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The German Jet Program 1939-1945

by

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Abstract

The Messerschmitt Me 262 *Schwalbe* was the most technologically advanced aircraft in World War II. But, like any other weapons system, it took years to develop; years arguably wasted in the production of this revolutionary aircraft. However, the developmental timeline was normal, if not accelerated. During wartime conditions, the Germans were able to produce an aircraft that outstripped any Allied plane. But in the end, there were only 1,294 Me 262s produced. Adolf Hitler's decisions did not have any far-reaching impact on the German jet program; his decisions came at a time when the plane was still in the developmental stage, or when there were not enough jets to affect the outcome of the air war. Hitler's decisions were well documented and continue to be the basis for historical arguments to this day. However, there were more important factors that decided the development of jet aircraft within Germany, chiefly the development of the Junkers Jumo 004 jet engines. The German jet program in both the experimental and operational stages depended on the Junkers engines. Consequently, it was the lack of engines that delayed the program, and little else. The jet program, and the Me 262 specifically, were initially hampered by the lack of engines, then restricted by their unreliability. Finally, the Allies directly influenced the German jet program with their strategic bombing campaigns. Through constant disruption of German aircraft manufacture and transportation, the Allies were able to hamper the development process, but not completely destroy it. Although the Allies were responsible for the destruction of many German planes and pilots, and the thousand-bomber raids that destroyed Germany's economy and resources, the jet program continued. In fact, there was no shortage of pilots or fuel for the German jet program in the closing stages of the war. However, the Allies nullified the qualitative advantage of jet technology in Germany with overwhelming material superiority during World War II.

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wife and better half, Jennifer. For your love and support, thanks. And yes, I'm finally done (the thesis at least). The rantings are all mine, I intend to stir up controversy, and make sure that the next time I go to an air museum the guide doesn't say that if the Me 262 would have been developed sooner we would all be goose-stepping and speaking German. History requires revision, aggressive history is my intention.

For Jennifer
my distraction

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Introduction

On 18 July 1942 Me 262 V3 (**PC+UC**) took off from the airfield at Leipheim on pure jet power. The third prototype of the Messerschmitt Me 262 was powered by the revolutionary axial-flow turbojet manufactured by Junkers, the Jumo 004. Over the next three years, while Germany fought a desperate struggle for the Continent of Europe, the Me 262 became the first operational jet aircraft in history. However, the Me 262 was plagued on a number of levels by controversy. Chapter I deals with the myriad decisions made pertaining to the German jet program that have been cited as directly responsible for the tardy development of the Me 262. And, while these decisions are documented and well known, it is the duty of every historian to question the obvious and look for alternate answers. Initially, Adolf Hitler expressly forbid the development of any weapons program that would not reach fruition as early as February 1940. Paradoxically, the *Reichsluftfahrtministerium* (*RLM* – German Air Ministry) ordered Project "Vulcan," which included the development of jet planes, with priority for all the necessary materials, in December 1942; this allowed the still experimental jet programs to continue and even added important materials for their construction. But by far the most famous decision made by Hitler came in May 1944. The oft quoted order was that Hitler was incensed that no Me 262s had been produced as bombers, and that all subsequent jets were to be bombers - not even referred to as fighters. The argument was that this threw off production of the Me 262 by as much as six months and the jets were not available to

the Luftwaffe when they needed them the most: during the invasion of the Continent by the Allies on D-Day, 6 June 1944.[1]

Immediately after the war a number of historians argued that the Me 262 could have been put into operational use earlier and that it was delayed due to mistakes made by Hitler and the *RLM*. Post-war reports from captured Germans blamed Hitler's decisions for the lack of jet planes during the war.[2] General Adolf Galland, *General der Jagdflieger* (General of Fighters), and commander of the all-jet unit *Jagd Verband* 44, argued that Hitler's decisions delayed the German jet program by as much as eighteen months from planning to operational status. This theme was followed for a number of years.[3] Only recently have historians begun to uncover more material and research further possible explanations for the delays faced by the German jet program. Some contemporary historians still mention Hitler's orders as responsible,[4] but new and exciting research has come to light that presents a technological argument for the delays in the German jet program.[5] Their arguments, followed closely and expanded upon in Chapter II of this thesis, are that the developmental delays faced by the German jet program can be directly attributed to the Junkers jet engines. The successful completion of the Me 262 depended on the development of the Junkers Jumo 004 engines, and it was the engines that in turn retarded testing and production of the jet aircraft. Furthermore, the short operational lifespan of the jet engines – rarely more than ten hours between major overhaul – dictated the availability of the jet for combat. In the end, it was the technology of the jet engines that determined the developmental timeline of the German jet program and the Messerschmitt Me 262.

Chapter III deals with production and other factors that influenced the Me 262. However, this thesis looks critically at the contentions that there were not enough pilots, fuel, or planes. There were not enough planes for full-scale jet combat to wrestle superiority away form the Allies, but of the 1,294 Me 262s constructed, at the end of the war Galland was able to supply his own command with enough planes for operations until they were overrun by American forces. Further, this thesis will show that there was no lack of pilots or fuel for the revolutionary fighter even in the dying days of World War II.

Chapter IV outlines actual jet operations and the effect of the Me 262 on air combat. But, in the end the Luftwaffe did not have enough planes of any kind, let alone jets, to stem the tide of Allied material air superiority. The accomplishments of the Me 262 were overwhelmed by Allied production and quantity in the last year of the war. The jet was nothing but a technological marvel in a losing cause; the Allies were able to negate its successes through quantitative superiority.

Finally, Chapter V concentrates on the impact of the German jet program on Allied aircraft development after the war. German technology was captured, and scientists were recruited, to establish the post-war air forces of the Allies following the collapse of the Third Reich. The major powers used German technology after the war to develop their own programs as they entered the Cold War era.

This thesis makes use of interesting material found at the Imperial War Museum in London, where the Milch Documents are located. The minutes of the *RLM* are stored there and this author was able to examine and make extensive use of the records of the Luftwaffe. In addition, this author was fortunate enough to be granted permission, as

well as copies, of Messerschmitt documents from the private collection of Manfred Boehme, who graciously offered assistance in locating relative documents. Further, two important historical works from J.R. Smith and Eddie Creek have recently been published that gave valuable insight into the Me 262 program and its development.[6] And, whereas early material is questioned, it has been incorporated to provide historical analysis of the German jet program. In conclusion, this thesis will defend the argument that the German jet program was most severely hindered by the development of the Junkers jet engines; development which could not have been hastened. Consequently, the decisions made concerning the jet program were irrelevant, the plane's testing was not even adequately completed before production began. In the end, it was the engines that determined the operational status of the Me 262 and its impact on the air war in World War II.

[1] Harold Faber (ed.), Luftwaffe, A History, (New York: Times Books, 1977). See also David Irving, Göring, A Biography, (New York: William Morrow and Company, Inc., 1989). See also Richard Suchenwirth, Historical Turning Points in the German Air Force War Effort, USAF Historical Studies Number 189, (New York: Arno Press, 1968).

[2] Adolf Galland, The Development of Jet and Rocket Airplanes in Germany 1938-1945. Extracted from European Contributions to the History of World War II. Monograph Number 7, Development and Planning in the German Air Force. Part I of the von Rohden Monograph, (Maxwell Air Force Base, Alabama: Foreign Documents Section, Air University Library, 1951). Translated and annotated by Alida Herling. See also Albert Speer, Inside the Third Reich, (New York: the Macmillan Company, 1970).

[3] See the above mentioned historians footnotes 1 and 2.

[4] John Foreman and S.E. Harvey, The Messerschmitt Me 262 Combat Diary, (Surrey, England: Air Research Publications, 1990).

[5] Manfred Boehme, *JG* 7, the World's First Jet Fighter unit 1944/1945, (Atglen,Pa.: Schiffer Military History, 1992). Translated by David Johnston. As well as J. Richard Smith and Eddie Creek, Me 262, West Sussex, England: Classic Publications, 1997 (Volume I) and 1998 (Volume II)).

[6] Smith and Creek. Both volumes of Me 262.

Chapter I

Decisions, Decisions

The sordid story of the German jet program always mentions Adolf Hitler's decision that the Messerschmitt Me 262 was to be constructed as a bomber and not a fighter.[1] Although the decision was important, it did not have the negative impact on the German jet program that to this day many historians continue to argue. Immediately after the war, men that were intimately involved in the German jet program blamed Hitler's interference for the delays in production of jet aircraft. Albert Speer, Minister of Munitions,[2] and Adolph Galland, General of Fighters and later leader of the jet unit *Jagdverband* (*JV*) 44,[3] blamed Hitler for his interference. After the war, historians repeated these arguments to substantiate the same position. In his post-war analysis of the Luftwaffe, Eugene Emme, writing for the US Air Force, used these documents to place blame on Hitler for his interference as well.[4] Other scholarship has followed this theme blaming Hitler for his negative influence on the German jet program. However, through careful analysis of the primary documents available from the Imperial War Museum (London) it is clear that although momentous decisions were made by Hitler, there were other factors that had far greater impact on the German jet program than individual decisions of the Führer. It was the lack of successful engines from the Junkers factory that influenced the program far more than any individual decisions. In the end, it was a lack of new technology that hindered the Me 262 from becoming operational earlier. The jet aircraft and its engines were brand new technologies that had to be developed fully before the Me 262 could become operational, regardless of the decisions of a few individuals.

The jet age began in 1935 with a young doctoral student, Hans von Ohain. His work in physics was based on a new and exciting form of propulsion for aircraft, the jet turbine engine. Ohain had taken the existing technology of steam turbines and adapted them for use in planes.[5] In his studies, Ohain took a steam powered centrifugal turbine engine and refined it to the point where it would be small and efficient enough for use as an aircraft power plant. Ohain was successful in revising the steam turbine, and created the first jet engine specifically designed for an aircraft, the Heinkel He S-3b.

The engine program had been sponsored by the founder of the Heinkel company, Ernst Heinkel. Obsessed with the quest for speed, Heinkel had directly supervised the construction of three of the fastest pre- World War II piston powered aircraft, and had won several speed and endurance competitions in Europe.[6] Heinkel saw a spark of brilliance in the young Ohain, and put him to work to create a revolutionary new power source for Heinkel planes. The He S-3b created by Ohain was coupled with the He 178 airframe, and the first jet airplane was born. On 27 August 1939 the He 178 took off from the Marienehe airfield and became the first jet plane in history.[7] One week before the beginning of World War II, the Germans began the jet age.

At the same time, and unknown to the German scientists, a similar project was taking place in England. Led by the famous Frank Whittle, the British were working on a jet plane of their own. However, Gloster E.28/39, the first British jet plane, did not fly until two years later, on 15 May 1941.[8]

Mention should also be made of the other Axis jet program. Although the Italians designed, built, and flew the world's second jet aircraft, their project did not have the desired power or speed. The only prototype of the Italian Caproni factory plane was

underpowered and was never considered for production. The Caproni-Campini N.1 first flew on 28 August 1940, and after disappointing testing was consigned to the Italian Air Force Museum, near Rome.[9] The Italian jet was not in fact a true turbo jet but rather a piston engine ducted fan powered aircraft. The piston engine powered a series of small fans in the tubular frame of the aircraft for propulsion.

However, in contrast to the British, the Germans decided to embark on a new scientific agenda. Instead of pursuing the technology of the centrifugal turbojet, they sought to create a new engine, the axial flow turbojet.[10] German scientists concentrated on the axial flow jets for a number of reasons. The axial flow engine was more streamlined than the centrifugal flow engine. The intake radius of the axial flow was smaller than the centrifugal flow engine, and the airframe created for the axial flow engine could carry the power plant rather than be built around it as was the case with the centrifugal flow engine. The Germans believed that the centrifugal flow engine had reached its potential in regards to both power and efficiency. Although the centrifugal engine was to become more powerful and efficient, German scientists saw greater potential in the axial flow design.[11] However, the axial flow engine had several drawbacks. First, and foremost, it was more difficult to construct. Second, it required more of the precious raw materials that were already scarce in Germany.

The projected airframes that the Germans were working on enforced the decision in favor of the axial flow turbojets. The plans submitted by both Heinkel and Professor Willi Messerschmitt's aircraft companies called for under-wing axial flow engines to power their revolutionary new aircraft. The Heinkel project, the He 280, proposed in 1939, and the Messerschmitt project 1065 – which would eventually become the

legendary Me 262 – were both low-wing, single-seat planes that were designed to carry two jet engines, one mounted under each wing.[12] This ended the testing of the centrifugal flow engine in Germany as the designers planned for engines to be built for specific airframes, not the other way around.

This was in direct contrast to the British who engineered an aircraft in the exact opposite way. The Gloster E.28/39 was designed specifically for the W.1 jet engine created by Frank Whittle.[13] The British designers decided to build an aircraft around an existing engine rather than redesign a power plant for a projected airframe. In the end, the Gloster project, which did not fly until two years after the German jet, led to the development of the British Gloster Meteor fighter jet. It was the only Allied jet aircraft to see operations before the end of the Second World War.

The *Reichsluftfahrtministerium* (*RLM*), the German high command for the Luftwaffe, commissioned proposals for the development of jet planes as early as 1938.[14] Both the Heinkel and Messerschmitt proposed projects for twin engine jet aircraft designed as jet interceptor-fighters to be used defensively against enemy air forces.[15] But, the German jet program was almost over even before it began. As early as 9 February 1940, under the direct influence of Reichsmarschall Hermann Göring, the Commander-in-Chief of the Luftwaffe, working under a direct order from Adolf Hitler, it was decreed that all projects that would not be operational within six months to a year were to be scrapped.[16] All experimental programs were to cease immediately in favor of producing the highest quantity of aircraft, regardless of quality. In the minds of the German High Command, the war would not last long, therefore there was no immediate need for experimental planes, only a dire need for as many planes as soon as possible.

This order was enforced the next year by Hitler under the ominous title of *Führerprotokoll* (Führer directive). On 11 September 1941 Hitler reiterated that all experimental projects that would not reach fruition within six months were to be terminated.[17] Finally, the order was tailored specifically for the Luftwaffe by January 1942 when Göring reworded the document to read: "The State Secretary and Inspector General, Luftwaffe, however , is required to evaluate all development projects in terms of their feasibility as regards the current status of raw materials and production capacity."[18] This order conveniently left the door open for Göring to decide the fate of Luftwaffe projects.

Paradoxically, later that year another order was issued by the *RLM* from Field Marshal Erhard Milch, the State Secretary of Aviation, which supported the experimental programs of Messerschmitt and Heinkel. Milch proposed "Project Vulcan", a priority designation for certain experimental projects then underway. In his words, it was for "The absolute demand for qualitative superiority of German air force equipment over that of the enemy countries has led me to order the creation of an urgent development and production program under the code word 'Vulcan.'" The program gave priority of equipment and materials to German projects that would produce jet fighters and bombers, their engines, and guided weapons. The projects that were given the code priority DE included the jet planes Me 163 (the Messerschmitt rocket fighter), Me 262 and He 280, the Ar 234 (Arado's jet bomber), and the Me 328 (Messerschmitt's pulse jet fighter).[19] This document illustrates the importance of the jet programs to Milch and the *RLM*, and shows that the *RLM* sensed a need for a qualitative advantage that these planes would provide in the future. Although Hitler and Göring were ready to shut down programs that would not

be available immediately, the decision by Milch shows foresight and planning for future Luftwaffe developments.

Fortunately, both Heinkel and Messerschmitt initially ignored the restrictive orders from Göring and Hitler, and both continued to develop their respective experimental jets. After both aircraft were built, and initial tests had been completed, the Milch order of December 1942 allowed them to continue officially sanctioned development of their jet programs.

On 30 March 1941 the He 280 flew for the first time under pure jet power. The Messerschmitt Me 262, formerly known as project 1065, did not fly under its own (jet) power until 18 July 1942. The airframes were technologically sound; the He 280 airframe was tested in gliding trials and the Me 262 was flown with a piston engine for trials before these dates. The delay faced by the German jet program, which would return to haunt the Germans, was the acquisition of the jet engines. Both the BMW (*Bayerische Motor Werke*)and Junkers factories were officially engaged in building the engines (the BMW 003 and the Junkers Jumo 004),[20] but both had trouble manufacturing the axial flow turbojets. Therefore, initial trials with the He 280 and the Me 262, before the power plants were available, were made with the He 280 tested as a glider and the Me 262 tested with the assistance of a piston engine. Both companies determined that the airframes were stable and acceptable, but had to wait until the development of the engines was complete.

It is interesting to note that the original plans for the production version of the Me 262, as submitted by Willi Messerschmitt, mentioned the bombs it was meant to carry. When Messerschmitt submitted his final plans for the construction of the Me 262 on 4

March 1943, there were specific instruction for the Me 262 to be able to carry bombs, "as per an order from the Führer, every fighter must henceforth be capable of performing in the fighter-bomber role. An installation capable of carrying 500kg of bombs is foreseen for the Me 262."[21] This is a very important point, as it makes clear that the Me 262 was intended to be able to carry bombs from the beginning of the project.

At the time, in compliance with the wishes of the *RLM*, all production fighter aircraft were to be constructed to perform dual roles.[22] As offensive weapons, they were to carry small bomb payloads to aid in tactical strikes in addition to their defensive fighter roles.[23] The Luftwaffe concentration on combined operations with the land forces, along with the lack of strategic direction from Göring, allowed the air arm of the German military to be used effectively as a tactical attack element.[24]

The German fighter had been initiated into the close air support role during the final stages of World War I, and that role was experimented with and continued throughout the German involvement in the Spanish Civil War. After the stunning successes of the campaigns against Poland and France, the principal German fighter, the Messerschmitt Bf 109, was produced as a *Jabo* (fighter/bomber).[25] This was not unusual: the British at the same time produced a fighter/bomber version of their famous Spitfire, the FB Mk. V.[26] However, it is important to note that the Messerschmitt company had already dealt with the order that fighters had to be able to perform the dual role of fighter/bomber. The documents suggest that Willi Messerschmitt consciously knew in 1943 that the production model Me 262 would have to be able to carry bombs as per Hitler's orders. This specific document is important to the developmental timeline of the Me 262 project. Suffice it to say that Messerschmitt was cognizant of the requirements

for his future fighter project in 1943, and it was no shock to him that it was supposed to carry bombs when the Me 262 went into production in 1944.

The testing went ahead, and both designs of the future German jet fighter continued to improve and show potential. As mentioned above, the He 280 first flew powered by jet engines on 30 March 1941. After the He S8A jet engines were completed by the Heinkel company, its chief test pilot Fritz Schäfer was able to make the first flight in the twin engine He 280 (GJ+CA: the call letters of the aircraft GJ, the German cross (+), CA).[27] The plane tested well and on 5 April 1941 a demonstration was held for Luftwaffe and *RLM* officials, including General Ernst Udet, the Luftwaffe's director of air armament. The response was good, but there was a general consensus that work needed to be done to improve the aircraft's engines.[28] Testing continued and work was in fact done by Ohain and the designers at Heinkel to improve both the airframe and the engines. Ohain supervised the development of the next generation of Heinkel engines, the He S11, and the airframe was redesigned with the tail of the original He 280 strengthened for stability at high speeds.

At the same time, work proceeded at the Messerschmitt factory on the Me 262. There were complications which almost finished the Messerschmitt project early in its testing stages. The first flights of the Me 262 Version 1 (V1: PC+UA) were powered by a Junkers Jumo 210 piston engine to test the stability of the airframe. Fortunately for the Me 262 project, the piston engine was retained for the first flight with the new BMW 003 jet engines. The jet engines failed after takeoff, and the pilot was able to land the plane safely thanks to the piston engine.[29]

By July 1942, the Junkers Jumo 004 engines were ready for flight testing. On 18 July Fritz Wendel took off from Leipheim airfield in Me 262 V3 (PC+UC), the first flight of the Me 262 under pure jet power. The Me 262 still needed work, however, and suggestions were immediately made for its improvement. Initially, the prototype was configured with tractor landing gear. This tail-dragging version led to immediate problems: the airflow of the jet engines did not flow over the elevator control surfaces of the plane, and it could not take off from the airfield. This was rectified early by the test pilot who gently stabbed the brakes at a ground speed of 112 mph to raise the tail.[30] The designers immediately saw the need for a tricycle landing gear which would incorporate a nosewheel, but this required a weight shift towards the nose, and design of a new undercarriage. The shift in the center of gravity was made with the planned addition of armaments in the nose, and the landing gear was subcontracted out to the Opel factory. It was not until the construction of Me 262 V5, equipped with a fixed nosewheel and V3 retrofit with the tricycle gear, that the Me 262 had the new landing gear configuration. Up to that point, the dangerous braking procedure had to be used to make the jet take off.

The *RLM* continued to play a substantial role in the development of the Me 262. In March 1943 the *RLM*, led by Göring, made another momentous decision, choosing the Me 262 design over the He 280.[31] The choice was made on the basis of firepower and range. The Me 262 project was designed for four 30mm cannons (Mk 108-A3) as compared to only three 20mm cannons (Mk 151/20) of the He 280. In addition, the projected range of the Me 262 was greater than that of the He 280, and this helped seal the fate of the Heinkel plane. However, the main problem faced by the jet program remained the lack of engines for both revolutionary planes.

In May the Luftwaffe finally had a chance to let one of their own fly the new Messerschmitt jet. Genneralleutnant (Lieutenant General) Adolph Galland, the commander of day fighters for the Luftwaffe, was invited to test fly the Me 262. Galland was the first regular Luftwaffe pilot to fly the revolutionary plane; all the other pilots had been Messerschmitt test pilots. Galland was immediately impressed by the capabilities of the Me 262 and extolled it in a report to the *RLM*.[32] He stated that the Me 262 was an incredible advance in aircraft technology and could represent an amazing advantage if the enemy continued to employ piston-engine planes. His opinion was that the Me 262 needed to be put into immediate production and all other programs classified secondary. According to a letter Galland wrote to Walter Boyne, he felt, "both excitement and relief - excitement at flying a clearly superior weapon which opened entirely new tactical possibilities, and relief at the prospect that Germany, which he knew could never again achieve quantitative superiority for its fighters against its enemies, might gain a significant qualitative superiority."[33] Although it would be a number of months before the Allies began their massive bomber raids accompanied by long-range escort fighters, Galland realized that the Allies were in a position to overtake the Germans in aircraft manufacturing. The Me 262 in his opinion was the equalizing factor defending Germany from air attack.

