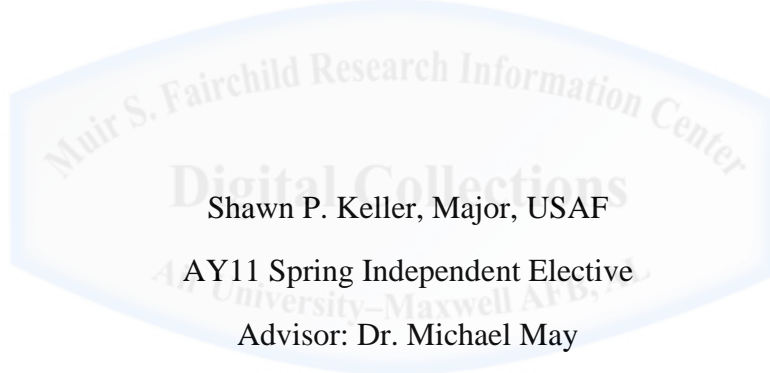


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*TURNING POINT: A HISTORY OF GERMAN PETROLEUM IN WORLD WAR II
AND ITS LESSONS FOR THE ROLE OF OIL IN MODERN AIR WARFARE*



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Military History is a window through which we may study the lessons of past combat. These lessons become clear only after thoughtful examination of events and factors that influenced them. Organizations that have not been willing to examine the past, especially their own, have usually paid a price for that oversight...History clearly points out that those who ignore the past are doomed to repeat old mistakes.

--General Robert C. Mathis, USAF

“No war for oil!” is a protest frequently heard whenever the United States responds with military power to a crisis in the Middle East. There are some who believe the 1990s Gulf War, and current U.S. conflicts in Iraq and Libya, were inappropriate responses driven purely by U.S. petroleum interests. Others would argue those claims are more rhetoric than reality, and that America has a larger strategic goal in the region. However, it does beg the question--Is oil really worth going to war over? And perhaps more importantly for both politicians and war planners--Is protecting oil a valid strategic military objective? When one examines history, the answer is a resounding yes. Since the birth of the industrial age, crude oil has not only been the life-blood of an increasingly global economy, but also a determining factor in success or failure on the battlefield. This is particularly true when one considers the application of air power. In a matter of a few short decades, powered flight drastically changed the face of warfare. And while nearly a century of evolution has transformed air power from a small, supporting actor on the battlefield into a dominant force that provides modern nations with rapid and decisive military response, one truth has remained constant. No air force can survive for long without adequate and unrestricted access to oil.

Perhaps more than any other modern conflict, World War II demonstrated the strategic advantage of air power. And equally as significant for air power proponents, the war revealed

the vital importance of petroleum to gaining and maintaining air superiority. Without oil, the Allies could never have won. In all of its precious forms, from motor fuel and synthetic rubber to machine lubricants for factories, oil was an indispensable resource. As British Air Ministry member and air power advocate J.M. Spaight wrote shortly after the war “Modern strategy, tactics and logistics are all founded on and presuppose the possession of the internal combustion engine and its oil, the modern counterpart of the horse and its fodder in the wars of the past.”¹ But despite its many advantages, technology has never been able to completely replace the human face of war. Time and again since the advent of industrial warfare, troops on the ground have ultimately decided the outcome of war. World War II was no different in this regard. However, for the first time in history, the war proved that victory on the ground is equally dependent on control of the skies. And it was in the conduct of air warfare that Germany’s lack of oil arguably took its biggest toll.

This study will begin with an overview of the German petroleum industry, both before and during the war. Particular attention will be focused on Germany’s lack of natural resources which, when combined with the growing demand of fuel for its military, led the *Reich* to rely heavily on synthetic fuel—an industry that ultimately proved vulnerable to Allied attack. It will then explore how the constant need for more oil drove German operational planning, resulting in the *Reich*’s fateful decision to launch Case BLUE in the summer of 1942 in a last-ditch effort to capture the Caucasus oilfields. Finally, evidence will be presented to show how protracted war in the East crippled the *Luftwaffe*’s ability to effectively train its force and defend its remaining petroleum sources in the German homeland. In what is perhaps the greatest irony of World War II, Germany’s relentless quest to capture Soviet oil caused them to lose what precious little of it they already possessed.

GERMAN PETROLEUM INDUSTRY: 1917-1945

In order to understand the *Luftwaffe*'s growing desperation for fuel as the war progressed, it is necessary to examine Germany's oil situation in the years leading up to World War II. Unlike its neighbors France and Great Britain, post-World War Germany could not rely on its meager colonial holdings or a seat at the table with the major American and European oil cartels to provide much needed crude. It is important to recognize that even if Germany had access to its own overseas oil reserves, the nation suffered such tremendous economic and political hardships in the wake of World War I that it likely would not have been capable of maximizing production in those early post-war years.

As a result, Germany found itself lagging behind and at the mercy of the global oil market. France was already a major player in the development of oil in the Middle East as early as the 1920s as a major stakeholder in a consortium initially known as the Turkish Petroleum Company Limited.² Later renamed the Iraq Petroleum Company (IPC), the consortium was an early effort to control oil exploration and production over an enormous swath of Mideast territory, at a time when many believed an oil shortage was imminent.³ Across the Channel, Great Britain was enjoying the benefits of not only its stake in IPC, but a handsome 40% share of Royal Dutch Shell.⁴ By the time war began in 1939, seven oil corporations (five American and two European) essentially controlled the global supply of oil.⁵

When its economy finally began to blossom in the 1930s, Germany quickly realized that the meager natural deposits of crude oil under its surface were woefully inadequate to meet the demands of its growing industrial centers. In an effort to decrease its dependence on imported oil, Germany nationalized the ownership of oil in the *Reich* in an attempt to speed up the

exploration and exploitation of domestic crude.⁶ While the surge in exploratory drilling uncovered significant new oil in Germany's northwest regions, particularly deposits at Reitbrook and Heide-Meldorf,⁷ it was not enough to provide substantial relief. Even if large deposits had been discovered, the waxy nature of German crude prevented it from being useful to the refining of motor and aircraft fuel—a critical resource for its growing military. However, German crude was well suited for lubricating oils and indeed provided an adequate supply of the product to both the defense and civilian manufacturing industries until the Allied bombing of refineries began to curtail its production in 1944⁸.

