: Effects of Strategic Bombing on German Transportation, p. 47.
82. Ibid., p. 47.
83. USSBS: Effects of Strategic Bombing on German Transportation, p. 79.
84. Ibid., p. 79.
85. Ibid., p. 79.
86. Ibid., p. 80.
87. Ibid., p. 80.
88. Ibid., p. 80.
89. Ibid., p. 80.
90. Ibid., p. 82.
91. Ibid., p. 89.
92. Ibid., p. 89.
93. Ibid., p. 82.
94. Ibid., p. 89.
95. Ibid., p. 89.
96. Ibid., p. 4.
97. Ibid., p. 75.
98. Ibid., p. 75.
99. Ibid., p. 57.
100. Ibid., p. 18.

101. USSBS: German Locomotive Industry during the War, p. 23.
102. John P. Carter, "The German Railways: An Analysis of Economic Adaptation", Land Economics, XXVIII, (November, 1952), p. 313.
103. USSBS: Effects of Strategic Bombing on German Transportation, p. 57.
104. USSBS: Effects of the Atomic Bombs on Hiroshima and Nagasaki, Chairman's Office, (30 June 1946), p. 8.
105. *Ibid.*, p. 11.
106. USSBS: Effects of Strategic Bombing on German Transportation, p. 4.

Bibliographical Essay

No discussion of the effects of strategic bombing can ignore the important groundwork which was done in the United States Strategic Bombing Survey. Particularly useful to my work on the railways were the Transportation Division's, Effects of Strategic Bombing on German Transportation and the Effects of Bombing on Railway Installations in Regensburg, Nuremburg and Munich. The Physical Damage Division's survey report of The German Locomotive Industry During the War adequately covers the topic of locomotives. Hebert Block's German Transportation Policy During the War is helpful in examining conditions up to 1943. Burton H. Klein's Germany's Economic Preparations for War and Alan S. Milward's The German Economy at War helps to put German war preparations into their proper perspective. Both United States and United Kingdom official histories have treated strategic bombing extensively. These can be located in Charles Webster and Noble Franklands' The Strategic Air Offensive Against Germany 1939-1945 and in James L. Cate and Wesley F. Craven's The Army Air Forces in World War II.

Bibliography

- Block, Hebert, German Transportation Policy During the War, Library of Congress Typescript, October 1944.
- Block, Hebert, "European Transportation Under German Rule," Social Research, XI (May 1944), 216-241.
- Carter, John P., "The German Railways: An Analysis of Economic Adaptation," Land Economics, XXVIII, November 1952.
- Cate, James L. and Craven, Wesley F., The Army Air Forces in World War II, Argument to VE Day, III., Chicago: University of Chicago Press, 1951.
- Coverdale and Colpitts, Report on the Deutsche Bundesbahn, July 12, 1950, New York, 1950.
- Dallin, Alexander, German Rule in Russia 1941-1945., London: MacMillan & Company, LTD., 1957.
- Earle, Edward Mead, ed., Makers of Modern Strategy, Princeton: Princeton University Press, 1943.
- Emerson, William R., Operation Pointblank, Colorado: Harmon Memorial Lectures, U.S. Air Force Academy, 1962.
- Frankland, Noble, "Some Reflections on the Strategic Air Offensive, 1939-1945," The Royal United Service Institute Journal, CVII, May 1962, pp. 94-110.
- Greenfield, Kent Roberts, American Strategy in World War II: A Reconsideration, Baltimore: John Hopkins Press, 1963.
- Harrison, Gordon A., Cross Channel Attack, Washington: Office of the Chief of Military History, 1951.
- Harris, Arthur, Bomber Offensive, London: Collins, 1947.
- Impact of Air Attack in World War II: Selected Data for Civil Defense Planning, Stanford Research Institute, Vol. 4, May 1953.
- Keital, Wilhelm, The Memoirs of Field Marshal Keital, ed. Walter Gorlitz, Tr., David Irving, New York: Stein and Day, 1966.