Two days later, a conference was held at the *RLM* to discuss the Me 262 program. After having defeated the He 280 for top priority, another plane directly competed with the Me 262 for the Reich's vital raw materials. The Me 209, another Messerschmitt project, was in its final stages of pre-production and under close scrutiny by the *RLM*. The Me 209 was the next generation fighter and an improvement on the basic design of

the Me 109. The Me 109 was still Germany's primary fighter, but it was reaching the end of its effectiveness as a defensive fighter. The Me 209 project proposed an improved engine and increased armament.[34] From the pilot's perspective, it was an extremely difficult aircraft to fly, and testing was hampered by numerous accidents. However, the Me 209 was a vast improvement on the Me 109, and the Messerschmitt factory and its subsidiaries were in a position to use most of the same manufacturing jigs for the Me 209 as were used for the Me 109. In addition, the engine used to test the prototype Me 209, the DB603 A-1, was already being produced and available. These were a few of the considerations that faced the *RLM* when it met in May 1943.

After careful consideration and deliberation, the decision was made to strike the Me 209 from the production inventory of Messerschmitt and pursue the development of the Me 262.[35] Erhard Milch ordered that the production of the Me 262 was to replace the Me 209. But the nuisance of the Me 209 was not over; this was but the first instance of many where the Me 209 came in direct conflict with the Me 262 project. And, as mentioned earlier, whereas the Me 262 had far greater potential than the Me 209 as a weapon, the Messerschmitt company at that time was in a better position to produce more Me 209s than Me 262s.

When Professor Messerschmitt was summoned to an *RLM* meeting the next month, his evaluation on the Me 262 program was critical.[36] He predicted that production of operational Me 262s could commence no earlier than January 1944. Messerschmitt was optimistic about the program, but realized the limitations of his manufacturing capabilities. His proposal called for the start of production in January 1944, 8 machines by the end of February, 21 in March, 40 in April, and 60 in May.

Thereafter, he promised production of only 60 aircraft a month through November 1944. And, it is important to note, Messerschmitt only proposed this number of airframes, while the flying operational aircraft depended on the delivery of successful engines from Junkers. He went on to state that the most he would be able to produce per month was 400 Me 262s, and this figure would not be attained before September 1945.[37] Incidentally, at this time the Messerschmitt company was producing over 500 Me 109 fighters alone per month.[38]

Messerschmitt was questioned at the conference regarding his thoughts on the Me 262 versus Me 209 projects. After stating the claims on behalf of the Me 262 program, he outlined the difficulties faced in producing the Me 209. Messerschmitt argued that for the production Me 209, the Daimler-Benz DB 627 and DB 628 engines were not ready for production. In addition, although some of the same Me 109 aircraft manufacturing jigs could be used to produce the Me 209, others would still have to be re-tooled. In his opinion, the same quantities of either the Me 262 or the Me 209 airframes could be produced, but he supported the production of the Me 262 over the Me 209.[39]

The Focke Wulf factory added to the turmoil of Luftwaffe procurement. The famous Focke Wulf FW 190 A-4 was beginning to roll off the production lines, and this aircraft was proving to be a good replacement for the aging Me 109 G and K series.[40] The improvements made to the FW 190 by the end of 1943 included the D-9 version, the plane that was to become the main high-altitude fighter of the Luftwaffe.

The production of the Focke Wulf planes allowed the Messerschmitt factory room to expand their production to other types of aircraft. But the projected production of new aircraft would, in the end, reduce the total output of Messerschmitt planes. The *RLM*

insisted on continued output of aircraft that were already being produced (specifically the Me 109), regardless of their obsolescence, in order to maintain available numbers for the Luftwaffe.[41] Even though Galland at this meeting called for the production of 1,000 Me 262s each month, and was supported in this by Milch, the jet was not ready for production on that scale. Messerschmitt argued that the production of the Me 262 relied on the engines that were sitting incomplete at the Junkers (Jumo 004) and BMW (003) factories.[42] In the end, it was agreed that 1,000 Me 262s would be produced per month by September 1945. Therefore, Galland and Milch got what they wanted, but they would have to wait.

Incredibly, in addition to the projected numbers of Me 262s that were to be constructed, the Me 209 project was resurrected. At the same meeting, it was decided that the 1,000 Me 262s each month were to be added to the 3,000 Me 209s and FW 190s that were to be produced concurrently.[43] *RLM* officials ordered that there was to be no loss of projected production of the Me 262, even though the Messerschmitt company had to almost completely retool for two new production models.[44] It was not until November 1943 that the Me 209 project was finally, and officially, scrapped. In the interim, between August and November, the Me 209 program consumed vast quantities of resources that could have been put to better use towards the Me 262. But it was not the materials misdirected to the Me 209 project that hindered the Me 262 project - without the essential power plants, the jet was no more than a high technology glider.

Arguably the most influential person to ever have contact with the German jet program was Adolf Hitler. He was finally shown the Me 262 on 26 November 1943, and immediately saw the weapon as the high speed bomber that he visualized as the tactical

bomber that would prevent an invasion of the European continent by the Allies.[45] This is one of the major areas of contention among historians of the Luftwaffe as it relates to the German jet program. The argument made is that Hitler's decision, later strongly enforced by a *Führerprotokoll,* was the downfall of the Me 262 program and the availability of the jet to the Luftwaffe's war effort.[46] For, the decision, and subsequent order, was that the Me 262 had to be able to carry bombs. Upon viewing the Me 262 in flight, Hitler inquired of Messerschmitt whether the bombing mechanisms were completed for the jet plane. As this topic had already been discussed by Göring and Messerschmitt two weeks earlier[47], Messerschmitt stated that the plane would be able to carry one 1,000 kg or two 500 kg bombs.[48] But the Me 262 shown Hitler was only a prototype; actual production had not yet begun. Testing of combat operations had not been done, and the plane went into production without such bombing tests. The production of the Me 262 by Messerschmitt intentionally omitted the bombing apparatus specifically ordered by Hitler. Messerschmitt, with the support of Galland, Milch, and Speer, Minister of Armaments, instead focused on the pure fighter version of the aircraft, according to Messerschmitt's own conception of the design of the Me 262.[49]

Junkers began the production of the Jumo 004B-1 engines as early as June 1943.[50] Although there were problems with the power plants, they were considered good enough for the program and given the go-ahead for production. But the immediate problem was the lack of strategically important raw materials. In the pre-production test models, the Junkers company was allowed to use whatever supplies were necessary to complete the engines. However, when production began, the lack of raw materials in Germany forced the use of other, less reliable products. One example was the jet combustion chamber.

Initially constructed with high-alloy steel, the production model was built with a mild steel sprayed with an aluminum coating.[51] The lack of necessary alloys and metals led to problems with the jet engines throughout their operational life. The dearth of strategically important raw materials was a constant concern for the Junkers factory, and there was a subsequent severe shortage of engines for the Me 262 program. It was not until April 1944 that engines in sufficient quantity were available for enough Me 262s for the Luftwaffe to form an advanced service testing unit. Designated *Erprobungskommando* (or shortened: *Ekdo*) 262, it was formed in April 1944 to evaluate the Me 262 under combat situations. *Ekdo* 262 received sixteen new jets for testing.[52]

The Messerschmitt company also faced problems in manufacturing the Me 262 airframe. On 17 August 1943, thanks to the US 8th Air Force, the Messerschmitt plant at Regensburg was bombed, and most of the aircraft manufacturing jigs were destroyed.[53] To protect the Me 262 program, a series of moves was initiated to relocate the manufacturing of the jet aircraft to small camouflaged forest factories. Messerschmitt was able to make up the losses, but once again outside factors determined the production rate of the Me 262.

Thus, even with the establishment of the first Me 262 unit in April 1944, there were still only a handful available aircraft.[54] Under the command of Hauptmann Werner Thierfelder, *Ekdo* 262 was instructed to evaluate the Me 262 in combat conditions. However, there were serious restrictions placed on the pilots of *Ekdo* 262. Initially, the planes had to undergo complete engine overhauls after only ten hours flight time.[55] The unreliability of the Junkers engines constrained the testing of the Me 262s by the Luftwaffe pilots. Not only did they have to deal with the lack of planes, but they

experienced a shortage of operational hours with each of the planes they possessed. But operational testing continued, and the pilots praised and criticized the new weapon. Although they enjoyed the superior speed of the Me 262, they did suggest a few concerns and modifications. For example, a pilot's report mentioned poor craftsmanship of the airframe itself, including loose rivets, poor oil levels, and control surface problems.[56] These were the problems that the Luftwaffe pilots were supposed to identify while testing the Me 262 under simulated combat conditions.

Additionally, the first Luftwaffe pilots to fly the Me 262 were not fighter pilots. Rather, they were drawn from the ranks of *ZG* 26 (*Zerstörergeschwader* – destroyer group), a Messerschmitt Bf 110 unit. The benefit of selecting these pilots was that they all had training on twin-engine fighter/bomber planes. It should be noted that the Bf 110, another Messerschmitt product, was a twin-engine heavy fighter that had served in the Luftwaffe from the start of the war. Although it did not realize its potential as a fighter, it was converted to a successful light bomber and excellent night fighter. The pilots of *Ekdo* 262 all had previous experience flying twin-engine aircraft as well as instrument and night flying. The use of these pilots is important in that they were ideally suited to test the twin-engine jet. The initial operational testing was made by pilots whose experience allowed them to make accurate diagnosis and predictions of the potentialities of the Me 262.

At about this time, the Allies came upon concrete proof of the existence of the new German jet. A report written by a French airframe worker at Messerschmitt's Augsburg plant was smuggled out of Germany. Therein he gave specific details of the production of the Me 262 and its operational capabilities. "A month ago two jet propelled

aircraft were tested. The first, with the typical airframe of the Me 210, had the two jet units in the wings [Me 262]. The second was a tailless aircraft [Me 163] ..." Concurrently, British reconnaissance planes had caught the Me 262 on film at the airfield at Lechfeld.[57] The British and Americans knew that they had a new and more dangerous foe to face in the air.

Hitler continued to have an effect on the production of the Me 262 in the early spring of 1944. In an official statement from Göring to Messerschmitt and the *RLM* dated 29 May 1944, taken verbatim from an order from Hitler, he conveyed Hitler's fury concerning the development of the Me 262. The Führer was incensed that production of the Me 262 had continued without the necessary equipment for bombing, and was irate that the pilots of *Ekdo* 262 had been testing the Me 262 without the ordered bomb racks. Göring reported on behalf of Hitler that the Me 262 was to be designated a *Schnellstbomber* (fast bomber); no further correspondence was to include reference to a fighter version.[58] Hitler vehemently ordered that it was not to be designated, called, or discussed as a fighter, and that all subsequent Me 262s produced had to be equipped to carry bombs. The plane was to be Hitler's jet bomber, and there was no more discussion allowed on the matter.

Even though important figures such as Milch, Speer, and Galland argued that the Me 262 was the perfect fighter plane to defend the Reich against the threat from the Americans and British, Hitler refused to budge.[59] But, in the end, it did not affect the production of the Me 262. Factors other than Hitler's personal decisions were by far more responsible for the delays faced in production of the Me 262.

Hitler did understand the value of the Me 262 as a fighter, but some things had to be worked out first As stated earlier, Hitler wanted a high speed ground attack aircraft against the imminent invasion of the Continent by the Allies. And the Me 262 was showing complexities above 9,000 meters (29,500 feet).[60] Therefore, the only role it was capable of performing at the time, with the equipment as tested, was under 25,000 feet altitude. According to Göring, the Me 262 was to be used as a high-speed bomber that could not be caught by the Allied planes at an altitude of between 4,000 and 6,000 meters (13,000 – 20,000 feet). It was decided at the meeting on 29 May 1944, specifically in the argument presented by Göring and supported by Galland, that the role ordered for the Me 262 was the correct one in light of the restrictions that the aircraft faced.[61] Therefore, Hitler's orders were correct for the Me 262. As reiterated by the historian Manfred Boehme:

> "[The] temporary use of the fast jet aircraft in the bomber role against the masses of troops and material during the decisive invasion of France promised a more effective operational result than their employment as fighters in the defense of the Reich cannot be dismissed out of hand."[62]

The use of the Me 262 as an interdiction bomber was the only role for which it was suited as the planes rolled off the production lines in the early stages of development. The Me 262 required more modifications, specifically better engines, before it became useful to the Luftwaffe as an interceptor fighter. In the end, it did not matter. There was only a handful of machines attached to *Ekdo* 262 available for tactical support missions on the day that the Allies stormed the beaches at Normandy. The wonder weapon of the Führer was not even ready for the invasion and was not used to repel the landings. It was still being subjected to Luftwaffe testing.

Incorporating the lessons learned by the testing unit *Ekdo* 262, the jet's speed was being utilized by a newly-formed reconnaissance unit. The only Me 262 group to fly operations before the D-Day invasion -*Einsatzkommando Braunegg*- was formed in Spring 1944. Equipped with three converted Me 262s for photographic missions, it was created as a reconnaissance unit. The cannons were replaced with cameras, and the bomb pylons were used to carry extra fuel for long-range missions.[63] The Me 262 thus equipped was able to outrun every Allied aircraft available. There is speculation that the group flew photographic missions over the British coast as early as the end of May that forewarned the Germans of the upcoming D-Day invasion. Interestingly, although the German records confirm the missions, no such records exist on the British side.[64]

Eventually, new Me 262 units were assigned. As the plane became available, pilots were chosen to fly the new machine. In addition to those from *ZG* 26 who were retrained on the Me 262, and who formed *Ekdo* 262, the pilots of *Kampfgeschwader* 51 (*KG* – Bomber group) "*Edelweiss*" were ordered to trade their Junkers Ju 88 medium (twin engine) bombers for Me 262s on 3 June 1944, three days before the Allied invasion. They formed *KG(J)* 51, the J denoting *Jäger* or fighter.[65] *KG(J)* 51 was created for the role of tactical bombing envisioned by Hitler. By June, the necessary fixtures for bombing had been incorporated into the pre-production design of the aircraft. However, as will be discussed later, the plane did not perform well in the new configuration, and was only used piecemeal against the Allies well after the Normandy landings. But it is important to note the date. The unit was equipped with the Me 262 specifically designed for bombing on 3 June. *KG(J)* 51 was equipped with fighter/bomber Me 262s before *Ekdo* 262 had even finished trials with the aircraft as a

fighter. Therefore, it can be argued that Hitler's order, which restricted the Me 262 to the bomber role, had absolutely no effect on production. In the end, the bombing unit was formed before the final testing had been completed on the plane as a fighter by *Ekdo* 262.

It was not until 26 July that the Me 262 finally saw action against an Allied plane. The first contact was between an Me 262 of *Ekdo* 262 and a Mosquito of 544 Squadron (British). The reconnaissance Mosquito of Pilot Officer A.S. Lobban was faster than almost all German fighters, and the pilot was surprised to see the German plane gaining on him. Eventually, the Mosquito was able to outmaneuver the Me 262 and evaded the German pursuit by diving into the clouds. Lobban landed at an Allied base in Italy, and the first confirmed combat against the new German jet was recorded.[66] The Allies had their first taste of combat against the German jets. The combat reports of the German jets will be presented in chapter four.

In addition, Galland, the General of Fighters, reformed *Ekdo* 262 into a new unit, *Kommando Nowotny*. Under the command of the charismatic Major Walter Nowotny, the group was formed to prove to the Führer that the Me 262 could function as a fighter.[67] Nowotny had been awarded the Oak Leaves with Swords and Diamonds to his Iron Cross for his mastery of air fighting, and had 256 confirmed kills. By the beginning of September 1944, there were enough planes for the formation of the group, and Galland jumped at the chance to form a fighter squadron with the Me 262.

Kommando Nowotny commenced operations on 7 October 1944 after gathering Major Nowotny, fifteen pilots from the former *Ekdo* 262, and various other pilots transferred from other *Jagdgeschwader* (fighter groups) across Germany. The unit was supported by the ground crew from *Ekdo* 262, who were the most familiar with the new

jet maintenance, and 52 Me 262 A-1s. Due to lack of foresight, the unit was unfit for operations and misfortune followed immediately. The foremost problem faced by *Kommando Nowotny* was unfamiliarity with the new machine. The pilots lacked sufficient training in the Me 262 to be effective.[68] After only a few check flights to gain rudimentary familiarity with the controls of the plane, they were expected to be able to fly combat operations. Only a short eight-to-ten-hour program was instituted to give the pilots basic instruction on the Me 262.[69] Fortunately, these pilots were all highly experienced veterans. As the war dragged on, the Luftwaffe was forced to use less experienced pilots, even for such highly complex aircraft as the Me 262, and this, as will be shown, led to disastrous results.

Likewise, no tactics had been developed for the Me 262. The pilots had to work out new combat tactics according to the incredible speeds of the Me 262. The Me 262 flew at speeds in excess of 850 kph(kilometers per hour); at least 150 kph faster than any Allied fighter, and at least 300 kph faster than the cruising speeds of Allied bombers. Therefore, to compensate for these incredible speeds, the pilots of *Kommando Nowotny* had to completely rewrite a tactical handbook for the Me 262.

And, as argued by the historian Boehme, the choice of operational airfields was poor.[70] Those at Achmer and Hesepe were along the path of the Allied bomber streams into and out of Germany, and thus were vulnerable to not only bombing, but were under the watchful eye of the Allied escort fighters. This led to serious problems because the Me 262 was very vulnerable at take off and landing, where it was underpowered and lacked maneuverability. After the first day of operations, when the *Kommando* lost three planes, including two pilots who were attacked while taking off, Major Nowotny's

request for cover fighters to protect the jets was finally granted. In the end, the German jets needed the protection of piston engine fighters (from *JG* 54) while they took off and landed; fighters to protect fighters.

At this time Hitler once again made his mark on the German jet program. After vehemently demanding that the Me 262 be produced solely as a bomber in May 1944, he was a little more lax after the successes of *Ekdo* 262 in bringing down high-speed British reconnaissance planes. Along with the constant badgering of the General of Fighters, Galland, Hitler decided on 20 August that five percent of the Me 262s coming off the production line could be fighters.[71] And, on 4 November 1944 Hitler allowed every Me 262 to be produced as a fighter. Part of this was due to the fact that the new high speed jet bomber, the Arado Ar 234, was finally being produced. The Ar 234 was designed specifically as a jet bomber, and had become available to the Luftwaffe in the Fall of 1944.[72] But, the condition still existed, which was expressly ignored, that the Me 262 had to be able to carry at least one 250 kg bomb.

By this time, the Allies had stepped up their bombing raids on Germany, and the few Me 262s that were available were insufficient to stem the Allied tide. However, the historical argument rages on. Could the Me 262s produced have made a difference? In the first eleven months of production, from January through November 1944, there were a reported 239 Me 262s produced.[73] Only 60 jets were delivered for combat operations to *KG* 51 (J), and another 52 to *Kommando Nowotny*. This is in comparison to the thousand bomber raids that were mounted by the Allies. Whereas the initial deliveries of Me 262s could have been put to excellent use training pilots for jet combat, they were instead thrown into the fray against the Allied bomber raids. Subsequently, there were high

losses of jets and pilots due to the lack of sufficiently developed tactics and poor training. There were some amazing accomplishments by the jet pilots of the Reich, but, for the most part, the effort was lost to the material superiority of the Allies in the closing stages of the war. The Germans had initiated a new phase in military aviation, but the jet airplane had not developed sufficiently to have a decisive impact on the air war over Germany during World War II.

In the final analysis, there were many decisions that influenced the course of the German jet program during the World War II. These decisions, under closer scrutiny, did not have the negative impact that was argued by so many scholars after the close of hostilities. Not only men within the Nazi system who had close contact with the Me 262 as exemplified by Galland, Göring, and Speer blamed Hitler for his interference, but also US post-war military analysts (such as Eugene Emme) and other military historians who supported the argument. However, in-depth research argues a number of important points. Messerschmitt knew as early as 1943 that the Me 262, just as his other fighter designs, had to be able to carry bombs. The order had come from Hitler that all fighters had to be capable of performing tactical bombing roles. And, although Hitler did force this point with the Me 262, the outcomes were not affected. The problems the plane faced at high altitudes prevented the aircraft from being useful against the high-flying Allied bombers. Therefore, Hitler's idea to use the Me 262 in the fighter/bomber role was a sound decision. The order only applied to a small number of planes before it was rescinded in November 1944. The few Me 262s available were restricted to piecemeal attacks against overwhelming Allied numerical superiority. Initially, the only role that the Me 262s seemed to excel at was to attack fast unarmed Allied reconnaissance aircraft.

It would take until the Winter of 1944/45 before the Junkers jet engines were sufficiently developed for the Me 262 to pose any threat whatsoever to Allied bombers and fighters.

Therefore, the popular misconception that the orders from the Führer had a devastating effect on the Me 262 program is incorrect. There were other, more important obstacles that the German jet program faced; factors which had more impact than Hitler's decisions. From the lack of Junkers engines to Allied activity against Germany and the lack of resources within Germany, there were many other reasons for the delays faced by the German jet program. The following chapters will deal with the events that had a much greater impact on the German jet program than the meddling of a few individuals within the Third Reich.

[1] See Harold Faber (ed.), Luftwaffe: A History, (New York: Time's Books, 1977).

[2] Albert Speer, Inside the Third Reich, (New York: Macmillan Co., 1970).

[3] Adolph Galland, The First and the Last, (London: Henry Holt and Company, 1954). Translated from the original German by Mervyn Savill. See also, Adolph Galland, The Development of Jet and Rocket Planes 1938-1944, Extracted from European Contributions to the History of World War II, 1939-1945 Monograph No. 7, Development and Planning in the German Air Force, Part 1. Prepared form official sources and personal experience of former German Air Force officers and known as the Von Rohden project, (Maxwell Air Force Base, Alabama: Foreign Documents Section, Air University Library, 31 July 1951), Translated by Alida Heerling.

[4] Eugene Emme, Hitler's Blitzbomber, Historical Notes on High Command Decisions Influencing the Tardy Operational Use of the Me-262 in German Air Defense, (Maxwell Air Force Base, Alabama: Documentary Research Division, Research Studies Institute, Air University, 1951).

[5] Brian Nichelson, Early Jet Engines and the Transition from Centrifugal to Axial Compressors: a Case Study in Technological Change, (Unpublished dissertation, University of Minnesota, 1988), pp. 4-6.

[6] Vincent Orange, "Fortunate Fascist Failures: the Case of the Heinkel Fighters" in Historical News, (No. 47, December, 1983), pp. 7-13.

[7] Walter Boyne, Messerschmitt Me 262, Arrow to the Future, (Atglen, Pa: Schiffer Military History, 1994) pp. 18-9.

[8] Michael Taylor (ed.), Jane's Encyclopedia of Aviation, (New York: Crescent Books, 1996. Third edition), p. 420.

[9] Walter Boyne, The Jet Age: Forty Years of Jet Aviation, (Washington, D.C.: Smithsonian Institute Press, 1979), pp. 48. See also D.R. Maguire, "Enemy Jet History" in The Journal of the Royal Aeronautical Society, (Vol. 52 (January 1948)), pp. 76- 84. Maguire labels the Italian jet as the Caproni-Campini C.C.2 in contrast official designation (according to Jane's) N.1.