The rise of National Socialism brought with it a boom of technology and manufacturing that restored Germany's standing as a European industrial power. Hitler's autarkic policies ensured that most of the *Reich's* industrial productivity focused inward on infrastructure development and domestic products for the German populace. However, the announcement of Hitler's "Four Year Plan" for the German economy in September of 1936 quickly redirected manufacturing efforts toward military aims. In a memorandum drafted a month before the plan's release, Hitler stated, "The extent and pace of the military development of our resources cannot be made too large or too rapid!"⁹ The Fuhrer's policy gave a green light to Nazi leaders who were quietly developing a plan for European conquest; the success of which required a buildup of massive military power. While the design of German military hardware in World War II is legendary and still touted by historians and military experts to this day for its technological brilliance, manufacture and operation of its war machines added to an already unquenchable thirst for oil.

By 1938, Germany's total oil supply had risen to approximately 44 million barrels.¹⁰ Of this total, domestic crude oil production accounted for only 3.8 million barrels while 60 percent (roughly 28 million barrels) of German oil was imported from overseas where the United States controlled the lion's share of production. The remaining imports came overland from European sources (3.3 million barrels from Romania alone¹¹), while another 9 million barrels were derived from the *Reich's* growing synthetic oil industry.¹² While this amount is scant in comparison to the 1 billion barrels that were domestically produced by the United States, or even the 183 million barrels produced by the Soviet Union in that same year,¹³ Hitler and his ministers knew that their pending plans for a European military campaign would dramatically increase demand.

Once war began in 1939, German industrial production grew at an exponential rate as battlefronts expanded and attrition rates for aircraft, ships and vehicles mounted at a frenzied pace. The *Luftwaffe*, for example, took delivery of 8,300 aircraft in 1939—a number that exploded to a peak production of 39,800 by 1944.¹⁴ With the disappearance of foreign imports from the west as a result of the Allied blockade, Germany took swift action to alleviate its desperate demand for oil. As the war escalated and fuel reserves began to tighten, production of domestic crude was stepped up dramatically, as was production of synthetic petroleum. Turning to their neighbors in the east, Germany pressed both Romania and the Soviet Union to significantly increase current oil exports. Romania was particularly critical to the *Reich's* oil stockpile program, producing 8 million barrels for German export in 1940—a staggering increase of 4.7 million barrels in only two years.¹⁵ By comparison, Soviet Union exports to

¹⁰ Authors note: Oil and aviation fuel quantities from this era were normally provided in metric tons. Conversion to the common U.S. measurement standard of barrels and gallons were calculated using the United States Energy Information Administration website (www.eia.doe.gov) and will be used throughout this study.

Germany only amounted to 4.5 million barrels—despite the fact that the USSR sat squarely on top of the world's largest oil reserves.¹⁶ By January 1941, six months before Hitler launched the Soviet invasion, Germany had managed to build petroleum reserves to an estimated 56 million barrels.

THE RISE OF SYNTHETIC OIL

Scientists had been experimenting with the technology of converting coal into oil since the early 20th century. Both products contain a similar mixture of basic hydrocarbons, so the process seemed to be a natural evolution as new developments in both manufacturing and chemistry emerged. Despite its possibilities, coal synthesis tended to be a process largely ignored by the rest of the world, particularly those nations with ready access to natural crude oil—the United States included. Germany, however, anxiously embraced synthetic petroleum technology even prior to World War I.¹⁷ Germany's aggressive development of synthetic fuel is in many ways the essential element that allowed the *Reich* to continue waging war long after the Allied blockade of September 1939 essentially cut off imports of crude oil.

It was as much Hitler's quest for German self-determination as actual oil demand that drove the *Reich's* burgeoning synthetic fuel industry. World War I taught Germany a brutal lesson. Their scarce organic oil resources made them vulnerable to reliance on other nations during the war, particularly Austria-Hungary and neighboring Romania. Germany experienced a severe oil crisis in the latter years of the Great War that significantly altered their strategic military objectives. Eerily reminiscent of Operation BARBAROSSA more than two decades later, Germany developed a plan to capture of the rich Baku oilfields in the Caucasus. However,

the British beat Germany to Baku in August 1918 dealing the Kaiser's army a serious blow.¹⁸ As Europe careened toward war in 1938, Germany did not intend to lose the race for oil again.

Germany saw synthetic petroleum as a way to use its existing organic coal to decrease reliance on foreign imports, while at the same time fill the growing need for fuel. Coal was the cornerstone of the German economy. Comprising 90% of Germany's energy consumption by 1937, coal was a natural resource that the *Reich* had in abundance.¹⁹ German mines were more highly mechanized than those of other European coal producers, an advantage that allowed them to out-produce their neighbors. For example, in 1938 the German coal output per man-hour exceeded that of Great Britain by one-third and was double that of peer competitors France and Belgium.²⁰ Germany produced 187.5 million tons of coal between 1938-1939, prior to the invasion of Poland. The production of coal increased between 1939-1944, reaching a peak of 268.9 million tons in 1944²¹. Part of that increase was a windfall from the coal rich regions in Czechoslovakia and Poland that were captured in the early years of the war. However, Germany was able to slightly increase its domestic coal production as well in an attempt to meet the growing demand for synthetic fuel and steel production.