- Klein, Burton H., Germany's Economic Preparations for War, Cambridge: Harvard University Press, 1959.
- Milward, Alan S., The German Economy at War, London: Althone Press, 1965.
- Medlicott, W. N., The Economic Blockade, II, London: His Majesty's Stationary Office, 1959.
- Kaldor, N., "The German War Economy", The Manchester School of Economic and Social Studies, XIV, (1946), 19-53.
- Pogue, Forrest C., The Supreme Command, Washington: Office of the Chief of Military History, 1954.
- Price, Alfred, Instruments of Darkness, London: William Kimber, 1967.
- Richardson, Helen R., Railroads in Defense and War, Washington: Association of American Railroads, 1953.
- Saundby, Air Chief Marshal Robert, Air Bombardment, New York: Harper and Butkins, 1961.
- Singer, H. W. "The German War Economy in the Light of Economic Periodicals", The Economic Journal, LI, December 1941, pp. 400-421.
- Stolper, Gustav, Hauser, Karl and Borchardt, Knut., The German Economy, 1870 to the Present, tr. Toni Stolper, New York: Harcourt, Brace and World, Inc., 1967.
- Tedder, Arthur Lord, Air Power in War, London: Hodder and Staughton, 1957.
- United States Strategic Bombing Survey, Effects of Strategic Bombing on German Transportation, Transportation Division, November 1945.
- United States Strategic Bombing Survey, Rail Operations over the Brenner Pass, Transportation Division, November 1945.
- United States Strategic Bombing Survey, Effects of Bombing on Railway Installations in Regensburg, Nuremburg and Munich, Transportation Division, October 1945.
- United States Strategic Bombing Survey, Overall Report (European War), September 1945.

United States Strategic Bombing Survey, The Impact of the Allied Air Effort on German Logistics, Military Analysis Division, January 1947.

United States Strategic Bombing Survey, The Effects of Strategic Bombing on the German War Economy, Overall Economic Effects Division, October 1945.

United States Strategic Bombing Survey, Bombing Accuracy, USAAF Heavy and Medium Bombers in the ETO, Military Analysis Division, November 1945.

United States Strategic Bombing Survey, German Locomotive Industry During the War, Physical Damage Division, January 1947.

United States Strategic Bombing Survey, The Effects of the Atomic Bombs on Hiroshima and Nagasaki, Chairman's office, June 1946.

United States Strategic Bombing Survey, Summary Report (European War), September 1945.

Van Fleet, James A., Rail Transport and the Winning of Wars, Washington: Association of American Railroads, 1956.

Verrier, Anthony, The Bomber Offensive, London: B. T. Batsford LTD. 1968.

Webster, Charles and Frankland, Noble, The Strategic Air Offensive Against Germany 1939-1945, I-IV, London: Her Majesty's Stationery Office, 1961.

Woolston, Maxine Y., The Structure of the Nazi Economy, New York: Russell & Russell, 1941.

Zilbert, Edward R., The Development of Hauptausschüsse und Ringe in the German War Economy, Rand Corporation, p. 3649, August 1967.

THE STRATEGIC BOMBING OF THE GERMAN RAILWAYS IN WORLD WAR II

by

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ABSTRACT

This thesis examines the effects of strategic bombing on the German railways during the Second World War.

First considerations are given to the condition of transportation within Germany prior to the outbreak of war. Given the usual limitations upon resources, the Nazi government chose to expend their energy upon peripheral matters within the field of transportation, namely roads and canals. Improvements here were accomplished much to the neglect of the railways.

The Nazi concept and planning of blitzkrieg warfare also resulted in the lack of expenditures in railway transportation. The German economy was expanded in 'width' to fight what the Germans thought was going to be a short war. An expansion of the economy in 'depth', which would have benefited such capital industries as the railways, connotated a long war. German leaders refused to consider this in their planning. Thus the railways lost much of the influence they had gained as the fourth branch of the armed forces in World War I.

Air operations conducted against railway facilities in Germany until September 1944, convinced railway officials that their system was crisis proof. Although initially unprepared for war the railways had withstood the strains for five years.

After the Allies successfully disrupted the French railways prior to D-Day, they began to devote greater attention to the system in Germany. Railways gained a priority position among the targets to be attacked. This increased tonnage of bombs dropped on the railways after September 1944, and the gradual occupation of Germany itself, played havoc with effective railway performance.

The effect of the bombing on passenger, freight and military traffic reveals that military movements are least effected. Freight traffic, especially that of coal, which was concentrated in the Ruhr, was disasterously influenced by air operations. The physical plant suffered only minimum damage throughout the war and was kept constantly under repair.

This report draws heavily upon the United States Strategic Bombing Survey, especially those of the Transportation Division, and the official histories of the war, both British and American.