[10] Nichelson, chapter 3 "The Axial-Flow Compressor Realizes its Potential" pp. 93-135.

[11] Hans von Ohain, "The Evolution and Future of Aeropropulsion Systems." In The Jet Age, edited by Walter Boyne pp. 25-46.

[12] Joachim Dressel, Manfried Griehl, and Jochen Menke (eds.), Heinkel He 280, the World's First Jet Aircraft, (West Chester, Pa: Schiffer Military History, 1991), pp. 4-7. Hans Ebert, Johann Kaiser, and Klaus Peters, Willi Messerschmitt – Pionier der Luftfahrt und des Leichtbaues – Eine Biographie, (Bonn: Bernard & Graefe Verlag, 1992), pp. 232-4.

[13] Sir Frank Whittle, "The Birth of the Jet Engine in Britain." In Walter Boyne (ed.) The Jet Age, pp. 12, 14-7.

[14] Hans Ebert et al, p. 232.

[15] Ibid. See also for Heinkel's proposal Joachim Dressel et al, pp. 4-5.

[16] Richard Suchenwirth, Historical Turning Points in the German Air Force War Effort, USAF Historical Studies Number 189,(New York: Arno Press, 1968), pp. 50-1.

[17] Faber, p. 116.

[18] Suchenwirth, pp. 51-2.

[19] Manfred Boehme, JG 7: The World's First Jet Fighter Unit 1944/1945, (Atglen, Pa: Schiffer Military History, 1992), Translated by David Johnston, pp. 22-3. See also J. Richard Smith and Eddie Creek, Me262, (West Sussex, England: Classic Publications, 1997), Volume I, pp. 96-7.

[20] J.R. Smith and Antony Kay, German Aircraft of the Second World War, (London: Putnam, 1972), p. 294.

[21] Boehme, p. 23. The Messerschmitt documents come from the personal collection of Boehme.

[22] Ibid, p. 40. See also Horst Boog, Die Deutsche Luftwaffenführung 1935-1945, (Stuttgart: Deutsche Verlags-Anstalt, 1982), pp.124-30. And, this order is evident in the development of all of the Luftwaffe fighter types. The Bf (Me) 109 E-4b was the first example of the single engine fighter-bomber, and later models including the Me 109F and the FW 190 A-3/U1 and U7, A-5, A-10, and D-9. All mentioned in Smith et al, pp. 173-96 (FW 190), 467-92 (Me 109).

[23] As mentioned in James Corum, "The Luftwaffe's Army Support Doctrine, 1918-1941" in The Journal of Military History, (Volume 59 (January 1995)), pp. 53-76.
[24] Ibid, pp. 76-7.
[25] Heinz Nowarra, Messerschmitt Bf 109, (Somerset, England: Haynes Publishing Group, 1989), pp. 94-112, in the chapter entitled "Battle of Britain" where he discusses the development of the Bf 109 E-4B (bomber version) and its use as a fighter-bomber in the Battle. See also Hans Ebert et al, pp. 241-2.
[26] Ibid. p. 118. See also John Turner, British Aircraft of World War II, (Edinburgh: Sidgwick & Jackson Ltd., 1975), pp. 46-7.
[27] Dressel et al, p. 13.
[28] Smith et al, pp. 294-5.
[29] Boyne, Messerschmitt... p. 28.
[30] Ibid, p. 29.
[31] Imperial War Museum, London, England. Milch Document Collection (hereafter cited as IWM Milch Documents), Volume 36, dated 22 March 1943, decision of the Me 262 over the He 280.
[32] Boehme, p. 29-31.
[33] Boyne, Messerschmitt..., p. 33.
[34] Smith et al, pp. 520-5.
[35] IWM Milch Documents, Volume 20, 25 May 1943.
[36] IWM Milch Documents, Volume 21, 22 June 1943.
[37] Ibid, with two production centers producing Me 262s exclusively. The numbers projected were (for the months following November 1944) 40, 90, 140, 180, up to 400 in September 1945.
[38] Nowarra, p. 297. Taken from the year (1943) total of 6,247.
[39] IWM Milch Documents, Volume 21, 22 June 1943. See also Mano Ziegler, Turbinenjäger Me 262, (Stuttgart: Motorbuch Verlag, 1978), pp. 70- 3.
[40] Tony Wood and Bill Gunston, Hitler's Luftwaffe, (London: Salamander Press, 1977), pp. 164-8.
[41] IWM Milch Documents, Volume 24, 13 August 1943.
[42] Ibid.
[43] Ibid.
[44] Boehme, p. 35.
[45] Boyne, Messerschmitt..., p. 35. See also Smith, p. 537.
[46] Including, but not limited to: Albert Speer, Inside the Third Reich, (New York: Macmillan Company, 1970), pp.362-4. See also Faber, p.116; David Irving, The Rise and Fall of the Luftwaffe, (London: Weidenfeld and Nicolson, 1973), and both Galland books mentioned above.
[47] IWM Milch Documents, Volume 63, "Reichsmarschall (Göring) at the Messerschmitt company factory at Regensburg, 2 November 1943." Where he discusses with Messerschmitt the orders of the Führer concerning the implementation of bomb racks on the production version of the Me 262 fighter/bomber.
[48] Irving, pp. 257-8.
[49] Boehme, pp. 41-2.
[50] Smith et al, pp. 536-7. The Jumo 004 A-1 was cleared for production in June 1943.
[51] T.A. Heppenheimer, "Jet Plane" in Invention and Technology. (Fall 1993), pp. 45-57. See also Jeffery Ethell and Alfred Price, World War II Fighting Jets, (Annapolis, MD: Naval Institute Press, 1994), pp.19-20.
[52] Ethell and Price, p. 20.
[53] Boyne, Messerschmitt..., p. 158. See also John Foreman and S.E. Harvey, The Messerschmitt Me 262 Combat Diary, (Surrey, England: Air Research Publications, 1995), pp. 34-7. However recent research suggests that *Ekdo* 262 only had one Me 262 in April (Me 262 V8) and did not receive more until May. See Smith and Creek, pp. 234-5. This evidence is corroborated by Adolf Galland's production figures in The Development..., p. 41, where he asserts that only one production Me 262 was built during March, none in April, and eight in May.
[54] Foreman and Harvey, pp. 34-7.
[55] Ibid, pp. 37-8.
[56] Boehme, pp. 46-9.
[57] Foreman et al, pp. 34.
[58] IWM Milch Documents, Volume 58, Dated 28 May 1944.
[59] Speer, pp. 362-4.

[60] IWM Milch Documents Volume 64, 29 May 1944.
[61] Ibid.
[62] Boehme, p. 43.
[63] Foreman, .p 40.
[64] Ibid, p. 43.
[65] Ibid, pp. 38-9.
[66] Ibid, pp. 42-4.
[67] Boehme, pp. 53-4.
[68] Ibid, pp. 53-4.
[69] Boyne, Messerschmitt..., p. 38.
[70] Boehme. pp. 53,
[71] Ibid, p. 43. See also Boyne, Messerschmitt..., pp. 158.
[72] Boehme, pp. 43-4.
[73] Ibid, p. 44. Boehme reports 239 Me 262s produced for the Luftwaffe, whereas Manfred Griehl and Joachim Dressel, Luftwaffe Combat Aircraft, (Atglen, Pa.: Schiffer Military History, 1994), p. 53, record only 177 Me 262s produced in the same time.

Chapter II

Pre-Production

The technological advances made by the Germans during wartime were amazing; development of weapons systems under the constraints of war and constant Allied harassment was unmatched. This is best illustrated by the breakthroughs accomplished in the field of aeronautical engineering. In addition to the rocket program at Peenemünde and the rocket planes devised by Willi Messerschmitt and the Fiesler company, the German jet program was an example of ingenuity. The development of the jet program was exemplified by the Messerschmitt Me 262 project, the first operational jet aircraft, and followed two distinct timelines: the development of the airframe and that of the powerplants. This chapter discusses the theoretical background of both the engines and the airframes which led to experimentation, testing, and final development of the Me 262 as a combat aircraft. Further, it presents some of the technological problems and solutions that were presented. Finally, this chapter analyzes some of the misconceptions surrounding the technological side of the German jet program.

Ernst Heinkel, the founder of the Heinkel factory, was obsessed with the quest for speed. During the inter-war years, he had designed and built three of the fastest planes in the world.[1] Although the Treaty of Versailles, which ended the First World War, limited German aircraft production to civil models, Heinkel was allowed to build racing planes. His designs were rejected by the Luftwaffe as fighter aircraft[2], but one of his commercial airliner prototypes, the Heinkel He 111, was retained by the Luftwaffe as a bomber. He continued his work on high-speed planes, and employed some of the finest aeronautical

engineers in Germany. Heinkel added the Günter twins - Walter and Siegfried - to his design team in 1931 and put them to work on high-speed aircraft. Their work led to the development of the world's first jet aircraft, the He 178.

Piston engines were reaching the apex of their efficiency. As power in the form of thrust from a piston engine was increased, corresponding weight increased exponentially. In other words, a doubling of horse power quadrupled the weight of an engine.[3] The piston engine was used and improved during the inter-war years, but Heinkel pursued alternative power plants for his airplane designs, employing a young scientist recently graduated from University of Göttingen, Hans von Ohain. Ohain had done his doctoral work on the use of turbine engines as aircraft power plants, and proposed that a steam turbine could be refined enough for a small, lightweight, gas powered turbine for use in planes.[4] Work on this experimental power plant began in 1936 with the Heinkel HeS 1, a centrifugal jet engine that ran on hydrogen. Experimentation continued until 1938, when Ohain introduced his next creation, the HeS 3, a liquid fuel injected model of the HeS 1 engine.

This revolutionary power plant was combined with an airframe that was specifically built to house the HeS 3b. The Heinkel He 178 made its debut on 27 August 1939, when it flew for the first time under jet power. The Germans began the jet age one week before the invasion of Poland in 1939. The He 178 was a simple plane designed to test Ohain's engine rather than for potential use as a future production plane. Even as the He 178 was making its first flights, the Heinkel design team was already working on other models. According to design specifications issued by the *Reichsluftfahrtministerium* (*RLM*), Heinkel proposed the He 280,[5] a twin jet engine low-

wing monoplane. This was in direct contrast to the design of the He 178, which was built around Ohain's HeS 3b centrifugal jet engine. The He 280 plans called for two axial-flow engines slung under the wings for power. The difference was in the design of the engines. The centrifugal jet engine was made up of an impeller that forced air outward through diffuser vanes and through a manifold, changing the air flow direction 90 degrees before it was ignited by the fuel to form thrust. The inherent problem with the centrifugal flow engine was that there was only one compressor unit; the combination of the impeller, diffuser vanes, and manifold. The axial-flow jet was theoretically more efficient because it employed as many compressor stages, in the form of turbines, as was necessary.[6] In addition, the axial-flow engine could be dismantled and each section tested as compared to the centrifugal engine, which could not and was tested on a trial-and-error basis. The centrifugal engine was, however, easier to construct, and was the first form of jet engine to be tested and flown. The axial-flow jet offered better efficiency and was more easily tested and modified. Thus, Heinkel, following his initial successes with a centrifugal flow jet engine, focused on the development and testing of axial-flow turbojet engines.

At the same time, there were two other significant jet programs underway independent and unknown to the German designers. The Italians were working on a primitive ducted-fan turbo jet aircraft known as the Caproni-Campini C.C. 2.[7] However, it was not a true jet; the engine was comprised of a piston engine that powered a ducted fan inside a tubular frame. It flew for the first time on 28 August 1940, a year and a day after the first flights by the He 178. But the Italian "jet" lacked power and did not live up

to its projected performance. It was subsequently retired and consigned to the Italian Air Force Museum near Rome.[8]

On the Allied side, work was underway in Britain as early as 1932. Frank Whittle obtained a patent for his turbojet engine and began independent work on his design. In comparison to the German project, Whittle did not receive official government or industry support and was forced to solicit private funding for his research. His company, Power Jets, was founded in 1936 with the help of private investments, and Whittle began building his first jet engine, the W.U. (Whittle Unit).[9] The descendent of this prototype, the W.1 jet engine, was completed by late 1940, and the plane that was specifically designed by Gloster to house the W.1 was completed by March 1941. Designated the E28/39, it was the first Allied jet plane to fly, taking to the air on 7 May 1941. Although there are reports that Whittle was the first to fly the E28/39, he admits that his "flight" was only a short bounce during a taxi-ing run and that Jerry Sawyer, a Gloster test pilot, was in fact the first to fly the British jet with a short straight flight.[10] The official flight of the Gloster E28/39 was on 15 May 1941, when Sawyer took off from Cranwell and flew for 17 minutes.[11] Whittle finally received official British government support for his jet project and his design team was sent to the US to complete a joint US/British jet plane making use of the British technology and American manufacturing capabilities.

In the meantime, work continued on the German jet program. After the initial successes of the He 178, Heinkel and Messerschmitt both submitted plans for a twin-engine jet fighter. Heinkel's design, the He 280, was approved by the *RLM* in September 1939 as a prototype for a future fighter. Messerschmitt's project 1065 – which later became the Me 262 – was submitted in June 1939, but underwent many design

modifications before the first prototype was constructed. Both were designed as potential Luftwaffe fighter planes, with the intention that they would be produced as such. Both were low-wing monoplanes with two under-wing jet engines. The He 280 planned for the installation of three machine guns, the Me 262 for four. Both designs were approved by the *RLM* and prototypes were constructed without engines for testing by their respective companies.

The He 280 underwent flight testing as a glider before the engines were completed by Heinkel, who had recruited another important engineer, Max Müller. Müller was working on an axial-flow jet engine when Heinkel acquired him from the Junkers factory, and was immediately put to work designing Heinkel's newest axial-flow jet for the He 280, the HeS 30.[12] The He 280 airframe was first tested as a glider as the engines were not ready. The prototype He 280 V1 (Version 1) was completed by September 1940 but neither Ohain's centrifugal HeS 8 nor Müller's HeS 30 were ready for flight testing. Therefore, until the end of March 1941, the He 280 was flight tested without engines. The glider tests were successful and there were no problems foreseen for the future jet plane. Ohain's engines were finally ready for flight testing and were fitted to the He 280 airframe. The plane flew under jet power for the first time on 30 March 1941 and the second generation of jet planes was born.

The choice between centrifugal and axial-flow engines was a concern for Heinkel. Ohain had only been able to produce 500kg static thrust out of a proposed 700kg from the HeS 8. Meanwhile, Müller was producing his planned 700kg thrust from the HeS 30, and as it was modified over the course of 1941, eventually delivered 900 kg thrust by the end of the year. Heinkel's decision, which was supported by the *RLM,* was in favor of the

axial-flow turbo jet engine (Müller's) over the centrifugal jet engine designed by Ohain.[13] The engine manufacturing team, led by Müller was moved to Stuttgart, and work continued on the HeS 30 (also known as the 109-006) as well as the next generation engine, the 109-011 designed to produce 1,300kg thrust. However, work on the HeS 30 was abandoned by order of the *RLM*'s Technical Department in order to concentrate on the more powerful 109-011, and the He 280 program was once again delayed due to a lack of engines.[14] It was a major setback for the He 280 program when Helmut Schelp of the Technical Department of the *RLM* dropped the HeS 30 (109-006), which was not completely tested in favor of the 109-011, which was an entirely new design. Had the development continued on the HeS 30, it could have proven to be an adequate power plant for the fledgling He 280. The *RLM* had given contracts for jet engines to other companies; the forerunners in the competition were Junkers and BMW (*Bayerische Motoren Werke*). Heinkel as well as Messerschmitt had to depend on these two companies for future delivery of jet engines.

The decision in favor of the axial-flow turbo jet over the centrifugal flow engine was a question of technological necessity. Although the axial-flow engine was more expensive and more difficult to build, it was preferred by the *RLM* and the engineers.[15] The axial-flow engine had a smaller intake diameter because the air flowed straight through rather than being compressed centrifugally. Thus, there was less drag in flight. It was also a more efficient engine. More turbines could be added for higher compression ratios to produce more thrust. Lastly, both the He 280 and Me 262 were designed to carry two axial-flow engines under the wings, whereas the He 178 (as well as the Gloster

E29/38) were aircraft designed around centrifugal jets, with the air flowing through the fuselage of the plane.

Messerschmitt had also developed a plan for a jet fighter. Designated project 1065, it was the early design for the Me 262. As early as 1939, Messerschmitt proposed a low-wing all-metal jet-powered plane capable of high speed and designed as a future fighter for the Luftwaffe. The plan was developed over time according to the specifications of the engine designers at both BMW and Junkers: the main changes were in the wing design. Originally, Messerschmitt proposed use of the same wing as another of his planes, the Me 109. However, this was changed and a completely new wing design was used in the prototype, the Me 262 V1 (PC+UA). To accommodate the larger and heavier Junkers Jumo 004 engine, the wing was redesigned with an 18-degree sweep from the engine nacelle to the wingtip. This not only accommodated the Junkers engine but also improved the plane's handling characteristics in wind tunnel testing at high speeds.[16] The Me 262 prototype was completed in February 1941, but it was some time before the jet engines were ready for flight testing.

Interestingly, the German jet program was almost entirely abandoned by Adolf Hitler even before it began. In February 1940, convinced that the war would not last long, Hitler ordered that all military projects that would not be operational within six months were to be stopped.[17] This included all experimental programs such as the He 280 and Me 262. This order was reinforced by Hitler again in 1941, but reworded by Hermann Göring in January 1942 when he was granted final say on all experimental programs based on availability of raw materials and production capacity.[18] In Hitler's

mind it was necessary to build quantity for the Luftwaffe without regard for future quality.

Conversely, there was a conflicting order issued by the *RLM* on 10 December 1942, giving highest priority to the experimental jet program. Field Marshal Erhard Milch, the State Secretary of Aviation, ordered "Project Vulcan."[19] In direct conflict with Hitler's orders, it gave priority for raw materials to the experimental programs for the He 280, Me 262, and other experimental Luftwaffe programs including the Me 163 (Messerschmitt's rocket fighter) and the Ar 234 (the Arado jet bomber). "Vulcan" ordered an "urgent development and production program" for the manufacture of qualitatively superior planes for the Luftwaffe.[20] Messerschmitt and Heinkel were able to continue their experimental programs developing jet planes with official *RLM* sanction. In the end, it showed the foresight of Milch and the *RLM* concerning the jet program for the future of the Luftwaffe. And, "Vulcan" gave important raw materials to Messerschmitt and Heinkel.

Messerschmitt and Heinkel decided to ignore the orders from Hitler and Göring, and without official sanction continued work on their experimental jets until December 1942. Both planes were built and preliminary tests had been completed even before "Project Vulcan" gave them permission to continue their work. By the time the *RLM* gave full support for their experiments, Messerschmitt and Heinkel had already flown their jet planes successfully.

The He 280 flew for the first time under pure jet power on 30 March 1941. It was an amazing feat for the Heinkel company as they conceived of and built both the airframe

and power plants. Their direct competitor, Messerschmitt, was responsible for building the airframe, but waited on the development of the engines from another company - Junkers. However, the HeS 8 engines used initially were expected to be replaced with the more powerful HeS 30s. But because of a delay in production, many different engine combinations were tested. While awaiting delivery of the new Heinkel HeS 30 engines, Walter Pulso pulse-jets were used to test pulse-jet viability in aeronautics. The pulse-jets provided thrust by drawing air in, mixing it with fuel, combusting it, and forcing the super-heated expanding air through a small exhaust without compressors or turbines. The pulse-jet was a simple though inefficient power plant that was eventually used in the expendable V-1 flying bomb. The tests with the He 280 showed that the pulse-jets were inefficient for use in fighter aircraft as they required too much fuel and limited operational flight time. Therefore, tests were suspended.[21]

About this time Messerschmitt conducted powered flights with the Me 262. However, the Messerschmitt program was a bit more problematic. Messerschmitt was incapable of manufacturing his own engines as Heinkel had done, and had to rely on outside companies for the power plants for the Me 262. The engines that Messerschmitt was counting on for his jet were being constructed by the Junkers and BMW companies, which had been put to work on turbo jet design as early as 1939 by the *RLM*.[22] Junkers was working on an axial-flow turbo jet designated Jumo 004 (official *RLM* designation 109-004) and BMW was busy engineering the BMW 003 (109-003). But, even though the Messerschmitt Me 262 airframe was ready for testing, the corresponding engines were not. Therefore, the first Me 262 flying tests were conducted with a piston-engine, a Jumo 210. The first flight of Me 262 V1 (PC+UA) was on 18 April 1941, piloted by

Messerschmitt's chief test pilot Fritz Wendel.[23] Me 262 V1 made forty-seven flights with the Jumo 210 to test the stability of the airframe and handling characteristics. Over a year passed before the Junkers jet engines were ready for flight.

BMW was the first to complete its jet engines for the Me 262. Me 262 V1 (PC+UA) was fitted with BMW 003 engines – the Jumo 210 was retained as a safety measure - and on 25 March 1942 it lifted off from Augsburg airfield. Immediately after takeoff, both turbojets failed; fortunately for the German jet program, the power of the Jumo 210 piston-engine and the skill of Wendel brought the plane safely back to earth. After dismantling the BMW 003 engines, it was determined that the compressor blades had failed and seized: BMW went back to the drawing board.[24] Although the events could have been much worse, the events were indeed a setback for the Me 262 program. The *RLM* reduced its order from twenty prototypes to only five, and the fate of the other fifteen planes was dependent on the successful testing with Junkers engines.[25] The Junkers Jumo 004s were finally ready and fit to Me 262 V3 (PC+UC) in early July 1942.

However, Junkers was having enormous difficulty producing jet engines for the Me 262 program. Although the prototype Me 262 V1 (PC+UA) was completed and ready for testing as early as January 1941, there were no jet engines for the aircraft.[26] Due to the failure of the BMW engines, it was two years between the time that the airframe was ready and the engines were completed for jet flight. Even in production, there were several failures and problems with the revolutionary power plants. The main problems faced by the German jet program are attributed to pre-production and

production problems of the Me 262 airframe at Messerschmitt and the development of the Jumo 004 power plant at Junkers.