Working to capitalize on Germany's abundant coal resources, German engineers developed a method to chemically synthesize coal into liquid petroleum. German scientist Friedrich Bergius pioneered the process, inventing an early high-pressure coal hydrogenation (liquefaction) procedure between 1910-1925. A decade later, Bergius began working with Franz Fischer and Hans Tropsch at the Kaiser-Wilhelm Institute for Coal Research (KWI) in Mülheim. Together they discovered a second coal conversion process, known as Fisher-Tropsch (F-T). When combined with hydrogenation, the two processes allowed Germany to establish the world's first technologically successful synthetic liquid fuel industry.²² The results were impressive.

When a group of American oil executives visited an early German synthetic plant in 1926, then Standard Oil president Walter Teagle remarked, “We were babies compared to what they were doing. I had not known what (synthetic) research meant until I saw it”.²³

German chemical giant IG Farben entered the realm of synthetic petroleum production with its first processing plant at Leuna in 1927. Production in that first year of operation yielded an impressive 2.2 million barrels, which was soon increased to an average output of 3.6 million annually.²⁴ It is little wonder that Germany was optimistic about the capabilities of synthetic fuel. So confident was Germany in their new technology that I.G. Farben Director, Dr. Heinrich Bütetisch, stated during post-war interrogations that it was the *Reich*'s intention “that half of the whole of the oil used in Germany should be synthetic.”²⁵ Whether a by-product of this enthusiasm, or a result of Hitler's demand for a petroleum independent Germany in his Four Year Plan, between 1934-1935 four additional I.G. Farben plants were constructed at Böhlen, Magdeburg, Schwarzheide and Zeitz.²⁶ By this time, other German chemical companies such as Ruhrchemie and Friedrich Krupp AG began liquid fuel production operations and by the end of 1945 twelve coal hydrogenation plants and nine F-T plants had been constructed.²⁷

However successful synthetic oil may have been at granting Germany some degree of petroleum independence, the technology did not come cheap. Capital and construction costs for the average F-T plant were on average RM 30 million (\$75 million)²⁸. Production costs for synthetic oil and refined fuel products were also exponentially higher than that for natural crude. The average manufacturing cost for a barrel of synthetic oil was between RM 32-45 (\$13-18) and processed fuel values averaged 23-26 pfennig per kg (approximately 31-44 cents per

²⁸ All figures are based on financial values for the period. No inflationary adjustments have been made to reflect current values.

gallon).²⁸ In comparison, a barrel of crude oil traded for 93 cents on the U.S. commodities exchange in December 1939 and in the same month a gallon of regular gasoline sold for 13.4 cents at the average New York City service station.²⁹

Early funding for synthetic development was primarily derived from capital investment by the companies themselves or from private investors and banks. However, by 1939 the costs of production grew untenable for private industry and the German government began absorbing more and more of the cost. A report in March 1939 stated that of the RM 132 million (\$328.6 million) already spent on synthetic fuel that year, the government contributed an estimated RM 70 million (\$174.3 million) in the form of manufacturing equipment purchases.³⁰ The high cost of production did little to hamper Germany's continued investment and reliance on the synthetic petroleum industry. By the eve of war in 1939, annual German synthetic production had grown to 16.7 million barrels.³¹ During its highest year of production in 1943, Germany produced 42 million barrels of synthetic petroleum; far exceeding the 34 million barrels of crude oil domestically produced or imported during the same period.³²

Aviation gasoline was one of the driving forces behind the increase in synthetic petroleum production. The *Luftwaffe* itself carried out blending of aviation gasoline, and of particular interest to them was the high-grade oil that could only be produced through the hydrogenation method rather than F-T.³³ By January 1941, Germany had stocks of aviation fuel totaling 219.5 million gallons, of which ninety-percent was a product of the synthetic fuel industry. However, war with the Soviet Union that summer and fall did not go as planned. The quick victory predicted by Hitler had turned into a protracted winter war and by the end of 1941 aviation fuel reserves were down to 91 million gallons.³⁴ Although synthetic production increased substantially in 1943 into early 1944 and boosted aviation fuel reserves, quantities

would never come close to the January 1941 figures. German supply would not be able to keep up with *Luftwaffe* demand for the rest of the war.

By most standards, Germany's synthetic fuel was a technological wonder, and equal in quality and performance to fuel refined from oil. This was particularly true of German diesel and motor gas. Development of high-performance aviation fuel proved to be the one exception. By the 1930s, standard aviation gasoline had an octane rating of 75-80³⁵. However, a breakthrough in gasoline technology occurred in the United States in 1935 that made it technically possible to produce aviation gas of up to 100 octane. By 1939, both the U.S. Army Air Corps and the RAF were using this higher-octane gasoline, allowing them to develop more powerful engines such as the Rolls Royce Merlin.

The net result was that U.S. and British aircraft were now able to fly 15 percent faster, increased their long-range bomber distance by 1,500 miles, and lifted altitude ceilings by 10,000 feet.³⁶ Ironically, Germany had also discovered a similar technology for high-test aviation fuel, however it proved to be much more cumbersome and expensive to produce than the American method.³⁷ As a result, the *Luftwaffe* did not demand high-octane fuel until late in the war when German engineers were working feverishly to develop aircraft engines that could compete with the newer and faster Allied fighters. Unfortunately for Germany, Allied assaults against the synthetic fuel plants had already made production of higher-octane fuel virtually impossible. Germany never obtained aviation fuel equal in quality to the Allied air forces, and *Luftwaffe* aircraft development suffered greatly for it.