Work began on the Junkers Jumo 004 (T1) engine in 1939. Dr. Anselm Franz, after finishing school in Switzerland, was offered a position in the engine development department at Junkers. The *RLM* contracted Junkers motor division, known as Jumo (for *Junkers Motorenbau*), to produce a prototype jet engine.[27] The prototype, which was constructed to operate on diesel fuel, was first run in October 1940 without an exhaust nozzle. After configuring the various pieces and assembling them, the designers bench tested the engine at the end of January 1941 to a top thrust of 430 kp (950lbs). The engine was still underpowered according to the *RLM* contract (which required 600 kp from the engine) and work continued.[28] The engine finally reached its expected thrust goals in August after replacing the original alloy compressor blades with steel ones. Flight tests were initiated using the Jumo 004 on a Messerschmitt Bf 110 flying test bed, where the engine would be run up after the plane became airborne under its own piston power. These tests on the stability of the engine in flight began in March 1942. After successful tests under the Me 110, the *RLM* ordered an additional 80 Jumo 004s late in summer 1942.[29] Therefore, it is clear that the testing of the Jumo 004 prototypes was not even completed when Me 262 V3 took off powered by the Jumo 004 powerplants.

At this stage, the engines were still experimental, another important point in the development of the German jet. The initial engines, used to power the Me 262 V series, were built as experimental engines. There were no restrictions on the materials used to construct the first Jumo 004, made of raw materials such as nickel, cobalt, and molybdenum in quantities that were not acceptable on the production models because of

their scarcity. The designer, Dr. Franz, knew this. He realized that once the Jumo 004 was ready for production, it would have to be redesigned incorporating less of the valuable and scarce raw materials that were simply not available.[30] This, in turn, created problems with the production units that did not contain the scarce raw materials but were forced to use less-reliable substitutes.

The prototype Me 262 airframe was married to the experimental Junkers Jumo 004 engines and the maiden flight under pure jet power took place on 18 July 1942. Messerschmitt had no great difficulty designing the airframe as he had been creating cutting-edge designs for years. The engine, on the other hand, was completely new technology that had to go through years of trial-and-error before it could be used as it was intended. And, it would be another two years of testing and refining before the Me 262 was available to the Luftwaffe for combat operations.

On 18 July 1942 the Me 262 was finally ready to fly. Outfitted with two Junkers Jumo 004 A-0 engines, the plane that signified the technological superiority of the Luftwaffe was ready. With Wendel at the controls, the plane rolled out for taxi-ing trials. Unfortunately, another problem arose. The original Me 262 was configured as a tail-dragging aircraft with a wheel in the tail. The Jumo 210 piston-engine had created enough air flow over the elevators on the tail to allow the plane to take off. However, with the new jets, there was no air flow over the elevator surfaces, and the plane refused to lift off. Wendel, an experienced pilot, tried the dangerous technique of braking at 112mph to get the tail to unstick from the ground. It was successful, and the Me 262 V3 (PC+UC) took off on its maiden voyage under jet power.[31] The initial flight was smooth and trouble-free; Wendel flew circuits around the airfield for twelve minutes. Later that

day, Wendel flew another thirteen-minute flight and achieved 550kmh with the jet plane. In his flight report, Wendel stated that the plane performed well after the initial dangerous braking procedure, and that the engines were smooth and efficient.[32]

Immediately following the first flight, suggestions were made to improve the Me 262 V3. First and foremost, Fritz Wendel suggested a tricycle undercarriage incorporating a nosewheel. It would eliminate the need for the pilot to stab the brakes to get the tail to lift off from the ground. In addition, Wendel suggested reconfiguration of the wing. Originally designed as a straight wing to the engine, then a sweep of the section from the engine to the tip, Wendel found that the wing was unstable making turning difficult. He proposed a swept wing from the root to the tip and the thickening of the wing. After completion, this led to a thirty per cent increase in lift.[33]

The Me 262 V3 was tested further until 11 August when Heinrich Beauvis, an official *RLM* test pilot, flew the plane. He was unable to duplicate Wendel's braking procedure, and crashed the plane causing significant damage. Regardless, the *RLM* issued orders for five more prototypes and ten pre-production models. The ten 0-series aircraft (Me 262 A-0), to be designated V 11 to V 20, were to include the safer nosewheel tricycle undercarriage. The *RLM* order was expanded again in October after a successful flight by Beauvis to thirty 0-series aircraft to be fitted with tricycle gear, to be completed by the end of 1943. However, the order was rejected by Messerschmitt because of a lack of production capability; he promised only ten machines by the deadline.[34]

By 4 March 1943, Messerschmitt had drawn up final plans for the Me 262. In accordance with the wishes of the *RLM*, and to make some serious decisions concerning

the German jet program, these production plans were submitted. Messerschmitt outlined the final specifications for the production version of the Me 262 including speed, range, and armaments. It is important to note that the production program planned for bomb racks according to an order from Hitler concerning the construction of fighter planes.[35] Hitler was insistent that all fighter models be capable of carrying bombs for tactical bombing missions, and the Me 262 was no exception. The original production program planned for the installation of bomb racks for 500kg bombs.

The Messerschmitt production plans of March 1943 allowed the *RLM* to make a momentous decision later that month. In a conference headed by Göring on the 22 March, the *RLM* chose the Me 262 over the He 280.[36] This decision was based on a number of factors. After careful consideration of production plans, the Me 262 was selected over the He 280 based on speed, armament, and range. The Me 262 was more heavily armed, (four 30mm cannons as compared to three 20mm cannons) and had a greater range than the He 280. In addition, Heinkel was having trouble fitting the Junkers Jumo 004 engines to his plane: the Jumo 004s were too big for the He 280 and, according to the test pilots, there was insufficient ground clearance with the new engines for safe handling of the aircraft on the ground.[37] The He 280 program was scrapped and the remaining He 280s were relegated to use as test aircraft.

Although the Me 262 won the competition with the He 280, there was another aircraft that had a direct influence on its development. After the flight testing of the Me 262, another Messerschmitt project was vying for precious raw materials and official recognition from the *RLM*: the Me 209. The successor to the mainstay of the Luftwaffe, the Me 209 was wreaking havoc on the Me 262 program. As stated earlier,

Messerschmitt had to turn down an expanded order for thirty Me 262s (over the original ten) due to the fact that his manufacturing plants were busy preparing to produce the Me 209. The latter used many of the same jigs and forms as the Me 109, consequently, it would have been easier to produce than the Me 262.[38] However, Messerschmitt argued that although the engines were not yet ready for the Me 262, the production engines were not ready for the Me 209 either. The *RLM* decided to strike the Me 209 from Messerschmitt's production workload. Incidentally, this was not the last time the Me 209 would come in direct conflict with the Me 262.

This decision was supported by the General of Fighters (*General der Jagdflieger*) Adolf Galland. One of the first Luftwaffe pilots to fly the Me 262 – his flight took place on 22 May 1943 – Galland had written the report and oral defense of the Me 262, which was presented at the 25 May conference.[39] Galland was overwhelmingly impressed with the Me 262 and demanded that it replace Messerschmitt Me 109 production immediately. He argued that the Focke-Wulf FW 190 could be produced as the main piston-engine fighter for the Luftwaffe, and that Messerschmitt should concentrate all production on the Me 262. Galland requested the impossible figure of 1,000 Me 262s per month for the Luftwaffe fighter arm. In Galland's opinion, the Me 262 was more advanced than the proposed Me 209; the Me 209 was obsolescent when compared to the Me 262. In his diary he outlined his intentions, "Drop Me 209, put the Me 262 in its place."[40] His opinion swayed the conference and Milch ordered the first 100 Me 262s to be produced by the end of 1943.[41]

In June 1943 Messerschmitt was summoned before the *RLM* to give his outlook on the competing programs.[42] He stated that he would be able to start production of Me

262s no earlier than January 1944 due to limited manufacturing capabilities, and projected delivery of the first 100 machines no earlier than May 1944 (8 in February, 21 in March, 40 in April, and 60 in May). After May, he proposed 60 Me 262s per month through November. The most he could hope to produce was a total of only 400 per month, and even this number was not attainable until September 1945. Messerschmitt's conclusions were based on projected output from two factories producing Me 262s exclusively.[43] And this was only the projected number of Me 262 airframes. The completed planes depended on the delivery of successful engines from Junkers.

Work continued on the Me 262, and Me 262 V5 (PC+UE) was ready to fly by June 1943. The V5 was the first Me 262 fit with the tricycle landing gear configuration, and the results were positive. Take off became easier and the pilot was afforded a better field of vision on the ground. The re-design was successful even though problems with the undercarriage were to haunt the future of the Me 262 program. The undercarriage, supplied by Opel, was too delicate for the heavy aircraft and there were a number of accidents on the ground when the nose wheel collapsed. And, the development of the undercarriage was a lengthy process in itself. According to the documents, it was not until March 1944 that Messerschmitt was comfortable enough with the landing gear to send a letter to Opel thanking him for the successful completion of the tricycle undercarriage for the Me 262.[44]

In July a new technology was incorporated into the Me 262 program as Me 262 V5 (PC+UE) was fit with two Rheinmetall-Borsig 109-502 solid-fuel rockets in addition to the Jumo 004s to assist takeoff.[45] The RATO (Rocket-Assisted Take-Off) units were expected to shorten not only the take-off roll, but also the time to reach altitude to

intercept Allied bomber formations. Although they were not incorporated in the production model, the experiment was one of the first successful uses of RATO units.

Testing was severely marred at the end of July when, in quick succession, two Me 262s (V4 and V5) crashed. Messerschmitt was down to two prototypes available for testing – V1 and V3. The crashes led to a decision by Hitler for caution in aircraft production. Messerschmitt had taken Milch's decision personally when the Me 209 program had been scrapped, and called on Hitler. Messerschmitt met with the Führer and informed Hitler that the Me 262 used more fuel than a conventional piston-engine plane, without telling him that the Me 262 used a low-grade diesel fuel, which Germany had in abundance.[46] Hitler, being uninformed at best, and often misinformed, ordered the resurrection of the Me 209 program. He wanted to make sure that there were planes, no matter how obsolescent, for the Luftwaffe.[47] This order was followed, and supported in another *RLM* conference in August. It was decided that in addition to the 1,000 Me 262s that were to be produced each month, a total of 3,000 Me 209s and FW 190s would be produced as well.[48] Messerschmitt was expected to be able to produce both the Me 262 and the Me 209 in quantities that were unrealizable for either program, let alone both. But, the effect was negligible. The dubious Me 209 program wasted scarce materials and manpower, as well as valuable time, but in the end the Me 262 program suffered for more obvious reasons. First, the strategy was appropriate. The Luftwaffe could have used the Me 209 if the Me 262 had been a total failure. And, it must be remembered that Messerschmitt was infamous for his aeronautical failures, such as the twin-engine Me 210 multi-purpose fighter. In addition, without the engines for the constructed Me 262s – unavailable from the Junkers factory – the plane was useless.

Production of the Me 262 was again halted on 17 August 1943 when the USAAF 8th Air Force bombed the Messerschmitt plant at Regensburg. Most of the manufacturing jigs for the Me 262 were destroyed in a raid specifically intended to disrupt the Luftwaffe's supply of planes.[49] Messerschmitt initiated a plan to not only disperse the production of the components of the Me 262, but also to move the manufacturing to forest factories.[50] This both helped and hindered the Me 262 program. After moving the production facilities to the forest factories near Augsburg and Oberammergau in early 1944, the manufacturing of the planes was safer from Allied bombing. But because of the need to transport the parts for final assembly, the chaos in the transportation system faced in Germany as the Allies intensified bombing created bottlenecks and delayed the final production of Me 262s.

Finally, and officially, in November the Me 209 program was scrapped and Messerschmitt was allowed, and expected, to channel all of his resources into producing the Me 262 jet plane. The Me 209 was no longer competition for the Me 262 jet program.

November 1943 was an eventful month for the Me 262 program when Hitler saw the Me 262 for the first time. The Führer saw the plane on 26 November and his reaction was unanticipated and caused quite a stir then, and continues to influence historical writing to this day. Hitler, upon seeing the Me 262 for the first time, exclaimed that it was finally the high-speed bomber that he wanted.[51] He inquired whether the Me 262 could carry bombs, and Messerschmitt responded in the affirmative. However, it is important to note that the Me 262 was still undergoing testing, and that no production models were forthcoming. It did not matter if it could carry bombs, or if the hardware

had been built, the plane was not even ready for serial production. Messerschmitt worked on the bomb racks for the Me 262, but the question posed by Hitler was moot; testing needed to be completed on the Me 262 as a viable aircraft first before it could be used as either a fighter or bomber. Incidentally, Hitler ordered that the Me 262 be produced only as a high-speed bomber until November 1944 (when the true jet bomber Arado Ar 234 became available), but by then the Me 262 was only barely entering service with the Luftwaffe, and it was entering operational service as a fighter, contrary to Hitler's orders.[52]

Junkers had been given the go-ahead for production of the Jumo 004 engines in June 1943.[53] The main problem faced by Junkers was the lack of strategically important raw materials. Whereas the prototype engines had been constructed without concern for the amount of materials used, there were severe restrictions placed on the production model. Less reliable materials and construction techniques were employed in the production engines and there were corresponding failures in the power plants. For example, in the original engine the combustion chamber was made of a high-alloy steel but the production model was built with a mild steel sprayed with an aluminum coating.[54] The use of *Ersatz* materials constrained the Junkers Jumo 004 to a short ten-hour operational life before complete overhauls were necessary. Although the engine was improved and made more reliable, the lack of important materials led to a shortened operational life for the engine during its entire career as a Luftwaffe power plant. Subsequently, there was a severe shortage of engines from Junkers for the Me 262 program, and it was not until April 1944 that there were enough engines for the waiting Me 262s for the formation of a Luftwaffe testing unit, *Erprobungskommando (Ekdo)* 262.

The factory testing was complete and sixteen Me 262s were delivered to *Ekdo* 262, based at Lechfeld.[55] Although the unit was formed in December 1943, the planes were not ready and were not delivered until April 1944. *Ekdo* 262 was responsible for putting the Me 262 through its paces and evaluating the aircraft for use in combat situations. Composed of former Me 110 pilots (the Me 110 was a twin-engine heavy fighter), they were all acquainted with both multiple-engine and instrument flying. Captain Werner Thierfelder was selected as the commander and the pilots began their initialization with the Me 262. Immediate concerns arose relative to the aircraft and its Junkers engines, which were still unreliable. The pilots were only allowed ten hours flight time before each engine had to undergo complete overhaul. However, flight testing of the Me 262 went ahead and the pilots identified many improvements for the new plane. In their reports, there was concern regarding the construction of the plane itself and the poor performance of the engines at low speeds, specifically on take off and landing.[56]

The *Ekdo* pilots suggested immediate improvements to the airframe. Due to the plane's high speeds, new difficulties arose that were unanticipated. Initially, the Me 262s were delivered with fabric-covered control surfaces. This was common practice on all Messerschmitt planes, and no difficulties were expected. Unfortunately, at speeds above 750 km/h, the fabric control surfaces would flutter or bubble disrupting airflow, causing the pilot to lose control.[57] Immediate provisions were taken to rectify the problem. However, according to Messerschmitt, the Me 262 was not ready for front-line operations due to the difficulties that were being discovered and the changes that were suggested by *Ekdo* 262.[58] The plane was cutting-edge technology and had to be modified as problems

arose. The process was time-consuming as the pilots found problems and the Messerschmitt plant worked quickly to fix them. The airframe was steadily improved through the suggestions of the *Ekdo* pilots. Messerschmitt was able to remedy many of the manufacturing problems in the aircraft before production began in earnest.

There were two areas which continued to concern the pilots. Coincidentally, both were out of Messerschmitt's sphere of influence and could not be substantially improved. One was the Junkers engines; the other was the Opel undercarriage. Junkers did improve on the original Jumo 004A engine and delivered the first Jumo 004B-1 in June 1943. However, Junkers lacked the necessary materials to build the engine. The Jumo 004C was manufactured with air-cooled turbine blades. The Jumo 004B-4 series employed this construction method and was produced and delivered beginning in December 1944.[59] This engine was an innovation because it used no nickel and only 2.2 kg of chrome in each engine.[60] The engine's high altitude performance was improved a great deal but the low-speed characteristics remained unchanged. To the pilot's chagrin, the engines performed poorly on take-off and landing throughout the operational life of the Junker's engines. This caused a number of problems for the Me 262 pilots and eventually they required fighter escort, provided by *JG* 54 (piston engine Me 109s), during take-off and landing. The Me 109s protected the vulnerable jets from Allied fighters over German air space when the Me 262s took-off and landed. Still, a number of jets were lost to Allied fighters because of the limitations of the engines at low speeds.

In addition, there were serious problems with the landing gear developed by Opel. The nose gear was notoriously weak and there were many Me 262s lost to accidents on the ground. The problem stemmed from the manufacturing methods of the undercarriage.

Instead of using machine forging for the nosewheel shaft, seamless steel tubing was used. The plane's nose gear was prone to collapse while being towed on the ground or when the pilot made too heavy a landing. A full 34 percent of all Me 262 accidents were attributed to undercarriage failure, which is comparable to 33 percent losses due to engine failure.[61] Therefore, almost two-thirds of losses due to accidents could have been avoided with more attention paid to the construction of the landing gear and the engines. And, there were more Me 262s lost to accidents than to actual combat. Had more attention been paid to these two systems, the Luftwaffe would have had more machines available for combat operations.

While *Ekdo* 262 was testing the Me 262 to prepare it for combat operations, Hitler again interfered with its technological development. Incensed that his order to produce the Me 262 as a bomber was not followed, he demanded that all Me 262s were to be constructed as bombers.[62] But, it is important to mention that *Ekdo* 262 was not even testing armed Me 262s; they were still trying to iron out the bugs in the aircraft and its engines. Also, there was no suitable bomb sight for the new plane. All bombing with the Me 262 was done by guesswork. Messerschmitt, although he had said that the bomb racks would be ready for December 1943, did not have the equipment designed for bomb installation. Coincidentally, on 28 May 1944, the same day that Göring passed on the message from Hitler that the Me 262 was not to be discussed as anything but a high-speed bomber, the first flight was made with a bomb-carrying Me 262. The Me 262 V10 took off carrying one 250kg bomb on an ETC 503 bomb rack.[63] The installation of bomb racks and bombs hampered the speed of the plane, the only clear advantage it possessed. New bomb racks, called *Wikingerschiff* (Viking Ship) for their shape, were designed and

tested for the Me 262. Hitler's idea was sound. He intended the Me 262 to be used as a nuisance bomber against the imminent Allied invasion of the continent, envisioning the Me 262 flying in to the landing site, dropping bombs in the confusion, and flying out using its superior speed to escape without damage. However, due to technological delays, no Me 262s were ready for the invasion on 6 June 1944.

In June, as the Allies gained a foothold on the Continent, the Me 262 went into series production. The problems with the engines and landing gear were not corrected, there was neither time nor materials available. The Luftwaffe required a substantially superior fighter to counter the Allies and had to rely on Messerschmitt's creation. Although it was not perfect, the Me 262 was constructed in the hopes that it would prove to be a decisive weapon against Allied bombers in the air, and Allied targets on the ground. The Me 262 in the end was rushed into production in spite of its technological problems because there was no other option. The Luftwaffe was desperate and had to gamble with any plane that had even the slightest potential of countering overwhelming Allied superiority in the air.

[1] Vincent Orange, "Fortunate Fascist Failures: The Case of the Heinkel Fighters" in Historical News, No. 47 (December, 1983), pp. 7-13.

[2] Ibid, specifically the He 112 which was dropped in favor of the Me 110 for fighter production before the war. p. 9.

[3] See P.J. McMahon, Aircraft Propulsion, (London: Pitman Publishing, 1971). Specifically the chapters "Propulsion Cycles" pp. 75-117, and "The Piston Aero-Engine" pp.308-29.

[4] From J. Richard Smith and Eddie Creek, Me 262, (West Sussex: Classic Publications, 1997), Volume 1, pp. 38-40.

[5] Joachim Dressel, Manfred Griehl, and Jochen Menke, Heinkel He 280, the World's First Jet Aircraft, (West Chester, Pa: Schiffer Military History, 1991), pp. 4-8.

[6] For a complete examination of centrifugal flow vs. axial-flow jets see Brian Nichelson, Early Jet Engines and the Transition from Centrifugal to Axial Compressors: A Case Study in Technological Change, (unpublished dissertation, University of Minnesota, 1988).

[7] D.R. Maguire, "Enemy Jet History" in The Journal of the Royal Aeronautical Society, Vol. 52 (Jan 1948), pp. 76-84.

[8] Walter Boyne and Donald Lopez, "Jet Fighters" in Walter Boyne and Donald Lopez (eds.), The Jet Age, (Washington, D.C.: Smithsonian Institution Press, 1979), pp. 47-68.

[9] Sir Frank Whittle, "The Birth of the Jet Engine in Britain" in Boyne et al, pp. 3-24.

[10] Ibid, p. 14.

[11] Michael Taylor, Jane's Encyclopedia of Aviation, (New York: Crescent Books, 1996), 1996 edition, p.420.

[12] J.R. Smith and Antony Kay, German Aircraft of the Second World War, (London: Putnam, 1972), pp. 293-5.

[13] The He 280 V2 was powered by axial-flow jet engines from Junkers (Jumo 004) by April 1943 (Smith and Kay, pp. 295-6) and Ohain's work was sidelined.

[14] Smith and Kay, pp. 295-6. The decision is dated Autumn 1942, when the HeS 30 could have been a suitable power plant for either jet program (He 280 or Me 262).

[15] Smith and Creek, pp. 45. See also Hans von Ohain, "The Evolution and Future of Aeropropulsion Systems," in Boyne and Lopez, pp. 25-46.

[16] Smith and Creek, pp. 59-69.

[17] Richard Suchenwirth, Historical Turning Points in the German Air Force War Effort, USAF Historical Studies Number 189 (New York: Arno Press, 1968), pp. 50-1.

[18] Ibid, pp. 51-2.

[19] Manfred Boehme, JG 7: The World's First Jet Fighter Unit 1944/1945, (Atglen, Pa: Schiffer Military History, 1992), pp. 22-3. See also, Smith and Creek, pp. 89, 96-7.

[20] Ibid.

[21] Smith and Kay, pp. 296. See also Dressel et al, pp.13-16.

[22] Smith and Kay, pp. 294.

[23] Smith and Creek, pp. 72, 76-7.

[24] Ibid, p. 86.

[25] Ibid.

[26] Boyne, Appendix B, p. 157, see also Smith and Creek, pp. 68, 72 who argue that the prototypes were completed by February and March.

[27] Hugh Morgan, Me 262 Stormbird Rising, (London: Osprey Publishing, 1994), pp. 20-1.

[28] Smith and Creek, p. 47.

[29] Ibid.

[30] Ibid, p. 49.

[31] Ibid, p.88, see also Boehme, pp. 20-1.

[32] Flight report reprinted in Boehme, pp. 20-1.

[33] Boyne, p. 30.

[34] Smith and Creek, p. 89.

[35] Messerschmitt documents dated 4 March 1943 supplied to this author by Manfred Boehme from his private collection.

[36] Imperial War Museum documents (hereafter cited as IWM documents) from the Milch Collection, Volume 36, dated 22 March 1943, decision of the Me 262 over the He 280.

[37] Smith and Creek, p. 99.

[38] IWM Milch documents, Volume 20, 25 May 1943. Conference on the Me 209 vs. the Me 262.

[39] For a complete transcript of the Galland report see Smith and Creek, p. 108, for the conference notes see IWM Milch Documents Volume 20, 25 May 1943.

[40] Smith and Creek, p.113.

[41] IWM Milch Documents, Volume 20, 25 May 1943.

[42] IWM Milch documents, Volume 21, 22 June 1943.

[43] Ibid, the numbers projected for the months following November 1944 were 40, 90, 140, 180, and up to 400 by September 1945.

[44] IWM Milch Documents, Messerschmitt to the General Director (Wagner) of Opel thanking him for the successful completion of the undercarriage and that it was ready for use in the Me 262. 20 March 1944.

[45] Smith and Kay, pp. 536-7.

[46] Smith and Creek, pp. 120-1.

[47] Ibid, pp. 143, 146.

[48] IWM Milch Documents, Volume 24, 13 August 1943.

[49] Boyne, p. 158.

[50] See Morgan, chapter four, "Dispersal of Production Facilities," pp. 46-57.

[51] Boehme, p. 40. See also Adolf Galland, The First and the Last, (London: Henry Holt and Company, 1954), pp. 277-8.

[52] For an interesting analysis of the Me 262's technological specifications see John Foster Jr., "Design Analysis of the Messerschmitt Me-262 Jet Fighter, Part I – The Airframe," in Aviation, Volume 44, October 1945, pp. 115-35.

[53] Smith and Kay, pp. 536-7.

[54] T.A. Heppenheimer, "Jet Plane" in Invention and Technology, (Fall 1993), pp. 45-57. See also Jefferey Ethell and Alfred Price, World War II Fighting Jets, (Annapolis, Md.: naval institute Press, 1994), pp. 19-20.

[55] Boyne, p. 158. But Smith and Creek argue that there was only one Me 262 (V8) delivered to *Ekdo* 262 in April, and only two followed the next month. This is supported by the production figures presented by Adolf Galland, The Development of Jet and Rocket Airplanes in Germany 1938-1945, Extracted from European Contributions to the History of world War II, 1939-1945, Monograph No. 7, Development and Planning in the German Air Force, Part I (the Von Rhoden Project), (Maxwell Air Force Base, Alabama: Foreign Documents Section, Air University Library, 1951), p.41, which states that only one Me 262 was produced in March, none in April and eight in May.

[56] Boehme, pp. 57-8.

[57] Ibid, pp. 47-9.

[58] Ibid, pp. 48-9. Boehme mentions a Messerschmitt document from 10 August 1944.

[59] For a complete discussion of the production Junkers Jumo 004 engine see John Foster Jr., "Design Analysis of the Me-262 Jet Fighter, Part II - The Power Plant," in Aviation, Volume 44, November 1945, pp. 115-30. In it he gives a complete technical analysis of the Jumo 004 engine that the Germans used in the Me 262.

[60] Morgan, pp. 22-25.

[61] Boyne, pp. 41-3.

[62] IWM Milch Documents, Volume 58, 28 May, 1944.

[63] Smith and Creek, p. 183.

Chapter III

Production

The Me 262 entered production with a number of flaws. The engines were difficult to control, performed poorly at low speeds, and had to be completely rebuilt after only a few hours operational flight time. The airframe was plagued by the landing gear, especially the nose wheel, which had a tendency to collapse if handled too roughly. The problems with the Me 262 led to many non-combat accidents and deaths. However, it was still the most technologically advanced plane in combat during World War II. In the hands of the experts who were chosen to fly it, it was a deadly weapon. And, in a time of despair for the Luftwaffe, it was the last and best chance to gain air superiority, or at least challenge the domination of the Allies in the air. The Me 262 was a ray of light in a dark and highly destructive war for the Germans. Therefore, the Me 262 was rushed into production, complete with its many flaws, and sent to the front. In addition, there were a number of outside factors that directly influenced production of the Me 262. Although a number of influences have been given undue credit by historians, there were some variables that did negatively impact production of the jet in Germany. The last best hope for the Luftwaffe was embodied in a plane with serious technological problems and severely limited production schedules. The Me 262 was the best chance the Luftwaffe had.

The foundation for the production of the German jet program, and the entire Luftwaffe, began on 18 October 1936, when Adolf Hitler issued a decree that made Hermann Göring the commissioner of the Four-Year Plan.[1] The plan was initiated to stockpile raw materials for the buildup of Germany's armed forces. Germany lacked many materials required in the production of arms and armor and Göring was put in charge, regardless of cost, of gathering up the necessary materials for both "(the) German army must be ready for action in four years," and " (the) German economy must be ready for war in four years."[2] The plan concentrated on two areas, supplementing the resources of Germany such as coal and oil, and supplying Germany with materials it did not produce on its own such as rubber and various metals. For the production of planes in particular, the plan focused on importing bauxite (essential for the production of aluminum), of which Germany only produced 2.3% of the world's supply. In addition, the plan was responsible for gathering nickel, chrome, titanium, and molybdenum, none of which were produced in Germany.[3] All of these precious metals, integral to the German jet program, had to be imported. It is important to note that the eventual enemies of Germany produced almost all of the world's supply of these important metals. The combined output of the US, USSR, and Britain of chrome was 58.5% of the world's supply, of molybdenum 92.6%, nickel 90.6%, and titanium 73.1%, whereas Germany produced none of these metals naturally; all had to be imported. When Germany went to war against the Allies, practically all of the world's supply of the important metals were lost to the German war effort.[4]

In addition to the 3.1 million tons of oil produced by the Fischer-Tropsch refinery, the program also set up the construction of ten synthetic plants to produce sufficient

quantities of oil and oil products to keep the German war machine running.[5] It was not until the Allied bombing campaign began in earnest against the synthetic oil plants that the Germans faced a pinch in their oil supplies.

There was a desperate shortage of the above-mentioned metals in Germany. Metals such as nickel, chrome, and molybdenum were necessary for the construction of the production Junkers Jumo 004 jet engines. These metals were very scarce in Germany during wartime. But, thanks to the Four-Year Plan, stockpiles were set up for the future of German aviation. Turkey exported chrome to Germany, but nickel and molybdenum (both indigenous to North America – Canada produced 87% of the World's nickel ore and the US produced 92.4% of the world's molybdenum[6]) were in very short supply in Germany. Therefore, even though the pre-war plan to acquire these metals was a move in the right direction, the shortages became acute after the war started. And, fighting against the Allies who held a virtual monopoly on the materials needed, the Germans were unable to obtain further shipments. The Germans were able to secure resources from their Russian allies before 1941 under the Non-Aggression Pact of 1939; Germany gained 70% of its chrome imports and one-third of its oil imports from Russia in 1940.[7] It is noteworthy that the Germans were able to gain resources through military expansion, bauxite (for the production of aluminum) from France, oil from Rumania, and (purchased) iron from Sweden[8], but the materials for the production of the Me 262 and subsequent jet aircraft were in very short supply – supplies that would only diminish during the course of the war.

Therefore, a new program was instituted to husband the precious raw materials of the Reich. Albert Speer was appointed the Minister of Armaments and Production early

in 1942.[9] After initial conflict with Göring, Speer was able to increase fighter production to higher levels than ever before realized within the Reich. Speer was responsible for streamlining the German war economy so that production could be increased. In order to do this he established an efficient system for ordering military hardware and setting up production schedules. He was also responsible for husbanding the dwindling supply of raw materials in Germany in order to reduce wastage. Finally, he was able to rationalize the war economy, and removed military officials from supervisory positions over the munitions plants. This final move directly increased the efficiency within German factories.[10]

In regards to the production of fighter aircraft, Speer was responsible for the creation of the *Jägerstab* (Fighter Staff) on 1 March 1944. By centralizing all fighter aircraft production efficiency was increased through co-operation.[11] Fighter planes received top priority for materials and the Me 262 was eventually provided with all the necessary materials for production.[12] However, supplies were dwindling, and even the Me 262 had to utilize substitute materials in its final construction. In the initial prototypes, there were no restrictions placed on the use of scarce raw materials. Although it is unclear how much restricted material the original prototype engines used, according to Dr. Anselm Franz, designer of the Jumo 004, the production engine had to be redesigned according to the availability of materials.[13] Therefore, with the development of the Junkers Jumo 004B-4 engines in December 1944, no nickel and only 2.2 kg of chrome were used in the manufacture of each engine. But the designers were forced to use *Ersatz* materials in their final construction such as aluminum coated mild-steel for high-temperature steel. The lack of raw materials led to severe constraints in the

operational life of the engines during the course of the war. And, in the end, it was the lack of reliable engines that hampered the effectiveness of the German jet in combat. However, there was no alternative to the lack of raw materials for the production of the jet engines within Germany. The problems with the jet engine was one example of the constraints due to the dearth of raw materials.

In addition, other programs interfered with the production of the Me 262. Although the Me 262 program was eventually the primary recipient of all necessary materials, other projects squandered the Reich's precious resources. The Me 209 project took up important time and energy that might have been used more effectively in the early development of the Me 262. But, the Me 262 was not seriously affected by the Me 209 program in that the Me 262 had not been completely tested prior to the dissolution of the Me 209 project. In the end, the Me 209 only took up time while the *RLM* argued the relative advantages of each of the Messerschmitt planes. The Me 209 was dropped in favor of the Me 262, and in the end the Me 262 was completed according to the developmental timeline of its engines.[14]

Another aeronautical engineering program within Germany used up valuable resources with dubious results. Arguably, the rocket program at Peenemünde had a directly negative impact on German jets.[15] The rockets did take up a lot of manpower and time for their negligible effects on the Allies, but the German Army's retaliation weapons did not directly influence the jets. The rocket program began in earnest in July 1944 and as many as 600 A-4 (V2) rockets were delivered per month by September.[16] The rockets were intended to replace German bomber production, with unmanned bombs to retaliate against the Allies. With the successful V- weapons, the Germans had no need

for bombers, and could concentrate all their aircraft production on defensive fighters such as the Me 262. The V2 was to be the offensive weapon against Britain, to force the British into a state of panic.[17] In the Nordhausen underground bunker, the V2s were built side-by-side with the Junkers Jumo 004 engines for the Me 262 fighter planes.[18] Unfortunately for the Germans, the V2 rocket was not nearly as successful as envisioned. Of the approximately six thousand V2s constructed between July 1944 and April 1945, only half were actually launched: 1,054 V2s fell on British soil, and 1,675 fell on the Continent as the Germans launched the weapon to stem the Allied advance across Europe.[19] In the end, the V2 was as ineffective as the other German wonder weapons; it did not cause significant damage or win the war.

Production of the Me 262 was also dependant on the availability of manpower in Germany. Unskilled laborers were drawn from non-combatant Germans as well as prisoners-of-war and foreign laborers, which were in ample supply throughout the war. But, skilled aircraft designers and machinists were in short supply as is shown from the numerous requests submitted by Willy Messerschmitt for skilled laborers.[20] The lack of skilled engineers led to faulty construction through both inadequacy and sabotage, and the planes consequently suffered. Many aircraft delivered to operational units required extensive modification and repair prior to combat; some were even damaged or destroyed before they arrived at their destination because of poor craftsmanship. The lack of skilled labor affected all German military equipment in the final stages of the war, not just the Me 262.

Another major problem faced by the Luftwaffe was a lack of fuel. Although the Me 262 ran on diesel, bottlenecks created by Allied bombing often prevented fuel from

reaching its assigned units.[21] Added to this was the Allied bombing of the Böhlen and Merseburg oil refineries in March 1945, which severely reduced the output of the Me 262's J2 fuel supplies.[22] However, in contrast to the rest of the Luftwaffe planes that relied on high-grade aviation fuel, the Me 262 squadrons did not suffer from a significant lack of fuel during the last months of the war. Whereas the stockpiles of aviation fuel were all but depleted by December 1944, with only 44,000 tons for operations, German supply and stockpiles of J2 diesel fuel for the Me 262 were not severely restricted by Allied bombing. Although the jet program used almost as much J2 as was produced in 1944-45, there were stockpiles of over 100,000 tons of diesel in reserve at the end of the war.[23]

Another problem faced by the Luftwaffe in the closing stages of the war was a lack of pilots. However, the jet program did not suffer for need of experienced pilots, as has been argued.[24] The Luftwaffe on the whole did suffer from a lack of training, especially in the areas of familiarity with combat aircraft and instrument flying, but the Me 262 pilots (specifically *JV* 44) were all experienced fighter pilots under the command of one of the greatest German aces, Adolf Galland. Overall, the Luftwaffe pilots suffered because of Allied air superiority and the losses were made up with inexperienced crews.[25] These inexperienced crews were spending ever less time in training and operational testing before entering combat as compared to their Allied counterparts, and most flew in machines that were outclassed. But, this was not the case for the jet pilots, who were chosen from experienced pilots for testing and with the formation of jet squadrons. German jet pilots were the most experienced bomber and fighter pilots of the Reich, and only had to concentrate on familiarization with the new machines. Although Allied air

superiority made even the Me 262 vulnerable in the air – Me 262s frequently flew against 1:10 odds– the jet pilots were in a better position to make an impact with the jet than the inexperienced pilots in obsolete planes. And, as mentioned by Galland, many of the Me 262 pilots were volunteers who came out of retirement and from other squadrons without official transfers to fly the revolutionary new jet plane.[26] Therefore, even though the Luftwaffe suffered from a lack of experienced pilots in the closing stages of the war, the jet program attracted and received an abundance of experienced and effective pilots. In the end, there were often more pilots than machines in the operational jet units.

The biggest problem confronting the Germans was the Allies. The material superiority of the Allies contributed to the downfall of the Luftwaffe on a number of levels. The numerical superiority of Allied fighters meant that a large number of German planes were shot down. This led to the lack of pilots mentioned above. In the final months of the war, the Germans were producing far more fighter planes than ever before: between 2,500 and 3,300 fighter planes (single- and twin-engine) per month.[27] However, the Allies (British and Americans) combined were able to manufacture over 9,000 fighters alone per month in the last year of the war.[28] It must be remembered that only 1,294 of the German aircraft built in the final year were jets, all others were planes that were inferior to the comparable Allied planes. Clearly, the Allies were in command of the air through numerical superiority.

In addition to the fighters, the Allies were producing bombers at staggering rates: over 3,500 per month.[29] The Allied bombers faced fewer numbers of German defenders each day as their fuel was constricted. The bombers became virtually immune from the defenses of the Germans through sheer numerical superiority. With loss rates of less than

three per cent on average during the last year of the war,[30] the Allies stepped up their escorted bomber raids deep into the heart of Germany. The Germans were unable to defend their oil plants and transportation centers against Allied air superiority. The Allies, through their actions, crushed the Luftwaffe on the ground by destroying their planes at the manufacturing plants and fuel at the refineries. Eventually, the Allies enjoyed mastery of the air through quantitative superiority.

One last attempt was made in March 1945 to streamline supply for the Me 262 program. Hitler ordered that procurement for the Me 262 was to have top priority within the Reich and subjected the jet program to the control of the *SS*. *Obergruppenführer* Hans Kammler became the *Bevöllmachtigter der Führer für Strahlflugzeuge* (Hitler's Plenipotentiary for Jet Aircraft), and was ordered to take over the supervision of jet construction from Speer.[31] Kammler had been in charge of the V2 rocket program and had overseen the rocket *Blitz* of London during the fall of 1944. He was instructed to supervise further construction of the jet fighters – Me 262 and He 162 – and make sure they reached their assigned units. In the final month of production, 231 Me 262s were handed over to the Luftwaffe, but only 120 were actually delivered to operational units. The assignment of Kammler to head jet procurement was not an answer to a problem, it was simply a quick fix for the lack of leadership Hitler perceived in the final stages of the war. In the end, it was irrelevant who was in charge of the jets; the war was already lost.

There were a number of factors that had a direct influence on the German jet program. In the end, the decisions surrounding the German jet program were not as negative as is often argued. However, the German jet program did suffer from both the lack of technology and Allied action. The development of the technology was influenced

as early as 1939 when the Germans cut themselves off from the world's supply of vital raw materials that were necessary for jet components. When the Germans began World War II, they could only use what they had collected from the Four-Year Plan, the supplies they still received from their allies (including Russia up to 1941), and what they could make or take. However, many of the vital raw materials for the jet program quickly became unavailable. Then the Allies came with their bomber fleets, first the British at night, then the Americans during the day. Although the Germans were able to deal with them initially, the development by the Americans of the P-51 Mustang with long-range capabilities, operational in spring 1944, spelled doom for the Luftwaffe. The Allies were able to whittle away at the precious resources of the Reich while Luftwaffe losses continued to mount. The Luftwaffe lost not only machines, which could be replaced, but also the limited number of pilots which were in short supply to begin with. The Allies effectively targeted the resources of the Reich in order to keep the pilots that were available on the ground. The oil campaigns of Bomber Command and the USAAF constricted the flow of aviation fuel to the combat squadrons so that, in the end, there was no gas for the planes. The choice to raid German oil production was made by the Allies and was a major component in the months leading up to Normandy.[32] In the final year of the war, the Allies concentrated about fifteen per cent of all bombs on German oil production, dropping over 215,000 tons of explosives on refineries.[33] The repeated attacks on German oil targets reduced the output of the refineries while at the same time more fuel was being used to combat the Allied raids. In the end, the Allies defeated the Germans by reducing fuel production to almost nothing by the start of 1945.[34]

The Allies also targeted the aircraft factories in order to cut off the flow of machines to the Luftwaffe. The Allies concentrated two per cent of all its bombing raids on German aircraft factories with a total of 38,220 tons of bombs falling on the targets during 1944.[35] Lastly, the Allies bombed the transportation networks so that the necessary supplies could not reach the Luftwaffe units and they were starved for spare parts and supplies. The German transportation system was the hardest hit with one-third of all Allied bombs falling on rail networks and autobahns.[36] And, the Allies were all but immune to German counter-attacks. The German fighters that were available were hopelessly outclassed qualitatively and quantitatively in the closing stages of the war. The only encouraging situation in Germany was the jet wonder weapon. Without a serious lack of fuel, and with enough pilots, all that the few jet units lacked was sufficient numbers of machines. However, the Allies prevailed against a technologically superior enemy with quantity. The Germans were never in a position to send up more than fifty Me 262s against an overwhelming (over 2,000) Allied force,[37] and the jets lost to numerically superior forces.

Amidst the strategic crises of pilots, fuel, raw materials, and Allied bombing, the production of Me 262 A-1as began. In the summer of 1944 construction of the jet began in earnest. The accelerated production schedule tried to correct problems with the Me 262 as they were uncovered by *Ekdo* 262, such as the fabric-covered control surfaces, but some of the problems continued without repair. The most glaring examples were the engines and the landing gear. It was not until December 1944 that a more reliable engine, the Junkers Jumo 004b-4 series, was introduced which lengthened the operational lifetime of the jet plane between maintenance checks.[38] But it is important to note that

series production commenced prior to final testing with *Ekdo* 262. The first Me 262s were delivered to operational squadrons while *Ekdo* 262 was still testing the plane.

Production centers for the Me 262 were almost as interesting as the plane itself. Willy Messerschmitt took advantage of the vast forests surrounding his Augsburg plant and moved production into camouflaged forest factories. The small wooden buildings housed the necessary tools and equipment to produce sub-assemblies for the Me 262. Hidden from the air, the forest factories were an important step in the construction of the German jets. One example of a Messerschmitt forest factory was the plant at Horgau just outside Augsburg. The twenty-one wooden buildings were staffed by 845 workers and produced nose and tail sections for the Me 262. The roofs of the buildings were painted green, and were covered by the trees making them invisible from the air. It was not until after the end of the war that the Allies learned the exact location of the elusive forest factories.[39] But, the forest factories were vulnerable in other ways. The Allies were able to disrupt transport to and from the factories, particularly German rail transport. The dispersed factories relied more heavily on the fragile German transportation networks.

Other production centers were designed to withstand Allied bombardment rather than hide from it. Two kinds of underground factories were used that were impervious to Allied raids. The Germans initially used abandoned mines and mountain tunnels to relocate production to areas safe from Allied bombing. However, conditions in these workshops were poor at best; they suffered from a lack of heat, light, ventilation and sanitation. One of the main problems was with handling of materials and workers. In abandoned mines, vertical elevators were used to transport materials and workers to the shop area. In the mines and tunnels that had horizontal entrances, there was a danger

from cave-ins. Further, few of the underground factories were lined with concrete and dust and falling rock were a constant hazard.[40] Regardless of the conditions, the underground factories were almost immune to Allied bombing and production was subsequently moved underground. The German war economy was prioritized and following the rocket program, the Me 262 was the next on the list to be moved underground.[41]

In addition to these "natural" facilities, there were man-made bunkers proposed to house production. Three massive bunkers for use by the Messerschmitt works began construction near Landsberg am Lech. Code named *Ringeltaube* (Wood Pigeon), the three bunkers were designed as facilities for the manufacture of Me 262s from start to finish. The bunkers were designed as multi-level, 1,000,000 square-foot production centers that could not only accommodate trains delivering materials but were close enough to Autobahns for immediate flight testing of finished Me 262s.[42] It is interesting that the Germans initially dispersed production from larger companies to smaller factories, specifically forest factories and underground plants, but at the end of the war planned for the re-centralization of production to massive underground bunkers. Regardless, the Messerschmitt bunkers were not able to deliver any planes before the end of the war. The Herculean efforts to centralize production in massive bunkers did not pay off for the jet program; no Me 262s were produced in the Landsberg bunkers, which were not even complete by May 1945. And, according to the United States Strategic bombing Survey, the greatest achievement of the Allied bombing effort was the response of the Germans to evade it. In the end the Germans wasted manpower and material building bomb proof shelters for the production of important war material. According to

the USSBS, "The aircraft industry was blasted out of its well planned plants in established industrial centers and forced to disperse to hundreds of makeshift factories all over Germany. It burrowed under the ground, fled to wooden sheds in the forests, and finally, at the end of the war, was in the process of covering itself with mountains of reinforced concrete."[43]

The production schedule for the Me 262 was initially set by Messerschmitt at the first hundred planes by the middle of May 1944 with 60 Me 262s a month thereafter until November, when an expanded production schedule would commence.[44] After November 1944 production would increase to a maximum of 400 planes a month by September 1945.[45] However, due to a lack of engines from the Junkers company, construction of the planned Me 262s was severely curtailed and only nine production machines were built prior to the Allied invasion.[46] Incidentally, the first 100 Me 262s were not complete before the middle of August 1944.[47] The planes were not available because of a lack of engines and the many modifications advised by *Ekdo* 262, which was ordered specifically to find and suggest modifications on the novel jet.