SOVIET OIL AND WAR IN THE EAST

Much has been written regarding the *Wehrmacht's* crushing defeat in the Soviet campaigns, and it is not the purpose of this study to provide intricate details of the ground war in the East. However, any examination of German air power, particularly on the Eastern Front, must give ample consideration to details on the ground. Increasing limitations on aircraft and fuel and the vast airspace over the Soviet Union combined with fundamental elements of German air doctrine to relegate the *Luftwaffe*, at least initially, to a tactical support arm of the Army in the East. While long-term plans called for the expansion of a broader, more strategic role for air power against Soviet lines of communication and industry, the *Luftwaffe* was simply not equipped or prepared to conduct these missions simultaneously. As Generalleutnant Hermann Plocher, commander of the *Luftwaffe* V Air Corps during the Soviet campaigns, recalled:

“Operations against the Soviet arms industry, especially in the Urals, were postponed until after the end of mobile ground operations, probably because any earlier attempt to carry out such missions would seriously overtax the *Luftwaffe*. Therefore, German air strikes were to be mainly tactical in nature, often in close support of ground forces, with the objectives of eliminating Russian air forces and disrupting Soviet communications.”³⁸

Additionally, it is important to examine the overall conduct of war in the East from 1941-1942 as it was the leading factor in determining the overall fate of Germany's oil supply. Particular attention must be given to how Germany's failure to decisively defeat the Soviet Army in short order exacerbated the *Reich's* fuel position; becoming the deciding factor in subsequent planning for the German summer offensive of 1942.

Operation BARBAROSSA began on June 22, 1941 with a sweeping attack that extended along a 1,400-mile long front from the Arctic Ocean to the Black Sea. As overwhelming as Germany's continuation of *Blitzkrieg* on a grand scale must have first seemed to the surprised Soviet Army, within weeks it was readily apparent that the Fuhrer's guarantee of a short war would not come to fruition. Several of Germany's senior military advisors were skeptical of Hitler's assumption that the war would be over before winter, including Field Marshal Erhard Milch, State Secretary of Aviation, who remarked:

"I had been then asked whether or not we should prepare for winter. This was months in advance. I thereupon gave the order to prepare everything for winter; the war will last several years in the East. At that time the official opinion was otherwise."³⁹

By the end of 1941 Germany found itself bogged down in a brutal winter campaign that it was grossly ill prepared to wage, in the home court of a Soviet enemy that was not as "primitive" as Hitler and the *Reich* war planners had mistakenly assumed.

To make matters worse, Germany was using far more of its fuel resources than had been calculated in the initial plans for BARBAROSSA. In the case of the *Luftwaffe*, fuel expenditures for the Soviet campaign were significant. In the first half of 1941 prior to the invasion, the *Luftwaffe* used an estimated 148 million gallons of aviation fuel. From June through December that amount more than doubled to 307 million, just slightly less than the 309 million gallons of fuel used by the *Luftwaffe* for the entire year in 1940.⁴⁰ Total German production of aviation fuel in 1941 was only 326 million gallons—a significant deficit in light of the 456 million gallons used for the year. As a result, *Luftwaffe* fuel reserves fell dramatically from 219 million gallons in January 1941 down to 91 million by December.⁴¹ The *Reich*'s weakened oil supply was readily apparent not only to Hitler and his economic ministers, but was also noticed by Allied

intelligence agencies. The British Air Ministry Weekly Intelligence Summary (AMWIS) from February 18th, 1942 made the following observation regarding Germany's fuel position:

The Russian campaign, which so greatly exceeded in scale any previous mechanized battles, has run down even the considerable stocks which Germany had last June to a level which is more than uncomfortably low, and the "oil expert" can at last lay his hand on his heart and say the German's are likely to run out of oil before very long—unless they get the Caucasus without delay.⁴²

The Soviet counter-offensive in the winter of 1941-42 finally convinced Hitler that it would be foolish to risk a continued push for Moscow. His dreams of a triumphant march through Red Square were dashed for good, but the Fuhrer knew Germany could not remain on the defensive in the east. The Soviet Union had the oil, food and raw materials that the German military desperately needed to continue the war. Although the *Reich's* offensive planning for the summer of 1942 was limited in nature when compared to the massive invasion it had launched the previous year, Hitler still believed that a successful push in the direction of Stalingrad and the Caucasus oil fields was both possible and necessary.

While grandiose considering the *Wehrmacht's* current situation in the Soviet Union, Hitler's new strategy in the East was to penetrate deep into the southwest reaches of the Caucasus, opening a potential avenue to move a portion of his forces into Turkey which he hoped would enter the war on the side of the Axis. Hitler calculated that this move would protect his right flank from the Soviet Army and allow him to threaten a push into Iran, possibly forcing Great Britain to broker a deal for peace on generous terms before the industrial might of the United States entered the war in full force. But first, Germany had to capture the Caucasus oil fields and alleviate the petroleum crisis that was threatening to destroy the entire war. Fuhrer

Directive 41 was released on April 5th, 1942 with operations planned to commence the following month.

The plan, code named *Fall Blau* (Code BLUE), essentially divided the remaining *Wehrmacht* forces of Army Group South in two. Army Group A, spearheaded by the First Panzer Army, was to head south and capture the oilfields at Grozny and Maikop before crossing the Caucasus Mountains to take the main objective—the immense reserves at Baku. Army Group B, led by the 4th Panzer Army, would attack toward the southeast from Kharkov in the direction of Stalingrad and the Volga. Its main effort would be to both block concentrations of the Soviet Army along the Don River from attacking Army Group A's main thrust toward the oilfields, and to deliver a crippling blow to Soviet supply lines and industrial centers in the south.