In addition to the difficult production schedules, the Messerschmitt company also had to deal with and deliver the plane as a bomber. By order of Adolf Hitler, the Me 262 was supposed to be built as a high-speed bomber, not a fighter.[48] The Me 262 was seen by Hitler as his invulnerable weapon to disrupt the Allied landings and supply lines. But it must be remembered that there were no Me 262 available for operations against the Allies on D-Day. And the lack of bomb racks or suitable bomb sights prevented the Me 262 from being much more than a nuisance bomber even when it was eventually used in that role.

The Me 262 was finally cleared for operations and *KG(J)* 51 (*Kampfgeschwader* (Jäger)– Bombing Group (Fighter)) was formed on 3 June 1944.[49] The unit began conversion training from Messerschmitt Me 410s (twin-engine fighter/bombers) to their new Me 262 beginning on 20 June 1944. *KG(J)* 51 was a *Jabo* (fighter/bomber) squadron equipped with bomb-carrying Me 262s. With only two of the four 30mm cannons, and two 250kg bombs, the role of *KG(J)* 51 was to provide tactical bombing for land forces. Although the bombing was not at all accurate, the pilots flew missions against tactically important targets such as bridges and the supply lines of the advancing Allies. There were other *Jabo* units formed with the Me 262, but only one, *KG(J)* 54 was operational before the end of the war.

Initially, besides the Me 262s that were delivered to *Ekdo* 262, all the Me 262s produced were equipped with bomb racks. All discussion of the Me 262 as a fighter had been forbidden by Hitler; he insisted that the Me 262 was his fast bomber.[50] It was not until 20 August that Hitler allowed one of every twenty Me 262 to be produced as a fighter, and thereafter, on 20 September, Hitler agreed with Speer that production should be shifted back to the fighter sector.[51] Due to increased production the Messerschmitt Me 262 was finally assigned to an operational fighter squadron on 26 September 1944. During testing, *Ekdo* 262 had been busy flying sorties against Allied reconnaissance planes, using the superior speed of the Me 262 to catch and down high-flying Mosquitos, Spitfires, and Lightnings. Galland was finally granted the power to form a fighter squadron made up of pilots from *Ekdo* 262 and *ZG* 26 (*Zerstörergeschwader* – Destroyer Unit). The unit was designated *JG* 6 (*Jagdgeschwader*) and based at Achmer.[52]

In November Hitler finally released the Me 262 for fighter production.[53] The jet had proven itself against enemy planes and it was clear that the Me 262 was not suited for bombing. Hitler still insisted that the Me 262 be capable of carrying at least one 250kg bomb, but this order was expressly ignored by Messerschmitt and the operational units that flew the jet fighter. The release of the Me 262 was attributed to the completion of another jet project built specifically for bombing. The first of the Arado Ar 234 jet bombers were coming off the production line, and Hitler had acquired his high-speed bomber. The Ar 234 was the second operational jet aircraft of the German jet program.

Fitted with BMW 003 engines, the first two operational Ar 234s were delivered to 1./*Versuchsverband Ob.d.L* (reconnaissance group *Oberbefehlshaber der Luftwaffe* (C-in-C of the Luftwaffe)) in July 1944.[54] These machines were set up to fly photographic missions and were able to evade enemy aircraft with their superior speed. The BMW engines were no more reliable than the Junkers engines and had to be completely overhauled after only ten hours. But, the operational Ar 234 was similar to the Me 262 in that it could evade Allied aircraft because of its amazing speeds in excess of 740 km/h.

Between September and November 1944, three additional Ar 234 reconnaissance groups were formed, designated *Sonderkommando Götz, Hecht,* and *Sperling*.[55] They all employed the new production Ar 234B-1, a twin-engine high-wing jet bomber. All three were disbanded in January 1945, then reformed and renamed 1./(F) 100, 1./(F) 123 (based at Rheine), and 1./(F) 33 (based in Denmark).

The first Ar 234 bombing group was not operational until the Ardennes Offensive in December 1944 when *KG* 76 flew bombing missions against the Allies. Sorties

increased as planes became available and *KG* 76 flew bombing missions until the close of hostilities. The two most important contributions of *KG* 76 were the bombing of the bridge at Remagen in March 1945, and the combined jet operations of Ar 234s and Me 262 – providing fighter support – in the same attack.[56] The Ar 234 was refined throughout the war with five prototypes built as four-engine bombers (with four BMW 003s) and designated Ar 234C. But, including the prototypes, only 214 Ar 234s were built before the end of the war.[57]

During this time, the Me 262 also was tested with a number of weapons and engine configurations. A two-seat trainer, Me 262 B-1a, was constructed and adapted, with the addition of radar, to the role of night fighter – Me 262 B1a/U1.[58] In addition to the Me 262 A-1a, the original fighter, and the Me 262 A-1a *Jabo* fighter/ bomber, a pure fighter version, the Me 262 A-1a/Ua, was added which incorporated six guns of varying caliber. It carried two Mk 108 cannons (30mm), two Mk 103 (30mm), and two Mk 151/20 (20mm); an amazing firepower combination. Later variants included fitting one large cannon to each of two prototypes, one had a 50mm, the other a single 55mm cannon in the nose; both models were designated Me 262 A-1a/U4. Other versions were tested with increased bomb loads including the Me 262 A-2a *Blitzbomber,* which incorporated only two Mk 108 cannon, but carried either two 250kg or one 500kg bomb. The Me 262 A-2a/U2 was designed as a bomber and instead of guns in the nose added a prone bomb aimer in a glass nose cone. The final variants to see operational testing were the Me 262 C-2b *Heimatschützer* (Home Defender) I and II. The first was tested with the original two Jumo 004 engines as well as a Walter HWK 509 A-2 rocket engine installed in the tail to aid take off and initial climb. The second variant incorporated the BMW 003 TLR

composite engines, which housed BMW P.3395 RATO units in the same nacelle as the axial-flow engines. The combination of jet and rocket engines shortened the take off and climb of the interceptor when it took off to engage Allied planes.[59] Although only two models, the Me 262 A-1a (including the *Jabo*) and B-1a/U1 were combat operational, there were many projects in testing for increased performance and effectiveness of the jet fighter. But, by the end of the war only 1,294 Me 262s had been built for the Luftwaffe, and half of those in the final three months of production.[60] There were simply too few Me 262 jet planes produced to significantly affect the material superiority of the Allies in the closing stages of the war.

The final jet program that Germany introduced during World War II was the Heinkel He 162. Designed as a last-ditch effort to put jet technology into use, it was designed and flown in a matter of weeks. Heinkel proposed the plans for the aircraft in September 1944 and it was unofficially designated Salamander, after the creature with the mythical ability to live through fire.[61] The first prototype flew on 6 December 1944 and, indicative of the Luftwaffe's predicament, planning, pre-production, and production was ordered immediately. Using a minimum of strategically important raw materials, and extensive use of wood and plywood, the single-seat single-engine (BMW 003) He 162 was designed to be built quickly and easily in the shrinking Reich. Production began in January 1945, but only 37 were completed before the end of the war.[62] The only two units to receive the He 162 were *Erprobungskommando* 162, renamed *Einsatzkommando Bär* for its commander Oberstleutnant Heinz Bär, and *JG* 1. The He 162 was not involved in many combats with Allied pilots, but one report, from a P-51 Mustang pilot, stated that the He 162 was very maneuverable and faster than the Allied fighter.[63] It was

designed as a fighter – one not only easy to produce but also easy to fly by even the most inexperienced pilots; hence the official *RLM* designation *Volksjäger* (people's fighter). However, it was just as, if not more, temperamental than any Luftwaffe fighter, and its limited availability meant that there were few available for combat. J. R. Smith and Antony Kay argue that there were only 275 (as opposed to Galland's report of 116) completed, but there were another 800 nearly finished at the end of the war.[64]

Therefore, compared to the superiority of Allied material production, the Germans were only able to produce 1624 jet aircraft of all types in the final two years of the war.[65] In 1944 714 jets were constructed (564 Me 262s and 150 Ar 234s) and 910 in 1945 (730 Me 262s, 64 Ar 234s, and 116 He 162s). This is compared to the bomber production of the Allies in which 1,000 bomber raids were common over the Reich. On the most active day, there were only 55 operational Me 262 fighters to turn back more than 2,000 Allied aircraft.[66] It was 10 April 1945, and the Allies controlled the air. In a last-ditch effort, 22 Allied planes were brought down but 27 Me 262s were lost to Allied action, a disaster from which the Luftwaffe never recovered.[67] The jet was too little too late to affect the quantitative superiority of the Allies. The jet fighter units, specifically JV 44, commanded by Galland, continued operations until 3 May 1945, when their airfield was over run by the Americans.[68]

In the end, the Germans did not secure enough raw materials for a long war. And the lack of raw materials was compounded by the material superiority of the Allies. With control of almost all of the natural resources in the world, the Allies were able to build weapons of war at levels unattainable by the Germans. And, in the case of the United States, there was no threat from bombing that the British and Germans faced. Therefore,

the Americans were able to build war machines at liberty, for liberty. The Germans suffered from a lack of foresight and raw materials which led to a lack of defensive capabilities against the overwhelming material superiority of the Allies. Thus, production of the Me 262 was hampered. There were simply not enough engines for the completion of machines for the Luftwaffe. In addition, production and delivery were severely constrained by Allied action. The focus of the Allied bomber campaign was the destruction of the Luftwaffe on the ground. German pilots were shot down and their replacements were not properly trained due to lack of fuel. This in turn produced inexperienced German pilots who were easy targets for Allied fighters. The new pilots were in turn shot down, and the Allied bombers reached their targets, once again destroying valuable German material. The Allies won the air war through material superiority and a lack of German foresight. Production of the Me 262 was subsequently effected by Allied air superiority. The destruction of German resources in turn impacted jet construction. Because of a lack of materials, Me 262s were delivered with severe limitations and flaws that were not corrected throughout its operational life. But the Me 262 was the only operational plane that was qualitatively better than Allied fighters. The Luftwaffe had to rely on their most novel creation, no matter how defective. And in the end, it was no more than a technological marvel; there were not enough Me 262s to make any difference in the air war over Europe.

[1]David Irving, Göring, A Biography, (New York: William Morrow and Company, Inc., 1989), pp. 162-9.
[2] Ibid, p. 167.
[3] I.C.B. Dear (ed.), The Oxford Companion to World War II, (Oxford: Oxford University Press, 1995), p. 931.
[4] Ibid.
[5] Burton Klein, Germany's Economic Preparations for War, (Cambridge, Mass.: Harvard University Press, 1959), p. 39.
[6] Dear, p. 1063.
[7] Klein, p. 63.
[8] Dear, p. 1063, France produced 16.5% of the world's bauxite, taken over by the Germans after the fall of France, p. 932, Romania provided "a large proportion of German oil requirements from 1940 to 1944." And pp. 1092-4, outlines the tonnage of iron imports from Sweden 1939-1944.
[9] Albert Speer, Inside the Third Reich, (New York: The Macmillan Company, 1970), pp. 194-7.
[10] Klein, pp. 220-4.
[11] R.J. Overy, The Air War 1939-1945, (Chelsea, Mi.: Scarborough House, 1980), pp. 158-9.
[12] Edward Zilbert, Albert Speer and the Nazi Ministry of Arms, (London: Associated University Press, 1981), pp. 239-40. See also Hans Ebert, Johann Kaiser, and Klaus Peters, Willy Messerschmitt – Pionier der Luftfahrt und des Leichtbaues, (Bonn: Bernard und Graefe Verlag, 1992), p. 244.
[13] J.R. Smith and Eddie Creek, Me 262, (West Sussex, England: Classic Publications, 1997), Volume I, p. 49.
[14] For the discussion of the Me 262 vs. the Me 209 programs see Imperial War Museum Documents from the Milch Collection, Volume 20, 25 May 1943. See also Chapter II.
[15] Williamson Murray, Strategy for Defeat, The Luftwaffe 1939-1945, (Maxwell Air Force Base, Alabama: Air University Press, 1983), pp. 300-1.
[16] J.R. Smith and Antony Kay, German Aircraft of the Second World War, (London: Putnam, 1972), p. 651. See also Norman Longmate, Hitler's Rockets, (London: Hutchinson, 1985), pp. 109-12.
[17] Longmate, p. 97.
[18] Alfred Price, The Last Year of the Luftwaffe, May 1944 to May 1945, (London: Arms and Armour Press, 1991), p.13.
[19] Smith and Kay, p. 652.
[20] Imperial War Museum, London, England, Milch Documents Collection (hereafter referred to as IWM Milch Documents), Volume 32, 5 January 1944. Messerschmitt Papers Messerschmitt to *RLM*, 30 March 1944 request for more manpower.
[21] David MacIsaac, Strategic Bombing in World War Two, (New York: Garland Publishing, Inc., 1976), p. 76, 78. See also Jesse Edgar (Lt. Colonel (Ret.)) Bombs Away! Thirty Was Enough, A Bombardier's Diary Account of Combat as a Member of a B-17 Crew With the Eighth Air Force, (unpublished), pp. 61-2, 66-76, where he gives a first hand account of bomb missions versus German oil refineries and marshalling yards.
[22] J.R. Smith and Eddie Creek, Me 262, (West Sussex: Classic Publications, 1998), Volume II, p. 401.
[23] The United States Strategic Bombing Survey (USSBS), (New York: Garland Publishing Inc., 1976), Volume I, pp. 8-9, 42-5. See in particular Chart 16, "German Production, Consumption, and Stocks: Aviation Gas, Motor Gasoline, Diesel Oil," p. 43.
[24] Harold Faber (ed.), Luftwaffe: A History, (New York: Times Books, 1977), pp. 269, 272.
[25] Murray, pp. 310-1, 314.
[26] Adolf Galland, The First and the Last, (New York: Henry Holt and Co., 1954), p. 294.
[27] Zilbert, p. 262.
[28] Taken from (USSBS) Volume II, Chapter VI "Effects of bombing on Aircraft Production," pp. 76-93, Figure VI "Comparison of United States and Germany Airplane Production," see also The Strategic Air War Against Germany 1939-1945, Reports of the British Bombing Survey Unit, (London: Frank Cass, 1998), p. 72, British production of all types of aircraft in 1944 was 26,500 planes. See also Overy, p. 77, 120, and 150. Overy presents production figures for the US and Britain for the year 1944, the average is over 9,000 fighters per month and 3,500 bombers per month for the year 1944. Production figures for 1945 can be calculated as 6,500 fighter and almost 4,000 bombers in the last six months of the war in Europe.

[29] Ibid.
[30] The Strategic Air War Against Germany, Chapter 10, " The Fight Against the German Air Defenses," pp. 50-2. Figure 11, 12.
[31] Smith and Creek, pp. 401-3. See also Hugh Morgan, Me 262 Stormbird Rising, (London: Osprey Publishing, 1994), p. 77.
[32] W.W. Rostow, Pre-Invasion Bombing Strategy, (Austin, Tx.: University of Texas Press, 1981), pp. 31-5.
[33] USSBS, Volume I, pp. 82, 41.
[34] Ibid, pp. 42-5.
[35] Ibid, pp. 8, 18.
[36] Ibid, p. 8.
[37] The date was 10 April 1945 as recounted in John Foreman and S.E. Harvey, The Messerschmitt Me 262 Combat Diary, (Surrey, England: Air Research Publications, 1990), pp. 236-44.
[38] Morgan, pp. 23-4.
[39] Ibid, pp. 46-7. See also USSBS, Volume 2, pp. 30-1.
[40]Ibid, p. 27.
[41] Ibid, p. 28.
[42] Ibid, p. 32. See also Morgan, pp. 47-9.
[43] USSBS, Volume 2, p. 32.
[44] IWM Milch Documents, Volume 21, dated 22 June 1943, Messerschmitt to Milch: Production schedule for the Me 262.
[45] Ibid.
[46] Adolf Galland, The Development of Jet and Rocket Planes in Germany 1938-1945, in European Contributions to the History of World War II, 1939-1945, Monograph Number 7, Development and Planning in the German Air Force, Part I of the Von Rohden Monograph. Translated and Annotated by Alida Herling. (Maxwell Air Force Base, Alabama: Foreign Documents Section, Air University Library, 1951), p. 41.
[47] Ibid.
[48] IWM Milch Documents, Volume 63, 2 November 1943, Göring to Messerschmitt et al on the development of the Me 262.
[49] Foreman and Harvey, pp. 38-9.
[50] IWM Milch Documents, Volume 58, dated 28 May 1944, Göring repeats Hitler's order that the Me 262 be referred to as a Schnellstbomber (fast bomber) and no mention was to be made of the plane as a fighter.
[51] Manfred Boehme, JG7, The World's First Jet Fighter Unit 1944/1945, (Atglen, Pa.: Schiffer Military History, 1992), pp. 42-4.
[52] Boehme, p. 53.
[53] Ibid, pp. 43-4.
[54] Smith and Kay, pp. 43-4.
[55] Ibid, pp. 44-5.
[56] Ibid, pp. 45-6.
[57] Galland, The Development..., p. 41.
[58] Boehme, p. 201.
[59] For complete analysis of the Me 262 variants consult Smith and Creek, "Projected Me 262 Developments," Volume 1, pp. 123-39, "Me 262 Variants," Volume 2, pp. 267-311, Smith and Kay, pp. 539-46, Boehme, pp. 201-2.
[60] According to Galland, The Development..., his table shows 564 Me 262s produced in March through December 1944 and 750 in January through March 1945.
[61] Smith and Kay, p. 308.
[62] Galland, The Development..., p.41.
[63] Smith and Kay, pp. 314-5.
[64] Ibid, p. 316.
[65] According to Galland, The Development..., p. 40.
[66] Foreman and Harvey, pp. 236-44.
[67] Ibid.
[68] Galland, The First and the Last, pp. 299-301.

Chapter IV

Operations

The Me 262 finally reached the operational squadrons. How well did it perform? The plane was a delight to fly as was exemplified by *General der Jagdflieger* (General of Fighters) Adolf Galland's comment, "It flies as if there is an angel pushing."[1] It was over a year between the first flight by Galland and the delivery of the first Me 262s to operational squadrons, but the Me 262 was an effective weapon for the Luftwaffe. However, the advantages that the Me 262 possessed in qualitative superiority were negated by the Allies in quantity. There were too few German jet fighters to stem the tide of Allied air superiority in the short operational lifetime of the German jet program.

Erprobungskommando 262 (testing squadron – shortened to *Ekdo*) was formed in December 1943 but did not receive its first jet until April 1944.[2] The jet was Me 262 V8 (VI+AC). This new research refutes the claims of Manfred Boehme, John Foreman, and S.E. Harvey who state that *Ekdo* 262 received sixteen production Me 262s in April.[3] There could not have been sixteen Me 262s delivered because they had not been completed. According to production figures presented by *General der Jagdflieger* Adolf Galland, the first nine production Me 262s were not even finished before the end of May 1944.[4] Although there were no Me 262s available for operations the day the Allies invaded the Continent on 6 June 1944, output was increased and in June twenty-six Me 262s rolled off the production lines. Manufacturing increased and Messerschmitt was manufacturing 124 Me 262s per month by the end of the year.[5]

Ekdo 262, commanded by *Hauptmann* Werner Thierfelder, was stationed at Lechfeld and the pilots chosen to test the Me 262 were drawn from *Zerstörergeschwader*

(*Zg* – destroyer squadron) 26. The importance of these pilots was that they were familiar with twin-engine aircraft as well as instrument flying and multi- role missions. They had been flying Messerschmitt Me 110s, twin-engine aircraft initially designed as heavy fighters, but the Me 110 was not as maneuverable as Allied fighters (specifically British Spitfires during the Battle of Britain) and was converted to a night fighter and light bomber. Therefore, the pilots adapted well to the twin-engine jet and were put to work testing the Me 262 for combat operations and devising new tactics for jet combat.[6]

The choice of Me 110 pilots was sound; they understood multi-engine aircraft and instrument flying. As compared to the pure fighter pilots who later flew the jet, the Me 110 pilots were more cautious in handling their aircraft and more cognizant of the jet's instruments – a major feedback mechanism for the pilot. In addition, the early Me 262 pilots were all veterans of air combat and operational experimentation, and could adapt their knowledge to use in jet planes. However, the *Ekdo* 262 pilots were hampered by the operational restrictions of the plane. After only ten hours orientation flying time, the pilots were declared proficient with the Me 262.[7] There were no instructional two-seat Me 262s at this point, and all flying was solo. The pilots were also restricted with regards to the plane itself; the Junkers Jumo 004 engine required complete overhauls after only ten hours flying time. Therefore, the planes themselves limited the amount of testing time of the eight *Ekdo* 262 pilots. But, the pilots did perform a vital task in the development of the Me 262. Initially, they suggested improvements on the aircraft itself, from fixing rivets and panels to other minor production problems that had to be corrected by the ground crew at the airfield.[8] The craftsmanship of the plane was often suspect, and *Ekdo* 262 ground staff repeatedly made field modifications to make the aircraft

serviceable. As flight testing progressed, other modifications were required for the Me 262. Initially delivered with fabric-covered control surfaces, it was found that they were not suitable for high-speed flight. The fabric would expand and bubble at speed over 750 km/h and cause severe problems with control of the aircraft. They had to be replaced with metal-covered control surfaces and the Messerschmitt plant was put to work correcting early pre-production problems. These problems were rectified while *Ekdo* 262 hammered out tactical guidelines for the Me 262.

The tactics that were developed for the Me 262 were simple but effective. Using the superior firepower (four 30 mm cannons) and speed of the aircraft, it was decided that a "bounce" technique was appropriate. The Me 262 pilots would attack Allied planes from a higher vantage point, then fly in guns blazing, and use the amazing speed of the Me 262 to avoid damage to their own aircraft.[9] If necessary, the Me 262 pilots would make a long high-speed sweeping turn and come around for another pass. The original Me 262s delivered to *Ekdo* 262 did not have bomb racks and the unit did not form tactics based on Hitler's order that every Me 262 was required to carry bombs. The production aircraft, with the bomb racks, were delivered to the second Me 262 unit, *KG(J)* 51 (*Kampfgeschwader (Jäger)*-bomber squadron (fighter)).[10] *KG(J)* 51 was formed on 3 June 1944 and ordered to commence operations as soon as the first Me 262s, equipped with bomb racks, were available. It was to take several weeks for the design modifications to be completed on the Me 262 for the unit to have any available planes. Hitler's wish of fast bombers at the Allied landings was not attained. *KG(J)* 51 did participate in several high-speed bombing missions including tactical bombing of Allied targets such as bridges and roads as they advanced across Europe.