The plan was a gamble, but the *Reich* had few options on the table in light of the tremendous toll the winter campaign had taken on the *Wehrmacht*. *Blitzkrieg* had died in the snow and mud of the Russian steppes and Germany had no choice but to reinvent its army and air force to fight a protracted war. From a strategic perspective, the oilfields were a logical objective and a risk worth taking for the Germans. British Ministry of Economic Warfare production estimates for 1942 suggested that Maikop and Grozny were each producing approximately 18.3 million barrels of oil annually. Baku, the Crown Jewel of Caucasus oil production and one of the world's richest oilfields, was capable of churning out a staggering 176 million barrels per year.⁴³ Control of Caucasus oil would not only provide a permanent solution to the German oil crisis. It would be a deathblow to Soviet war production and allow Germany to continue the fight against its growing list of adversaries, which now included the United States.

Military historian, Dr. Joel Hayward, best describes how Hitler's planning and execution of Code BLUE was a significant divergence from traditional military strategy:

Operation BARBAROSSA had been conceived in basic accordance with Clausewitz's fundamental rule of warfare that the proper objective of a campaign is the defeat of the enemy's military forces in the field and that the seizure of economic and political objectives must follow, not precede, this. However, Hitler's decision in the winter of 1941/42 to seize the Caucasus oilfields, rather than force a decisive battle on the Soviet armed forces, violated Clausewitz's rule...(his decision) was based, not on ignorance of the basic tenets of military theory, but on deep concern over his struggling economy and the perceived lack of feasible alternative strategies.⁴⁴

But as Hayward also wisely pointed out, unlike Clausewitz, Hitler was commanding mechanized armies in a war between major industrialized nations. Now more than ever, the fate of the *Reich* depended on Caucasus oil. The dire situation prompted Hitler to declare during a meeting with his senior officers from Army Group South; "If I do not get the oil of Maikop and Grozny then I must end this war".⁴⁵

The main thrust toward the Caucasus was delayed in May 1942 by unexpected Soviet resistance around the Kerch peninsula in the Crimea.⁴⁶ This might have served as a harbinger for the Germans of the disaster that awaited them in the south, however, once D-Day for Case Blue commenced in earnest on June 28th, early success by the *Wehrmacht* greatly encouraged Hitler and the German high command. German forces quickly advanced from Kharkov, crossing the Donetz River and heading toward the Don with little resistance from the Soviet Army, which was seemingly overwhelmed by the offensive. By August 9th, Army Group A had taken the oilfields at Maikop and continued to push south at a rapid pace. On August 21st, Hitler was

briefed that Bavarian mountain troops had raised the Nazi flag on the summit of Mount Elbus, the highest point in the Caucasus.⁴⁷

At this point, Hitler made a fateful decision that many historians consider the turning point of the war. Concerned that Army Group South would be attacked from the flank as it made its way down the Don-Donetz corridor, he ordered the 6th Army to proceed alone to Stalingrad, which it was then directed to seize and hold as a blocking point against Soviet attacks. The Battle of Stalingrad began on August 23rd, 1942, with the *Luftwaffe*'s only initial contribution being to reduce the city to a rubble-filled landscape, which made the house-to-house fighting that soon followed a living hell for the *Wehrmacht*. Case BLUE continued, but Hitler's growing obsession with Stalingrad, namesake of his Soviet nemesis, drained the life out of an otherwise progressive campaign to take the Caucasus.

The diversion of equipment, supplies and precious fuel to support the encircled 6th Army redirected enormous amounts of time and resources from other critical operations in the East to Stalingrad. By the time Field Marshall Paulus surrendered the remnants of the 6th Army to General Shumilov on the morning of January 31, 1943, Germany's fate was essentially sealed. Robbed of critical logistics and *Luftwaffe* air support by the events at Stalingrad, the remaining German troops in the Caucasus were unable to defend against a substantial Soviet counter-attack and retreated north through Rostov in order to avoid being encircled themselves. Maikop, the only oilfield Germany was able to capture, was abandoned before it ever produced any significant oil for the Germans. The *Reich* would never again threaten Caucasus oil.⁴⁸

To imply that the German war machine ceased to operate with the loss of the Caucasus would be grossly inaccurate. However, it did have far reaching consequences for Germany and

its air force, particularly in two vital operational areas. First, the nagging shortage of fuel had a devastating impact on the *Luftwaffe*'s pilot training program, which was already deficient in some regards. This factor is often ignored in conversations regarding the Allies' triumph in gaining air supremacy over Germany—the precursor to a successful Combined Bomber Offensive. However, it was this deficiency in the number of skilled and experienced pilots available to replace the dramatic *Luftwaffe* losses that made the CBO much more effective than it might have been. If Germany had been able to launch an effective air defense with a well-trained fighter corps, they may have been able to change the outcome or at least hold off the complete destruction of their industrial centers long enough to replenish their fuel and armaments. Second, the aforementioned training issue, combined with the diversion of precious fuel, aircraft and crews to the protracted war in the East, left the *Luftwaffe* forces remaining in Germany woefully inadequate to defend the homeland's industrial and transportation centers. This relentless Allied bombing raids that began in May 1944 devastated the synthetic fuel industry and essentially grounded the *Luftwaffe* by the spring of 1945. The following sections will examine both of these theories in more detail.

IMPACTS ON LUFTWAFFE TRAINING

Of all the core elements essential to operating an air force, effective training is arguably the most important, yet can often be the most difficult to achieve. Air power was born of technology, and mastering that technology requires an ongoing cycle of training and experience. This was no less a reality for the *Luftwaffe* in the 1940s than it is for the U.S. Air Force today. Germany's pilot training program was initially as robust as its Allied counterparts, at least on the surface. Post-war analysis of *Luftwaffe*'s training, both by former *Luftwaffe* officers and air

power historians, revealed that German flight training was systemically flawed well before the high losses and dwindling fuel supplies compounded the problem.