Another unit that received a handful of Me 262 for operations was *Einsatzkommando Braunegg*, a reconnaissance squadron that evaluated the Me 262 as a high-speed photo reconnaissance plane.[11] Armed with only cameras, *Braunegg* used the Me 262 to take high-altitude pictures of Allied formations. According to German records, *Einsatzkommando Braunegg* was in operation before the Allied invasion and took pictures of the buildup in Britain. However, these claims are refuted by the British.[12]

Ekdo 262 lost an important member of its cadre when their commander, Thierfelder, was killed on 18 July. The reports are conflicting as to whether he was shot down: German reports claim that he was the victim of Allied air activity while Allied reports do not claim any jets shot down. In all probability, his Me 262 crashed due to technical difficulties with the engines.[13] His death cost *Ekdo* 262 its commander.

Testing continued and its persistence finally paid off. On 25 July 1944 *Ekdo* 262 submitted a claim for its first aerial victory. Although *Leutnant* Alfred Schreiber claimed the destruction of a reconnaissance Mosquito over Germany, and the destruction was awarded by the *RLM*, the Allied plane actually escaped. Schreiber attacked the high-flying Mosquito but lost it in the clouds after four firing passes. The Mosquito dove for a cloud bank and finally made it safely to Italy. The encounter was the first Allied report of an engagement with the Me 262.[14]

Piecemeal attacks on lone reconnaissance planes and small medium bomber formations continued throughout the summer as the Allies advanced across Europe. It was not until 28 August that the first recorded Allied fighter engaged a German combat jet. *Oberfeldwebel* Hieronymus Lauer of *KG(J)* 51 was returning to base when he was

spotted by American P-47 Thunderbolts, which took up the chase. In an effort to evade them, the German crash landed. American pilots Joe Myers and M.D. Croy shared the first Allied victory over a Me 262.[15] The fight between German jets and Allied fighters had begun.

In September, Me 262 airfields were relocated further inside the shrinking Reich. The first to move was *KG(J)* 51, which after an attack by British bombers and the loss of some of their scarce jets on the ground, moved from Holland to Rheine, inside Germany, where they continued operations until the end of the war.

During this time, Hitler finally allowed the Me 262 to be used as a fighter. Rescinding his previous order that the Me 262 be used, and referred to, as a bomber, he released one in every twenty Me 262s as fighters.[16] Then, just as the true jet bomber, the Arado Ar 234, was rolling off the production lines, Hitler gave his consent to the production of the Me 262 as a fighter. The subsequent formation of the first jet fighter unit was a direct result of this decision. At the end of September, pilots and planes from *Ekdo* 262 as well as *ZG* 26 (*Zerstörergeschwader* – Destroyer Squadron) were drawn together to form a new Me 262 unit, *Kommando Nowotny*.[17] Named after its commander, Major Walter Nowotny, the group was an expanded version of *Ekdo* 262 and was to continue operational testing without combat in the Me 262. However, their grace period was severely shortened by an air raid alarm on 7 October. Although the dozen available aircraft were not ready for combat, Nowotny gave the order to scramble. The first operational sortie went badly for the Germans: three Me 262s were shot down in exchange for two Allied planes. The three Me 262s were caught by American P-51 Mustangs during take off and the Americans took advantage of the jets' low take off

speeds and attacked. Three jets and one irreplaceable pilot were lost. Immediately after the first sortie, Nowotny requested protecting planes for the jets while they took off and landed. Because of the jets' low speeds while starting up and upon landing, they were vulnerable to prowling American fighters. Nowotny's request was granted and Focke-Wulf Fw 190s from *JG* 54 (*Jagdgeschwader* – Fighter Squadron) were transferred to provide aerial cover the jets.[18] The removal of more fighters for the defense of the Reich was a necessary evil to provide protection for the jets. However, with an adequate fighter screen, there was a substantial decrease in the number of jet losses during take off and landing.

Over the next month, *Kommando Nowotny* was engaged in battle with the Allied air forces. There were many teething problems with the new jets in addition to the questionable location of the airfields at Achmer and Hesepe. These airfields were located directly on the incoming and outgoing flight paths of the Allied heavy bombers. The airfields were ideal for the interception of bombers but made the German jets vulnerable to the escort fighters that accompanied the Allied bombers. On 11 September 1944 the first combat between Me 262s and Allied heavy bombers took place. Up to this point, the Me 262s had been engaged in combat with reconnaissance aircraft and light bombers. On that fateful day, a handful of Me 262s joined piston-engine Me 109s and Fw 190s in an attack on the "Bloody Hundredth," the USAAF's 8th Air Force 100th bomb group. The Americans lost a total of twenty-four aircraft compared to fifteen German piston-engine planes and no jets.[19] At this point, the Allies were becoming concerned over the German jet. Although there were few jets, the Allies did not know how many the Germans were able to construct and commit operationally. The Allies were worried about the threat of

substantial numbers of German jets which could disturb Allied air superiority. According to the commander of the British 2nd Tactical Air Force, who provided ground support for the Allies on the Continent, Air Marshall Sir Arthur Coningham, "German jets could wash away our great air superiority tomorrow."[20] The Allies were concerned about instant German qualitative superiority, although the Germans were still having great difficulty making more than a few dozen jets operational each month. Incidentally, the only Allied jet to see combat during World War II was the British Gloster Meteor I which was flown in Home Defense against the German V-1 "Buzz Bomb."

Kommando Nowotny did well until 8 November 1944. Major Nowotny took off with only one other pilot to engage American bombers returning to England after a raid over Germany. During the fight, Schall, Nowotny's wingman, was shot down but parachuted to safety. Nowotny, after downing two American planes, was last seen diving through the clouds and straight into the ground. However, in another instance of conflicting reports, it is unclear whether Nowotny succumbed to Allied fighters or simply lost control of his jet.[21] In any event, the leader of *Kommando Nowotny* was dead, and after a month of fighting the unit had recorded twenty-six victories for twenty-six losses.[22] The squadron was immediately returned to Lechfeld for retraining and reassignment.

As previously mentioned, on 14 November 1944 Hitler finally ordered that all Me 262s were to be produced as fighters. The decision was irrelevant in the end; the operational Me 262s had been split between *KG(J)* 51 and *Ekdo* 262/*Kommando Nowotny* and neither group had been particularly successful. *KG(J)* 51 was operational too late to affect the outcomes of the Allied landings in Normandy. In fact, without a

proper bombsight, the Me 262's small payload was almost useless. According to Wendel (the chief Messerschmitt test pilot, who was still testing the Me 262), "In level Flight, the Revi [gun/bomb sight] was useless for accurate bombing. Pinpoint targets could not be hit. *Kommando Schenk* [the official name of the III *Gruppe* of *KG(J)* 51] was therefore unable to claim any tactical successes."[23] In comparison, the fighter equipped *Ekdo* 262/*Kommando Nowotny* had accounted for the destruction of only around forty Allied planes.[24] With the limited numbers of jet aircraft available, and the numerous accidents and losses, the Me 262 was not a decisive weapon as it was envisioned. The Germans possessed neither the machines nor the pilots to turn the tide of Allied air superiority.

Following the loss of Major Nowotny, and after a brief rest, *Kommando Nowotny* was reassigned and renamed *JG* 7. On 19 November 1944 *General der Jagdflieger* Galland used his position to form the new jet fighter group at Lechfeld to counter the Allied threat from the air. Using the most experienced pilots from the former *Kommando Nowotny* as well as others from *JG* 3 and *JG* 6, Galland formed the first operational jet fighter squadron.[25] Buildup continued throughout November and December, although Me 262 production was far behind schedule. By the end of November, the squadron still had only eleven Me 262s for operations. Therefore, it was decreed that there were to be no engagements with escorted Allied bombers.[26] The unit was only allowed to attack unarmed reconnaissance planes. Losses of machines and pilots due to accidents continued to mount to the dismay of the group commander, *Oberst* Johannes Steinhoff. During December alone, ten Me 262s were destroyed and five damaged in accidents with the corresponding loss of four pilots.[27]

During the last month of 1944, the Luftwaffe was busy reassigning pilots to jet squadrons. Beginning with bomber groups, pilots were being transferred for jet familiarization training. The bomber pilots were the first to be relocated for a number of reasons. Their previous training made them ideally suited to the twin-engine Me 262. There were few bombers being produced in the wake of constant Allied attacks; priority was on the construction of fighters. Finally, the high-octane fuel that the bombers required was in short supply in Germany, whereas the diesel which powered the jets was plentiful. Although five bomber squadrons were reassigned to jet training units (*KG* 6, 27, 30, 54, and 55), none were operational for months due to lack of planes and supplies. *KG* 54 was not operational until February 1945; only one *KG* 6 *Gruppe* was operational by April 1945 and was named *Gefechtsverband Hogeback* after its squadron leader *Oberstleutnant* Hermann Hogeback. The other three *Geschwaders* (27, 30, and 55) were not operational with jet aircraft before the end of the war.[28]

Other Me 262 units were formed as training squadrons to familiarize pilots with the Me 262. *Ergänzungsjagdgeschwader* 2 (*EJG* – fighter training squadron) was formed to train pilots at Lechfeld for jet operations. *Hauptmann* Horst Geyer commanded the training squadron from the end of October until early January 1945, when it was taken over by *Major* Heinz Bär. Bär later disbanded the training unit when he joined *JV* 44 (*Jagdverband* – fighter association), led by the charismatic Galland. *Ergänzungsgruppe Kampfgeschwader* 1 (*EKG* – Bomber Training Squadron) was also set up at Lechfeld to train bomber pilots on the Me 262.

As mentioned earlier there were two jet units formed which used the high-speed Me 262 for photo reconnaissance. *Kommando Braunegg* was a *Gruppe* in

Nahaufklärungsgruppe 6 *(NAGr)* based at Münster-Handorf until February, when the unit went through a number of moves until the end of the war. In addition, 1./*Versuchsverband OKL (Oberkommando der Luftwaffe* – Luftwaffe High Command) was formed as a special duties unit equipped with the most technologically advanced German and Allied aircraft for testing. The records are incomplete on the unit's activities within the Luftwaffe to this day.[29] It was amalgamated into *NAGr* 6 in March 1945.[30]

Finally, there were a number of Me 262 fighter squadrons formed before the end of the war in a last-ditch effort to stem Allied air superiority. In addition to the above mentioned *JG* 7, which is dealt with in depth by Manfred Boehme,[31] there were other units specifically formed as jet fighter units. 10./ *NJG* 11 *(Nachtjagergeschwader* – night fighter squadron), also known as *Kommando Welter,* was a night fighter squadron that employed the Me 262 A-1a and B-1a/U1 (two-seater) in night operations. From November 1944 to the end of the war, more than 160 sorties were flown by the twenty-five Me 262s that were operational with the squadron. *Kommando Welter* amassed 48 aerial victories against a loss of five aircraft and six pilots and as many radio operators. The unit focused its fury on the high-speed British Mosquitos that flew pathfinder and reconnaissance missions over Germany. *Welter* moved a number of times during the last months of the war, and was finally forced to use Autobahns as airfields as the Allies overran German airfields.[32]

In an effort to protect industrial targets, one *Industrie Schutz Staffeln (ISS)* squadron employed Me 262s in the defense of German industry around Lager-Lechfeld. The unit was ordered to protect vital targets from Allied bombing in the immediate vicinity of their airfield.

Finally, one jet fighter unit was formed as the foremost fighter squadron of the Reich. *Jagdverband* 44 was formed in February 1945 from the best the Luftwaffe had to offer. The "Squadron of *Experten*" was formed by Galland in the final stages of the war to combat the Allied air menace. Galland was given permission to form the unit and personally hand-picked the best pilots in the Luftwaffe, including *Obersts* (Colonels) Heinz Bär, Johannes Steinhoff, Günther Lützow, and Gerhard Barkhorn. All had been *Geschwader* commanders and all had amassed extraordinary victory tallies and decorations. Although they realized that the end of the war was near, there was general consensus that it was a privilege to fly the Luftwaffe's finest fighter even in defeat. Many of the pilots came to the unit voluntarily, without official transfers, from retirement or leave, in an effort to become the first jet fighter pilots in history.[33] *JV* 44 began operations on 31 March 1945 from the Munich-Riem airfield. The pilots were about to embark on the final stages of the air war during World War II.

Outfitted with as many Me 262s as they could find, and funneling the aircraft straight from the factories, initially there was no lack of machines. Until the end of the war when there were more pilots than planes, *JV* 44 had the highest priority on planes and supplies. Fighting bravely until the last, *JV* 44 was responsible for the destruction of 50 Allied planes in its short 34-day operational history. And, even though Galland went to hospital after being wounded on 26 April,[34] the unit continued until it was overrun by the Allies on 3 May.[35]

However, the Germans were only able to mount piecemeal attacks against overwhelming Allied air superiority. Even on the most active day for the Me 262, 10 April 1945, only 55 Me 262s were available against an attack by over 2,000 Allied

aircraft.[36] The Luftwaffe had been hopelessly outclassed by the material superiority of the Allies. In the end, it was as Galland stated, "Militarily speaking the war is lost. Even our action here cannot change anything. I shall continue to fight, because operation with the Me 262 has got hold of me, because I am proud to belong to the last fighter pilots of the German Luftwaffe. Only those who feel the same are to go on flying with me."[37]

With regard to the other two German jets, there were fewer machines available for operations. The Arado Ar 234 jet bomber was delivered primarily to *KG* 76 for daylight operations against Allied targets. Its most important contribution was the bombing of the Bridge at Remagen on 7 March 1945. In the first instance of combined operations, Me 262s from *KG(J)* 51 flew fighter cover for the jet bombers while they bombed the bridge.[38] The Ar 234 was used until the end of the war as both a nuisance bomber and a high-speed photo reconnaissance plane. Invulnerable to Allied piston planes due to its high-speed capabilities, the Ar 234 was perfectly suited to these roles. Known units to receive and operate the Ar 234 jet bomber included *Kg* 76, 1(F)/ *Aufklärungsgruppe* 5, 33, and 123 (photo reconnaissance), and 1(F)/ 100.[39] But only *KG* 76 employed the Ar 234 as a bomber; the other squadrons were relegated to reconnaissance missions.

Finally, the last jet plane produced in the dying days of the war was the Heinkel He 162. Only 116 were constructed in the last two months of the war,[40] and only one squadron, *JG* 1, had acquired He 162s and was operational before the end of the war. Incidentally, *JG* 1 surrendered a mere four days after receiving their first complement of He 162s.[41] Because of its novelty and difficult handling characteristics, the He 162 was forbidden from engaging Allied aircraft and only one combat report exists. The American P-51 Mustang pilot who had a chance meeting with the He 162 stated that the

German plane was highly maneuverable and very fast.[42] The He 162 illustrated that even though the Germans had the technology, they could not put it into operational use. It was a case of too little too late.

The operational exploits of the Me 262 are well chronicled in the study by John Foreman and S.E. Harvey.[43] Through research of the relevant documents in the Public Records Office in England they have compiled a complete list of all the Allied planes lost to the Me 262 in combat. In addition, they outline the Me 262 losses in combat. Compared to Me 262 claims of 446 Allied planes downed between 26 July 1944 and the end of the war, the Allies (British and Americans) claimed 190 Me 262s destroyed.[44] Therefore, the Germans shot down 2.34 Allied planes for the loss of every Me 262. However, the Germans were able to only produce 1,294 Me 262s in the final months of the war,[45] while the Americans alone produced 49,761 planes between January and June 1945.[46] The figure is indicative of the amazing material superiority of the Allies over the Germans and their ability to out-produce the Germans. The latter were hopelessly outclassed in production of aircraft even though they possessed the technological edge with jet aircraft. There were not enough planes of any kind, let alone jet aircraft, to effect Allied production capabilities. But, the Me 262 in capable hands was a good weapon against Allied aircraft. The Germans had the technological edge, but little else.

In the end, the German operational jet program was nothing more than an amazing technological advance for the Luftwaffe. The jets did not make any difference in the air war over Europe. The choice of the initial airfields at Achmer and Hesepe put the Me 262 in direct conflict with American P-51 Mustangs and P-47 Thunderbolts who were able to exploit the jets' poor handling characteristics at low speeds. But the Me 262

did open a new phase of aerial warfare. When the jets were able to operate against the American and British "heavies" they were very effective and almost invulnerable. The Allied pilots had difficulty defending against the amazing speeds of the German jets, and there was understandable concern regarding the new German technology. The jets performed well at high altitude and speed but the jets often fought at a disadvantage with the more maneuverable Allied fighters than with their preferred targets: Allied bombers. The Germans also faced problems with the operational capabilities of the Me 262. The jet had many difficulties with its engines and landing gear which led to losses regardless of Allied action. These manufacturing problems were not resolved before the end of the war, which in turn led to less operational combat flight time. Lastly, there were too few jets to make an impact on Allied air superiority. The Germans were simply not able to produce enough jets to stem the tide of Allied material superiority. Although the jet pilots were able to "kill" almost two-and-a-half Allied planes against the loss of every jet, the battle of attrition in the air was in favor of the Allies. The Me 262 was only an advantage for its novel technology and did not have a decisive effect on the air war; the Allies were able to overcome German technology with overwhelming material superiority.

[1] J. Richard Smith and Eddie Creek, Me 262, Volume I, (West Sussex, England: Classic Publications, 1997), p. 108.

[2] J. Richard Smith and Eddie Creek, Me 262, Volume II, (West Sussex, England: Classic Publications, 1998), p. 234.

[3] Manfred Boehme, JG 7, the World's First Jet Fighter Unit 1944/1945, (Atglen, PA: Schiffer Military History, 1992), translated by David Johnston, pp. 53. See also, John Foreman and S.E. Harvey, The Messerschmitt Me 262 Combat Diary, (Surrey, England: Air Research Publications, 1995), pp. 34.

[4] Adolf Galland, The Development of Jet and Rocket Airplanes in Germany 1938-1945, extracted from European Contributions to the History of World War II, monograph Number 7, Development and Planning in the German Air Force, Part I of the Von Rohden Monograph. (Maxwell Air Force Base, Alabama: Foreign Documents Section, Air University Library, 1951), p.41. Galland states the production of Me 262s was one in March, none in April, and eight in May.

[5] Ibid, Production figures were: May 1944–8, June–26, July–55, Aug.–56, Sept.–81, Oct.–127, Nov.–86, Dec.–124. For a total of 564 built in 1944.

[6] Foreman and Harvey, pp. 37-8.

[7] Walter Boyne, Messerschmitt Me 262, Arrow to the Future, (Atglen, Pa: Schiffer Military History, 1994), p. 38.

[8] Boehme, pp. 47-8.

[9] Smith and Creek, Volume II, p. 240.

[10] Foreman and Harvey, pp. 38-40.

[11] Ibid, p. 40.

[12] Ibid.

[13] Ibid, pp. 41-2. See also Smith and Creek, Volume II, p. 245.

[14] Boyne, pp. 41-2, Boehme, p. 49, Smith and Creek, Volume II, pp. 247-8.

[15] Foreman and Harvey, p. 53.

[16] Boehme, p. 43.

[17] Smith and Creek, Volume II, p. 261.

[18] Ibid, p. 263.

[19] Foreman and Harvey, pp. 57-8.

[20] Smith and Creek, Volume II, p. 248.

[21] Boehme, pp. 62-3.

[22] Boyne, p. 42.

[23] Smith and Creek, Volume II, p. 363.

[24] Foreman and Harvey, pp. 55-100. Their painstaking analysis of German and Allied records provides an extensive account of the combat records of *Ekdo* 262 and *Kommando Nowotny* for the period in question.

[25] Boehme, pp. 71-2.

[26] Ibid, p. 73.

[27] Ibid.

[28] Hugh Morgan, Me 262 Stormbird Rising, (London: Osprey Publishing, 1994), pp. 97-101.

[29] Martin Windrow, German Air Force Fighters of World War Two, (Bucks, England: Hylton Lacy Roughwood Croft, 1968), Volume I, p. 61.

[30] Ibid, pp. 103-104. Morgan gives a complete listing of operational and assigned Me 262 units from October 1944 to May 1945.

[31] Boehme, in his book JG 7, provides an excellent unit history of the first jet unit.

[32] Morgan, p. 103.

[33] Adolf Galland, The First and the Last, (New York: Henry Holt and Company, 1954), p. 294. See also Boyne, p. 48.

[34] Galland, pp. 299-301. See also Boyne, p. 48.

[35] Galland, pp. 301-2.

[36] Foreman and Harvey, pp. 236-44.

[37] Galland, pp. 297, 99.

[38] Foreman and Harvey, pp. 169-70.

[39] Manfred Griehl and Joachim Dressel, Luftwaffe Combat Aircraft, translated by Don Cox, (Atglen, Pa.: Schiffer Military History, 1994), pp. 165-6.

[40] According to Galland, The Development..., p. 41.

[41] Bryan Philpott, German Military Aircraft, (London: Bison Books, 1981), p. 114.

[42] Smith and Creek, pp. 314-5.

[43] Foreman and Harvey.

[44] Ibid, pp. 355-78. Appendices IV "USAAF Fighter Air Combat Claims Against Me 262 Aircraft", V "RAAF Fighter Air Combat Claims Against Me 262 Aircraft", and VI "Known Claims By Jet Pilots."

[45] Galland, The Development..., p. 40.

[46] R.J. Overy, The Air War 1939-1945, (Chelsea, Mi.: Scarborough House, 1991), p. 150. The Allies (US, Britain, and the USSR) combined to produce 167,654 aircraft of all types in 1944 and 84, 806 in 1945. Some of these planes were obviously used in the Pacific theatre, and of those produced in 1945 some were built after the German capitulation, but the figures are representative of the relative production capacity of the Allies versus the Germans.

Chapter V

The Aftermath

At the end of the war, the Germans possessed technology that was as good as, and in many cases superior to, the Allies. In efforts to capture German technology the British, Americans, and Russians were pitted in competition against each other; programs were instituted on all sides to capture the technological resources of the defeated Reich. In the end all of the victorious powers were able to gain scientific knowledge from the Germans which launched the world into the cold war. But, it is interesting that the Germans also aided the Allies by handing over important technical drawings and information. For the most part, the Germans preferred to be captured by the Americans over all others and thus facilitated capture by US troops. The Americans, through German action and amazing organization, were able to gather important technical material and personnel for the benefit of the US War Department.

The first to benefit from German technology were the Japanese. Naval attachés had seen the Me 262 and Me 163 in flight and were immediately interested in the German planes. Plans were bought and shipped to Japan via submarine in December 1944[1] and construction of prototypes began of the Nakajima Kikka (Orange Blossom).[2] A smaller version of the Me 262, the Kikka was designed by the Japanese as a fast bomber. Powered by copies of the BMW 003 engines license-built in Japan, the Kikka first flew on 7 August 1945. In addition, the plans for the Me 163 were copied in the form of the Mitsubishi J8M1 Shusui. This rocket interceptor was a direct copy of the Me 163, but had a more troubled life in Japan. The first prototype exploded due to incorrect installation of the fuel system, and although fuel systems in the other six prototypes were

repaired, the end of the war prevented further testing.[3] The Japanese demonstrated the first example of incorporating German technology into their military programs, but the Japanese jets did not become operational before the end of World War II.

In Europe at the end of April 1945 there were no illusions about the end of the war. The Allies were pressing in from all sides of the shrinking Reich and some hard decisions had to be made. In the last days before the German surrender, Adolf Galland decided to hand over the Me 262s from *JV* 44 to the Americans. In an effort to contact the advancing American forces, Major Wilhelm Herget volunteered to fly a Fiesler Fi 156 *Storch* (Stork) liaison plane to contact the Americans and surrender. Herget was shot down by ground fire and no surrender was arranged.[4] As the Americans advanced on the airfield at Salzburg, the jets were set on fire.[5] No *JV* 44 jets were turned over to the enemy.

However, other jets were delivered to Allied forces. Four *KG(J)* 51 Me 262 pilots, unwilling to become prisoners of the Soviet Union, decided to fly from their airfield at Zatec, north of Prague, to German soil. Two of the pilots made it to the American occupied zone; one flew to Fassberg, where he surrendered to British forces. The last pilot, Wilhelm Batel, flew to Lüneberg Heath, close to his hometown, crash landed his Me 262, hid for the night, and made his way home. In the end he gave himself up to British authorities.[6]

Under similar circumstances two *KG(J)* 54 pilots also preferred American capture to Soviet imprisonment. They flew from Czechoslovakia to Austria on 8 May in order to surrender to American forces.[7] Finally, the ground crews of *NJG* 11 (Me 262) and *JG* 1 (He 162) lined up their aircraft on the tarmac at Leck in Schleswig-Holstein for takeover

by British forces.[8] The jet pilots of the Reich knew that the war was over and tried desperately to surrender to the Americans rather than be taken prisoner by the Soviets. The surrender benefited the Americans in that they were able to gather up planes, pilots and technicians from the German jet program.

Although the Germans aided the American effort to capture Nazi technology, as early as January 1945 the US Army set in motion plans designed to exploit the technological advancement of German scientists and material.[9] Beginning with **Operation Alsos**, headed by Lieutenant Colonel Boris Pash, the Army was interested in identifying and contacting German scientists and capturing technological data for use by the Americans.[10] Incidentally, a significant part of the operation was concerned with denying the same scientists and material to the Soviets.[11] Although **Alsos** was initially preoccupied with the German atomic weapons program, when it was determined that the Germans were still years behind the Americans, the plan was extended to all important German scientists. Renamed **Operation Paperclip** in May 1945, the group focused their attention on the German rocket works at Nordhausen and Peenemünde. Although the rocket platforms at Peenemünde were in the Soviet zone, the Americans were fortunate when the German scientists relocated to the Nordhausen rocket factory in the American zone.[12] The exodus was led by the prominent German rocket scientist Wernher von Braun who, along with over one hundred scientists and fourteen tons of rocket testing and design paperwork, surrendered to the Americans. The real successes came after V-E day when the US agreed to feed and house the German scientists' families in return for their services. The rocket scientists volunteered to assist the Americans and signed contracts to work in the United States. Therefore, although the Soviets commandeered most of the

rocket hardware at Peenemünde, the Americans obtained the services of the scientists and their knowledge to further their own rocket program.

All the Allies were also interested in German aeronautical innovation. The British and Americans were flying jet aircraft, but none compared to the Me 262. The USAAF concocted **Operation Lusty**: the acquisition of flyable examples of innovative German aircraft, including the Me 262. Led by Colonel Harold Watson, a group of American fighter pilots formed an Air Force Intelligence Team to gather planes for transport back to the United States for testing.[13] Known affectionately as "Watson's Whizzers," the unit unofficially became the first US jet squadron. In June 1945 they arrived at Lechfeld where a collection of German planes had been dumped after the surrender. Watson was able to identify the most airworthy and convince the German technicians to help repair the aircraft for his use. He gathered enough spare parts, manuals, and technical assistance to repair ten Me 262s for evacuation to the United States. In addition, two former Luftwaffe pilots were employed as trainers for the American pilots who were to take over the Me 262s. After brief instruction, and a few check flights, the American pilots were ready to ferry the planes to a French airfield for transport to the US. Watson had the German insignia painted over with American markings, and the planes were flown to Melun, France, where they were inspected by General Carl Spaatz. The planes were flown to Cherbourg, put on the aircraft carrier *HMS Reaper*, and sent, by sea, to Newark, New Jersey, for their new life as American test planes. After re-assembly, and ground testing to insure stability, they were flown to Freeman Field, Indiana, for testing.[14] The Me 262s were flight tested in the US for the Air Force, until they were sold as war surplus. Of the captured Me 262s several can now

be found in collections around the US. Although none remain in flying condition, there are several on static display including planes at the Smithsonian Institution, one at Wright Field in Dayton, Ohio, and an Me 262 at the Planes of Fame Museum in California.

Although the Americans did have their own jet planes before the capture of the German Me 262s, many lessons were learned from German technology and incorporated into subsequent American designs. The Me 262, when tested against American aircraft, proved the superiority of jets versus piston planes, especially when used in fighters. When the Me 262 was flown in mock combat against B-17 bombers, the jet demonstrated the ineffectiveness of the American powered turrets in tracking the high-speed fighter. The B-17 guns were not able to track the jet and the bomber's guns were shown to be obsolete. New defensive gun turrets had to be designed for the higher speeds of jet fighters of the future.

Although the Me 262 did not directly affect the American designs, other Messerschmitt experimental jet projects were studied for their technological advances. The Messerschmitt P. 1101 project introduced the idea of sweptback wings and variable-sweep wing technology.[15] The Americans adapted the swept-wing design to the Bell X-5 project, the first plane to fly with variable-geometry wings that could be adjusted to sweep at angles from 20 to 60 degrees.[16] The purpose of swept-wing technology was to investigate the handling characteristics of differing wing geometry at high speeds.

The Bell company also made use of German rocket technology in its X-1 program, the first plane to break the sound barrier. On 14 October 1947 Captain Charles "Chuck" Yeager, a World War II fighter ace in the European theatre, became the fastest man alive when he flew the Bell X-1 at Mach 1.015.[17] German aeronautical engineering

combined with rocket technology gave the Americans an advantage in post-war military and experimental aviation.

The Americans benefited most from the German rocket program. The captured material and scientists from Peenemünde were the foundation for the American space program which ultimately led to the moon landings. The Americans were without any substantial rocket program during the war; they instead focused on atomic power and weapons. At the end of the war, with the collection of the German rocket material, the Americans possessed a substantial lead in the post-war arms race. In comparison with the Soviets, who had an excellent wartime rocket program, the US had atomic weapons and was able to combine their technology with the captured German rockets to produce the world's first atomic ballistic missile by 1955: the *Jupiter*.

The British were also interested in German jet technology. Their team, led by Group Captain Alan Hards, the Commanding Officer of Experimental Flying, went to Germany to capture and test the Me 262.[18] His small team was comprised of not only jet pilots but British jet scientists. The team went to Leck airfield near Schleswig to fly captured Me 262s and return them to England. After visiting all of the German airfields in the British Occupied Zone, as well as airfields in the other Zones, the British gathered nine Me 262s; three each of the fighter, *Jabo*, and two-seat night fighter versions for testing. The planes were flown to Farnborough where two of the Me 262 fighters were put through extensive testing.[19] The British Me 262s were dispersed around the world or scrapped, subsequently, only one remains in Britain, at Cosford.[20] However, the British did not make use of the airframe or the engines of the German jet. Analysis of the technology was made but the RAF continued on its own course with the second

generation Meteor (Gloster Meteor II) and subsequent jets. The Me 262 and Me 163 were relegated to static post-war displays for the pleasure of British citizenry after testing was complete at Farnborough. The British decided to continue with their own jet programs and the German jets were either put on display, sent to Commonwealth Allies (such as the examples in South Africa, Australia, and the four that were reduced to scrap in Canada), or destroyed.

The story of the French utilization of the German jet program is somewhat more shrouded. After the war, France acquired seven Me 262s from captured German airfields, but only three were airworthy.[21] Of the three flyable machines, one crash landed in 1947 or 1948, leaving two Me 262s operational. These two flew for the *Armee de l' Air* until September 1948 as France worked to rebuild its air force.[22] It is apparent that the French relied on these two machines plus delivery of British de Havilland Vampires until 1952 when French aircraft production, rebuilt after the war, began to produce the first Dassault Ouragan fighter planes.[23] Designed by Marcel Bloch, and constructed by the company set up by Marcel Dassault, the French went on to become one of the leading manufacturers of jet-fighter aircraft after World War II. However, there is no evidence to suggest that the French made extensive use of either airframe or engine technology captured from the Germans.

The Soviets, on the other hand, made use of both the rocket and jet programs of the Reich. The USSR instituted programs to capture German technology but was hampered by German attempts to hand over the technology to the Americans. The frustration of the Soviets is clear in a statement by Joseph Stalin to his advisors, "We defeated Nazi armies; we occupy Berlin and Peenemünde; but the Americans get the

rocket engineers.... How and why was this allowed to happen?"[24] In the end, the Soviets did acquire most of the hardware from Peenemünde simply because the Americans were unable to remove it. But the Soviets found over the course of the next year that Germany did not have a substantial lead over the USSR in rocket technology, and many of the captured German rocket scientists were allowed to return to Germany.[25] However, jet technology was an entirely different affair. There were no jet programs in the USSR until well after the end of World War II. Soviet forces captured an intact Me 262 in March 1945 on the airfield at Kolberg-Bodenhagen, and it was returned to the Soviet Union for study and testing. The Me 262 airframe was not of particular interest but the engines (both the Junkers Jumo 004 and the BMW 003) were seen as revolutionary and important to any further air force projects.[26] Both the Mikoyan–Gurevich (MiG) and Sukhoi companies were issued instructions to design twin-engine jet fighter/bombers and the Yakovlev and Lavochkin companies were solicited to propose single-engine jet designs. All four companies submitted proposals, and all four were approved by fall 1945.

The MiG 9 became the first Soviet jet fighter when it flew on 24 April 1946. Powered by two captured BMW 003 engines, which were re-designated RD-20s, the first ten MiG 9s were produced and ready for flight after only 100 days.[27] The plane went on to successful service in the Soviet Air Force until about 1950 when it became obsolete.[28] The other twin-engine Soviet jet was the product of Pavel Sukhoi and his company. According to Hugh Morgan, the plane was designated Su 9 and was a direct copy of the Me 262 for Soviet use.[29] The plane was a twin-jet-engine fighter with several improvements on the captured Me 262. It included an ejection seat and rocket assisted take-off (RATO) units but had straight wings as opposed to swept wings. It flew for the

first time on 18 August 1946, but because it did not offer observable advantages over the MiG plane it was not put into production.

Single engine jet planes were also constructed in the Soviet Union based on captured German technology. The product of the Yakovlev company, the Yak 15, first flew on the same day as the MiG 9. Powered by a captured Junkers Jumo 004, it was a single engine design that was similar to the Gloster E28/39. The engine was installed in a tubular fuselage and air flowed directly through. The Yak 15 was approved and over 400 planes were built as both the Yak 15 and Yak 17 two-seater. Incidentally, the Yak 15 is said to have been flown by a female employee of the Yakovlev company, Olga Yamschikova, thus she would have been the first woman to fly a jet plane.[30] Lastly, the Lavochkin La 150 was a prototype jet plane that tested a pod and boom design. Unfortunately, the problems were not corrected and the plane was only retained as a test bed.[31] However, the technology provided by the German jet program was used extensively in the buildup of post-war Soviet planes.

Finally, there was a small jet program in the newly reunited state of Czechoslovakia. The new government gained control of the numerous factories which produced Me 262 components, including the Junkers Jumo 004 engines, following the German surrender. The factories, particularly Avia, continued production of the Czech version of the Me 262, the S-92, following the war.[32] The S-92 was an exact copy of the Me 262 and eventually formed the basis for the new Czech air force. By reconditioning several wartime Me 262s, and building several S-92s, the Czechs were able to form one squadron of S-92s. However, with the communist takeover of the country in 1948, the Avia plant was forced to build MiG 15s and the S-92 was relegated to the role of

training.[33] The Czechs were not strong enough to resist Soviet domination and the Me 262, built as the S-92, finished its operational life as a combat aircraft.

The operational lifespan of the Me 262 was extended beyond the end of World War II. The victors utilized the technological developments of the vanquished to varying degrees following the capitulation of Germany. Initially, Germany's ally Japan tried to put jet technology into practice before the end of the war in the Pacific. But, as history shows, Japan ran out of time. The United States learned several lessons from the experimental designs of Professor Willy Messerschmitt, but the Me 262 was not a dominant factor in the development of post-war US air technology. However, the US relied heavily on the breakthroughs in rocket technology that were accomplished in Germany during the war. Similarly, the British captured and tested German jets but chose to pursue their own designs and technology in the development of their post-war jet programs. The German jets in England were exiled to museums and displays. The French used Me 262s until better jets could be acquired; first British Vampires, then designs of their own making when French jet manufacture came into its own in the early 1950s. The Soviets were far more reliant on German technology. After the war, German engines, whether they were captured engines or copies, powered the Soviet Air Force for a number of years. And finally, in the most obvious case of imitation, the Czechs employed actual Me 262s and copied S-92 jet aircraft for their fledgling air force. In the end, the German jet program powered the Soviet Air Force and in the United States the German rocket program sent the first man to the moon.

[1] D.R. Maguire, "Enemy Jet History," in The Journal of the Royal Aeronautical Society, (Volume 52, January 1948), pp. 76-84.
[2] Walter Boyne, Messerschmitt Me 262 Arrow to the Future, (Atglen, Pa.: Schiffer Military History, 1994), p. 150. See also Enzo Angelucci, The Rand McNally Encyclopedia of Military Aircraft, 1914-1980, (New York: The Military Press, 1980), pp. 296-7.
[3] Angelucci, p. 240.
[4] John Foreman and S.E. Harvey, The Messerschmitt Me 262 Combat Diary, (Surrey, England: Air Research Publications, 1990), pp. 272-3.
[5] Adolf Galland, The First and the Last, (London: Henry Holt and Co., 1954), pp. 301-2.
[6] Foreman and Harvey, pp. 274-5.
[7] Ibid, p. 275.
[8] Ibid.
[9] Earl Ziemke, The U.S. Army in the Occupation of Germany 1944-1946, (Washington D.C.: Center of Military History, United States Army, 1975), Army Historical Series, p. 314.
[10] Linda Hunt, Secret Agenda: The United States Government, Nazi Scientists, and Project Paperclip, 1945 to 1990, (New York: St. Martin's Press, 1991), p. 11.
[11] Gregg Herken, The Winning Weapon: The Atomic Bomb in the Cold War, 1945-1950, (New York: Alfred A. Knopf, 1980), pp. 105-6.
[12] Dieter Huzel, Peenemünde to Canaveral, (Westport, Conn.: Greenwood Press Publishers, 1962), pp. 143-51.
[13] Walter Boyne, p. 41.
[14] Ibid, pp. 62-73. See also Hugh Morgan, Me 262 Stormbird Rising, (London: Osprey Publishing, 1994), pp. 130-45.
[15] J.R. Smith and Antony Kay, German Aircraft of the Second World War, (London: Putnam, 1972), pp. 622-3.
[16] Michael Taylor (ed.), Jane's Encyclopedia of Aviation, (New York: Crescent Books, 1996 edition), p. 135.
[17] Ibid, p. 134.
[18] Morgan, p. 146.
[19] Foreman and Harvey, p. 284.
[20] Morgan, p. 189.
[21] Ibid, p. 190.
[22] Ibid.
[23] Angelucci, p. 429.
[24] Eugene Emme (ed.), The History of Rocket Technology: Essays on Research, Development, and Utility, (Detroit: Wayne State University Press, 1964), p. 279.
[25] Michael Neufeld, The Rocket and the Reich: Peenemünde and the Coming of the Ballistic Missile Era, (New York: The Free Press, 1995), p. 272.
[26] Morgan, pp. 152-3.
[27] Ibid, p. 153.
[28] Taylor, p. 655.
[29] Morgan, pp. 155-7. However, the later Su 9 was a single engine interceptor with a distinctly non- Me 262 shape and powerplant. However, Morgan presents sources and pictures of a Sukhoi plane he has designated Su 9.
[30] Taylor, p. 900.
[31] Morgan, pp. 154-5.
[32] Ibid, pp. 158-9. See also Foreman and Harvey, p. 297.
[33] Jon Guttman, "The Cold War Accelerated Jet Aircraft development Without a Shot Being Fired in the 1940s," in Aviation History, January 1998, pp. 1-13.

Conclusion

During World War II, the Germans developed the most technologically advanced airplane in the world. The Messerschmitt Me 262 *Schwalbe* was the first operational combat jet aircraft in history and will always be remembered as one of the most significant developments in aeronautical engineering. However, due to a number of factors, the Me 262 did not become a decisive weapon as was envisioned. From High Command decisions to lack of necessary materials to Allied influence, the Me 262 became no more than a technological novelty in the closing stages of the war. However, contrary to popular opinion, the Me 262 could not have been the decisive weapon that the Nazis counted on.

The decisions of Adolf Hitler are often cited as excuses for the tardy development of the German jet. However, all the decisions combined did not impact the outcome of the Me 262 program as much as a lack of technology. Hitler did make several misinformed decisions based on his perceptions of the potentialities of the new jet plane, but in the end these decisions did not matter. Most of Hitler's decisions came before production of the aircraft even began, and even after production there were not enough planes for the decisions to have mattered. One of the main drawbacks of the German jet program was that there were simply not enough jets to make any difference. Hitler's decisions were impulsive, even absurd at times, but the Germans faced overwhelming odds against a materially superior enemy alliance.

Technology was the deciding factor in the development of the German jet program. The development of the jet engines seems in hindsight to have taken forever, while in reality the technological development followed logical and even accelerated

developmental timelines. A number of different variables had to be perfected, or at least tested, before the axial-flow Junkers Jumo 004 was developed. These included testing of the first German centrifugal-flow turbojets, characterized by the Heinkel HeS 3, and the theoretical development of compressors, combustion chambers, and turbines. It was the technological development of the engines for the Me 262 that took the longest, and in the end, were the weak link to the whole program. In fact, the airframe was unable to be completely tested until the engines were ready. In the service of *Ekdo* 262 the Me 262 was found to have major faults only when the engines could test the plane at the operational speeds. Then, the Me 262 had to undergo maintenance to correct structural problems discovered after high-speed trials took place. It was the engines that determined the developmental timeline of the Me 262; every other factor remained secondary.

Further, the development of the engines depended on the availability of resources within Germany. The Germans did not prepare adequately for a long war when it came to the acquisition of raw materials that were necessary for the development of the jet engine. However, even though it may seem this was a careless mistake, the Germans did not have any idea in 1936 of the amount of precious raw materials they would need as they had only the vaguest idea of the jet engine at the time. Lack of planning in 1936 in turn led to a dearth of raw materials for the future of the German jet program. But with hindsight it is easy to criticize; there was no prescience of the material needs for the jets.

When the Me 262 became operational there was no lack of experienced pilots for the jet. Many combat veterans were chosen or volunteered for operations with the jet units so that the best pilots of the Reich were lined up for service with the latest German

wonder weapon. Adolf Galland was instrumental with first setting up, and later forming under his own command, the only two jet fighter units in World War II. With the formation of *JG* 7, and later *JV* 44, the Germans were able to field the latest fighter with the most experienced cadre of pilots. The lack of experienced pilots did have a direct impact on the Luftwaffe as a whole, but the jet units did not suffer to the same extent. In the final months of the war, Germany's best pilots were privileged to fly the most advanced weapon available to them.

Furthermore, there was no shortage of fuel for the combat jet units. In comparison to the piston-engine planes of the Luftwaffe who were slowly starved of high-octane fuel by Allied raids, the jets had an ample supply of J2 diesel for operations. Diesel, which required less refinery, was not targeted by Allied bombing raids to the same extent as aviation-grade petroleum. High-octane fuel was used for both tanks and planes, and was a priority bomb target of the USAAF and British heavy bombers. However, diesel stockpiles, used primarily by the *Kriegsmarine* (German Navy) were not bombed to the same extent as the stockpiles and refineries for aviation fuel. Thus, even in the closing months of the war there was sufficient fuel for the Me 262s.

However, the Allies, through strategic bombing, did attain their goals. Not only did the Allies control most of the world's supply of raw materials, especially the metals used for the construction of aircraft and parts, but they also possessed the industrial base for equipping their fighting forces with overwhelming material superiority on a level unattainable by the Germans. In the final year of the war, the Allies amassed bomber fleets capable of mounting thousand-bomber raids deep into Germany. Added to this was the introduction of the P-51 Mustang long-range escort fighter by the Americans. The

USAAF then had the ability of providing fighter support for even the longest reaching bomber raids, and there was nothing the Germans could do to stop them. The Allies bombed Germany at will, destroying Germany's industry, oil production, and aircraft manufacturing. The Germans were forced into a battle of attrition for supremacy of the air; one in which they could not compete nor recover. The Allies crushed Germany not with quality but with quantity. In the end, even though the Germans possessed superior quality, the Allies won with numbers.

Finally, the Americans had atomic capabilities. There is no doubt that the Americans would not have hesitated to bring an end to the war in Europe with an atomic bomb similar to the ones dropped on Japan in August 1945. The war with Germany would have ended before the end of 1945 with an atomic bomb dropped on Berlin or any other German city.[1]

By the time the Me 262 reached operational squadrons the war was all but over for the Germans. In the end, Germany's lack of jet planes, planes that could not have been produced any sooner or in greater quantity, was irrelevant. The Me 262 was nothing but a marvelous example of German technology in the dying days of the war. The Me 262, and the whole German jet program followed a natural timeline to completion; one which could not have been accelerated. And considering it was under the constraints of a war, the development of jet power in Germany was an amazing accomplishment. In spite of a lack of materials, the constraints of technological advancement, and the Allies hammering away night and day, the development of the finest aircraft technology was unparalleled. However, in the end the jet did not save the Reich, the Germans were defeated by the incredible weight of Allied material superiority.

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[1] Manfred Boehme, JG 7, the World's First Jet Fighter Unit 1944/1945, (Atglen, Pa: Schiffer Military History, 1992), translated by David Johston, pp. 31.

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