When the office of Chief of Training was first set up in early 1939, the *Luftwaffe* was limited to three bomber pilot schools, one naval aviation school and only one fighter pilot school.⁴⁹ An additional obstacle presented itself in the decentralized operation of the *Luftwaffe* training program. The Chief of Training had no actual command authority over the training schools or the trainees. Instead, a network of Pilot Training Commanders, each subordinate to the various Air Fleet Commands, was established to manage training and equipment at the field level. In essence, the entire *Luftwaffe* training program was under the direct control of field commanders. As preparations for war intensified, Air Fleet Commanders quickly became more focused on expending resources to robust their air fleets, and less so on training a reserve cadre of skilled pilots. In one early instance, Air Fleet commanders collaborated to raid the flying schools of several JU-52s (a primary training aircraft) in order to press them into operational service for air transport.⁵⁰ These “raids” on training resources continued unabated, and significantly intensified, once war began. For the commander of a *Luftwaffe* Air Fleet in 1939, what need was there to worry about replacements for their well-trained pilot corps, many of whom had experienced aerial combat in the Great War little more than two decades earlier? Hitler and Göring promised their air commanders that the new German way of war was going to be a quick and decisive affair with minimal losses for the *Reich*. Most of them believed it.

The *Luftwaffe*'s optimism regarding low attrition rates was short-lived. Initial operations in Czechoslovakia and Poland went smoothly enough, but the campaigns in Scandinavia and France created a bigger problem for the *Luftwaffe* and losses were higher than expected. The situation worsened still in the summer of 1942 when the Battle of Britain dismantled the myth of

the invincible German air force in a few short months. Combat losses from May to December 1940 were estimated at 2,572 with another 1,379 aircraft lost to non-combat incidents. Overall, it represented a devastating 71% loss in total *Luftwaffe* strength over a period of only six months.⁵¹ At the time, German aircraft production was unhampered by Allied attacks, and a replacement aircraft could be built in a matter of week. Trained aircrew was another matter altogether. A good fighter pilot required at least one year of intense flight training and the average bomber crew as much as two years to be fully mission ready.⁵² Personnel losses were equally high during this period, and in August 1940 alone the total amounted to 216 pilots killed, another 264 missing and 93 either captured or injured.⁵³ The *Luftwaffe* entered 1940 with an experienced pilot corps, and the majority of losses came from this seasoned group of airmen. This factor compounded the impact of losses on the *Luftwaffe* as the percentage of fully operational crews continued to plummet, regardless of the number of new pilots coming out of the training pipeline. Near 90 percent before the summer of 1940, the operational readiness rates during August and September fell to 61 percent for bomber crews and 59 percent for fighter pilots.⁵⁴

The *Luftwaffe* had little time for recovery, even after the battles in France and Britain began to wind down. By early 1941, war was raging with Great Britain in North Africa and German forces encountered heavy resistance from the defiant Serbs in Yugoslavia. By summer, the bulk of the *Luftwaffe*, already battle weary from two years of war, found itself in the Soviet Union. The chronology of the Soviet war has already been covered in great detail, and it was here that the *Luftwaffe* suffered the greatest loss in aircraft and crews. Germany was losing, on average, 30 percent of its operational aircraft each month in the Eastern front between June 22 and November 1, 1941. The crew loss rates were approximately 10.7 percent monthly with an

average of 318 crewmembers lost.⁵⁵ As it did the year prior, the operational crew percentage also dropped dramatically in 1941-1942, primarily in response to the situation in the Soviet Union. By November 1941 the rate for bombers dropped to a dangerously low 45 percent, while in January 1942 the fighter pilots were not faring much better at a paltry 47 percent operational rate.⁵⁶ To make matters worse, in December 1941 Hitler personally directed the creation of four new air transport groups that were to be assigned immediately to the Fourth Air Fleet in support of the German troops bogged down in the brutal winter conditions outside of Leningrad and Moscow. The new transport groups were to be equipped with the last of the JU-52s belonging to the Chief of Training.⁵⁷

For the *Luftwaffe*, the crew losses were becoming unmanageable. The intense pressure to get German pilots through training led to lower standards for graduation, so much so that by July 1944, the average *Luftwaffe* pilot was experiencing only 115 total flight hours before being pushed out to an operational unit. His counterparts in the RAF and USAAF were receiving 340 and 360 total flying hours, respectively. For fighter pilots, the situation was even worse. They were only receiving an average of 30 instructional hours in fighter aircraft before being thrust into combat, while the RAF fighter pilot was getting more than twice that at 75 hours. The most highly trained fighter pilots during this time, in terms of training hours were the USAAF pilots who logged 165 hours of flight time in a combat aircraft before going to war.⁵⁸ As previously stated, both pilot attrition rates and a diminishing number of aircraft allocated for training were a primary cause of insufficient flying hours. However, restrictions on aircraft fuel also played a significant role in the gradual disintegration of the *Luftwaffe* training program. In 1942, the allocation of aviation fuel to the Chief of Training was so restricted that only a very limited number of personnel in certain critical categories could receive flight training at all. As a result,

the *Luftwaffe* trained a very small number of bomber and fighter pilots in the fall of 1942, and not nearly enough to replace the mounting losses as war intensified in the East.⁵⁹

In his analysis of the historical turning points leading to the *Luftwaffe's* defeat, German war historian Richard Suchenwirth had this to say about the dismal failure of the training program:

“Feldmarschall Milch may have exaggerated when he said: “The *Luftwaffe* training program, and with it the *Luftwaffe* itself, was throttled to death by the gasoline shortage.”...however, the turning point in the air war was certainly due in great part to Germany’s neglect of the training program and to the constant raids made on its resources.”⁶⁰

The Allies bombed airfields, destroyed aircraft factories and devastated the petroleum industry that Germany desperately needed to sustain its air war. But in a cruel twist of fate, the Silver Bullet that finally brought down the *Luftwaffe* came from within. The unsustainable attrition rate of pilots and aircrews, and Germany’s failure to train a robust reserve force of experienced aviators in the years leading up to war, proved to be an insurmountable challenge. When the Allied attacks on German oil began in earnest in May 1944, the *Luftwaffe* was essentially a hollow shell. A two-front war and rapidly dwindling fuel supplies left behind an operational air fleet that was dwarfed by the Allies, and a corps of aviators that were too poorly trained and inexperienced to make much of a difference. Needless to say, the results were devastating. The ensuing Allied Combined Bomber Offensive (CBO) systematically destroyed the *Reich's* remaining oil industry, and along with it, Germany’s ability to continue the war.

SITUATION ON THE GERMAN HOMEFRONT: 1944-1945

When the United States Army Air Forces (USAAF) conducted their first wave of unescorted daylight bomber attacks in the summer of 1943, the tremendous losses were a serious blow to the Allied air plan. However, tactics and procedures dramatically improved and new long-range fighter escorts were introduced that changed the game for the Allies. The actions of the USAAF in the last two years of the war impressed even their adversaries; prompting Generalleutnant Josef “Beppo” Schmid to remark after the war that, “...it has hereby been proved by them, at least for the time being, that air power may mean world power.”⁶¹ Even after air superiority was attained over most of the *Reich*, Allied attacks did not go completely unchallenged. Losses remained high for the USAAF well into April 1944, especially when pursuing high value targets that Germany tenaciously defended.

However, *Luftwaffe* resistance often proved counter-productive, playing into the hands of the Allies. Large-scale attacks on German industry and oil were highly successful in drawing defending *Luftwaffe* fighters into the air where they sustained heavy losses to Allied fighter escorts. The February 19, 1944 attacks on German aircraft factories, Operation ARGUMENT (later dubbed “Big Week” by historians), hit the *Luftwaffe* particularly hard. ARGUMENT was the beginning of a sustained period of combat designed to soften Germany’s industrial capacity, while at the same time decimate what remained of the *Luftwaffe* in anticipation of the Allied invasion at Normandy. The results were a German disaster, with the *Luftwaffe* sacrificing 54 percent of its operational fighters in the West in defense of the industrial centers.⁶² As Allied bombings diminished in preparation for Overlord, the Germans were lulled into thinking that their defenses had beaten back the air assault. In light of this news, Hitler directed the transfer of the bulk of *Luftwaffe* units to the Soviet front to support the war still raging in the East. When

the bombs began raining down day and night over Germany, the scant Luftwaffe forces left behind to guard the Fatherland faced an uphill climb.

When interrogated by the Allies immediately after the war, the former Reich Minister of Armaments and War Production, Albert Speer, stated, “The attack on oil plants on and after May 12, 1944, was the first heavy blow struck against German industry.”⁶³ Speer went on to write in his memoirs that the beginning of the CBO meant the end of German armaments production. He remarked that his tour of the Leuna synthetic oil plant a day after the bombing revealed “a tangle of broken and twisted pipe systems...the chemical plants had proven to be extremely sensitive to bombing.”⁶⁴ Germany was well aware of this vulnerability, and steps were taken, albeit slowly, to provide better protection for the plants already in existence, and to build new plants that placed the entire operation underground.⁶⁵ However, Allied intelligence picked up the German plan quickly. In a July 12, 1944 memorandum to the Joint Chiefs of Staff (Joint Intelligence Committee), the Combined Strategic Targets Committee requested that a study be conducted to investigate rumors of underground fuel plants, which it referred to as “most drastic measures” by the Germans.⁶⁶

Germany did indeed have a program in existence by the summer of 1944 to build seven large underground hydrogenation plants. The construction was to have been completed by the end of 1945 primarily by utilizing salvaged equipment from bombed plants. German oil industry experts estimated that the new plants would have the capacity to deliver an additional 2.2 million barrels of petroleum to the *Reich* monthly. The continued pounding of existing petroleum facilities and Germany’s rail transport system by Allied bombers ensured that the new plants were never built.⁶⁷ Additional German efforts to spare the existing synthetic plants through cover and concealment were simply implemented too late to be of any value. Speer pleaded

with Hitler on several occasions to redirect more of the *Lufwaffe's* available forces back to Germany in order to protect the synthetic plants. He recalled one such event that took place on July 28, 1944:

I implored Hitler in my memorandum to “reserve a significantly larger part of the fighter plane production for the home front.” I repeatedly asked him in the most urgent terms whether it would not be more useful “to give sufficiently high priority to protecting the home hydrogenation plants...(not doing so) makes it a certainty that in September or October the Luftwaffe both at the front and at home will be unable to operate because of the shortage of fuel.”⁶⁸

The damage Speer observed on his visit to the Leuna plant in May 1944 came at the beginning of the campaign to destroy German oil, in a month that Allied bombers dropped only 5,146 tons of bombs on the oil industry. In the following month of June, bomb tonnage more than tripled to 17,697 tons and reached its peak in November 1944 at a staggering 35,023 tons. Although the average varied, the amount of bombs dropped on petroleum targets would never drop below 12,000 tons until the end of the war.⁶⁹ By the end of September 1944, every major synthetic oil plant had been hit at least twice, along with 69 refineries and numerous storage installations.⁷⁰ When bombing of petroleum targets ended in April 1945, a total of 216,322 tons had rained down on German synthetic factories and oil refineries.

Oil production in the *Reich* plummeted quickly. In January 1944, total synthetic petroleum output was approximately 3.6 million barrels. In June, the month after the Allied petroleum raids began, production dropped by one-third to 2.2 million barrels. By the end of 1944 it had dropped another one-third, plummeting to 1.2 million barrels. On February 9, 1945, an intelligence report was forwarded to the British Economic Advisory Branch in London

indicating that only three German synthetic plants were believed to be in operation, and that with the remaining levels of production there would be “no output of high octane aviation fuel.” The report went on to predict that, “German land and air forces would, within a period of six weeks of knocking out the remaining plants, be virtually totally deprived of operational mobility.”⁷¹ One month later, in March 1945, German synthetic plants ceased oil production. Their last gasp netted the *Reich* a paltry monthly production total of 88,000 barrels.⁷²

Although Allied bombing did not put Germany’s synthetic oil plants completely out of business until the war was nearly over, Germany’s raw materials for production were another matter. Synthetic oil production depended on coal, and coal came under attack in the *Reich* very early in the war. The RAF began their attacks on German railway targets soon after Germany invaded Holland and Belgium in May 1940. The primary targets were in or near the Ruhr, which was the most important industrial area of the *Reich* and where 80% of Germany’s coal was produced.⁷³ The Ruhr district also contained the most concentrated network of marshalling yards in Germany. The number of yards was few, but they were large and highly intricate in design. Even moderate damage caused by bombing had a dramatic ripple effect across large sectors of the German rail system. The Allied attacks on the railroads continued in varying degrees throughout the war, and by late 1943 the coal transport situation had reached crisis levels.

The reason for the shortage, despite the abundance of coal that sat below ground throughout much of the *Reich*, was simple. Coal itself is nearly impossible to target, as the majority of mining operations are underground. However, coal had to be transported and German rail networks were easy to spot and thus highly vulnerable to bombing raids. This was especially true at night when most of the freight loading was accomplished and signal lights were necessary. Mines were only able to store a finite amount of coal. Once the storage areas were

filled to capacity, production of new coal had to be curtailed until the stored coal could be transported. In January 1945, for example, coal production capacity for the Ruhr was estimated at 12 million tons. However, the railroads were only capable of moving 5.5 to 6 million tons.⁷⁴ Coal piling up in storage yards, unlike coal in the ground, *was* susceptible to damage from bombing.

Allied damage to the coal industry meant that Germany was barely able to produce the amount of coal required to fire its factories and heat its homes. Now that coal was also the German military's primary source of liquid fuel, the situation only worsened. Shortages were a constant hardship for all of Germany and its occupied territories, particularly in the winter months. Although *Luftwaffe* forces that still remained over Germany did all they could to defend the railroads against the bombing raids, often inflicting heavy damage on Allied bombers, it was not enough to stop the bleeding. The number of coal cars spotted by Allied reconnaissance missions during 1943 dropped from approximately 75,000 daily in June to 45,200 by December and to 27,700 by February 1944.⁷⁵ Coal production continued to suffer greatly, diminishing to a paltry 1.7 million tons by February 1945⁷⁶. The decline in coal production, essential for synthetic fuel, was a devastating blow to Germany's aviation fuel supplies. As 1944 came to an end, the *Luftwaffe* could barely obtain enough fuel to fly. Germany's planned production for aviation fuel in January 1945 was 84 million gallons. Actual production was slightly less than 4 million gallons, and by March 1945 aviation fuel production ceased altogether.⁷⁷ The combined Allied attacks on Germany's synthetic fuel industry and transportation systems left the few remaining members of the *Luftwaffe* with no option but to watch helplessly from the ground as the remains of the Third *Reich* tumbled down around them.

CONCLUSIONS

“Good Lord, this is like an insane asylum! What is the matter with me that I cannot follow the flights of fancy of these people and can’t for the life of me see the ‘way out’ which they prophecy? Do they have a sixth sense that enables them to see things which I, as a normal mortal, am unable to see? That can’t be it! Yet there are so many things today that make me doubt the conclusions of my own common sense!”⁷⁸

-- Chief of Luftwaffe General Staff Karl Kollar

May 1945, from his diary entry titled “The last month”

Oil proved to be Germany's undoing. However, evidence presented clearly shows that Germany did not simply ignore their petroleum situation during the build-up for war. Indeed, concerns about the *Reich*'s lack of natural resources were at the forefront of planning considerations from beginning to end. In Case BLUE for example, Germany's desperate oil situation was actually *the* critical planning factor driving overall strategy for the summer 1942 campaigns in the East. Germany's failed oil plan helped seal the fate of its military for two reasons. First, poor leadership and planning denied the *Reich* the oil production and reserve goals it had set for itself in the 1936 Four Year Plan. Second, Hitler and his military planners grossly miscalculated the operational capability of their force in light of their available petroleum resources. This was particularly evident in Operation BARBAROSSA when the war Hitler promised would be over 'within months' lingered on into the brutal Russian winter. Germany's oil and fuel reserves never recovered from the blow. Once the Caucasus slipped from Hitler's grasp and Allied bombs began raining down on the German synthetic fuel industry in mid-1944, it was only a matter of time before the oil was gone. In the end, Germany simply ran out of gas.

The lessons of the *Luftwaffe* defeat in World War II are still relevant for today's Airmen. In modern air warfare, oil does matter. In spite of the current focus on COIN and stability operations in Afghanistan and Iraq, future conflicts with other industrialized nation-states are still the greatest threat facing the United States. Successful military action against an adversary such as Iran or North Korea will require quick, decisive and sustained delivery of conventional air power. The ability to achieve and maintain air superiority, in both current and future wars, is inextricably linked to the unrestricted and timely delivery of fuel. It is vital to both United States National Security and the armed forces to protect America's precious petroleum resources and ensure freedom of access for global oil markets. Whether it is preserving peace and stability in oil producing regions through the decisive application of air power, or implementing sound conservation methods to ensure the health of U.S. strategic reserves, the Air Force is a key player in protecting oil--the life-blood of the world economy. The future may well hold a cure for the world's dependence on petroleum. But for better or worse, it is clear that oil will, and should, remain a vital strategic military interest for years to come.

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