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**THE BATTLE OF BRITAIN:
AN ANALYSIS IN TERMS OF CENTER OF GRAVITY,
CULMINATING POINT, FOG, FRICTION
AND THE STRONGER FORM OF WAR**

A Monograph

by

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United States Air Force

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The Battle of Britain: An Analysis in Terms of
Center of Gravity, Culminating Point, Fog,
Friction and the Stronger Form of War.

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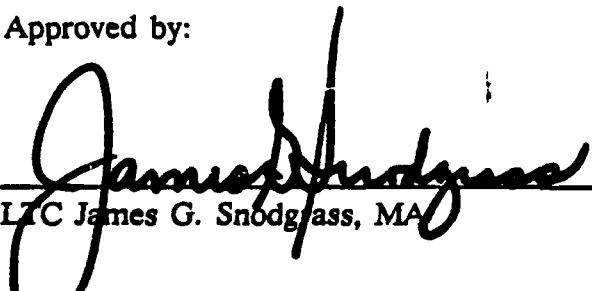
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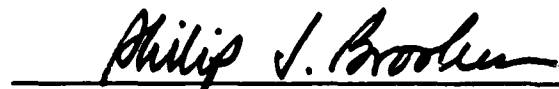
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ABSTRACT

THE BATTLE OF BRITAIN: AN ANALYSIS IN TERMS OF CENTER OF GRAVITY, CULMINATING POINT, FOG, FRICTION AND THE STRONGER FORM OF WAR by Oliver E. Lorenz, Major, USAF. 44 pages.

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The operational terms come from the works of Clausewitz and Jomini and are an integral part of FM 100-5, Operations. A model of center of gravity is presented to help visualize the concept and explain its importance. Center of gravity will be used more and more in Army writings and plans as they become more familiar and at ease with it.

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INTRODUCTION

The Air Force mission is to gain air supremacy and, by doing this, it indirectly supports the Army. Once air superiority is established, the Air Force directly supports the Army by air resupply and ground attack. It is important that Air Force officers understand and be able to apply the terms and ideas the ground commanders will be using. Common terminology leads to common understanding and can prevent critical errors. Do Army operational terms apply to an air battle? That is the main reason I decided to research the Battle of Britain. It was the first and arguably the only battle that was decided between opposing air elements without the direct involvement of ground or naval forces. This makes the Battle of Britain the "purest" use of air power on a grand scale.

Most of the operational terms I will use to analyze the Battle of Britain are contained in the Army's Field Manual 100-5, Operations. Other terms and ideas come from the works of the classical theorists Carl Von Clausewitz and Baron Henri Jomini whose writings have had a direct influence on FM 100-5. Clausewitz and Jomini were contemporaries of Napoleon who were trying to explain the great successes and influences Napoleon had

on warfare. Therefore Army doctrine can trace its origins back a couple of hundred years. The Air Force has only been around for 40 years and its doctrine is still evolving.

One of the most significant Clausewitzian concepts contained in FM 100-5 is the idea of "center of gravity." Clausewitz's center of gravity had a limited meaning which has been expanded in the modern interpretation in FM 100-5. Being able to identify and attack the enemy's center of gravity and protect your own, has been given a great deal of emphasis in FM 100-5. The concept will be used to analyze the Battle of Britain from the German standpoint, and an original model will be proposed to help identify and use the concept in future applications. The most important parts of the model are the relationship of Jomini's decisive points to the center of gravity, and the interrelation of the centers of gravity between levels of war.

Another Clausewitzian concept which will be examined is the superiority of the defense over the offense. Was the concept valid for the Battle of Britain? Also, how important a role did the "fog of war" and "friction" play in the outcome of the air battle? By answering these questions we may be able to discover if classical land warfare theory applies to air warfare.

CENTER OF GRAVITY AND DECISIVE POINTS

The idea of center of gravity is one of the most important concepts a military planner must understand. FM 100-5 says the essence of operational art "is the identification of the enemy's operational center of gravity...."¹ It is an idea that has generally been accepted throughout the Army. Air Force officers can expect to see more and more of the term as the Army uses it in their explanation of war plans, on exercises, and in professional articles. However, there are still some misconceptions about what a center of gravity is and to what levels of war it applies.

It is important for Air Force officers to understand center of gravity because it also applies to air operations. Center of gravity needs to be used when talking with the Army planner so he will understand Air Force concerns. It will also foster mutual understanding of important issues.

Clausewitz said, "One must keep the dominant characteristics of both belligerents in mind. Out of these characteristics a certain center of gravity develops, the hub of all power and movement, on which everything depends. That is the point against which all our energies should be directed."² Clausewitz went on

to say that at the strategic level there were five possible centers of gravity. They included the opposing nation's army, the capital, the army of the nation's protector, a key ally, and public opinion.³ Since Napoleon's time it has become increasingly more difficult to defeat a nation through one battle--the decisive battle. This is due to the vastness of area that an army or armies occupy, and also to the advances in technology. The only means now available to defeat an enemy is through the sequencing of major battles, major operations and campaigns.

FM 100-5 says center of gravity is "that capability, characteristic, or locality from which an armed force derives its freedom of action, physical strength or will to fight."⁴ It should be pointed out that Clausewitz's writings are based upon two levels of war, strategic and tactical, and that current Army doctrine is based upon three levels of war--tactical, operational and strategic. The Soviets think there are five. Center of gravity applies to all levels of war. While FM 100-5 states that all levels of war have centers of gravity, it is hard to envision a "hub of all power" at the tactical level. It would be easier if a new, less ostentatious term was used such as "Hub of Combat Power." This term is probably more applicable because at the

tactical level we are dealing primarily with a military orientation. At the operational and strategic levels, political, social and economic issues are involved and make up a major portion of their orientation.

Another concept which relates directly to center of gravity is the Jominian idea of decisive points. Jomini, who also was an interpreter of Napoleonic warfare, attributed Napoleon's success to his ability to know where the decisive points were and how to control them.

Jomini divided decisive points into two categories: geographic decisive points and decisive points of maneuver. Jomini called any point decisive if it was "capable of exercising a marked influence either upon the result of the campaign or upon a single enterprise."⁵ Attacking a decisive point should bring about the "most important results."⁶ Geographical decisive points are rivers, defiles, capitals, hills, and fortresses of lasting importance. As Jomini would say, they are "a consequence of the configuration of the country."⁷ Decisive points of maneuver are maneuvers "that can easily cut off the enemy from his base and supporting forces."⁸ From Jomini's definition of decisive points we can extrapolate that a decisive point is any force or decisive technology of the utmost importance to the enemy

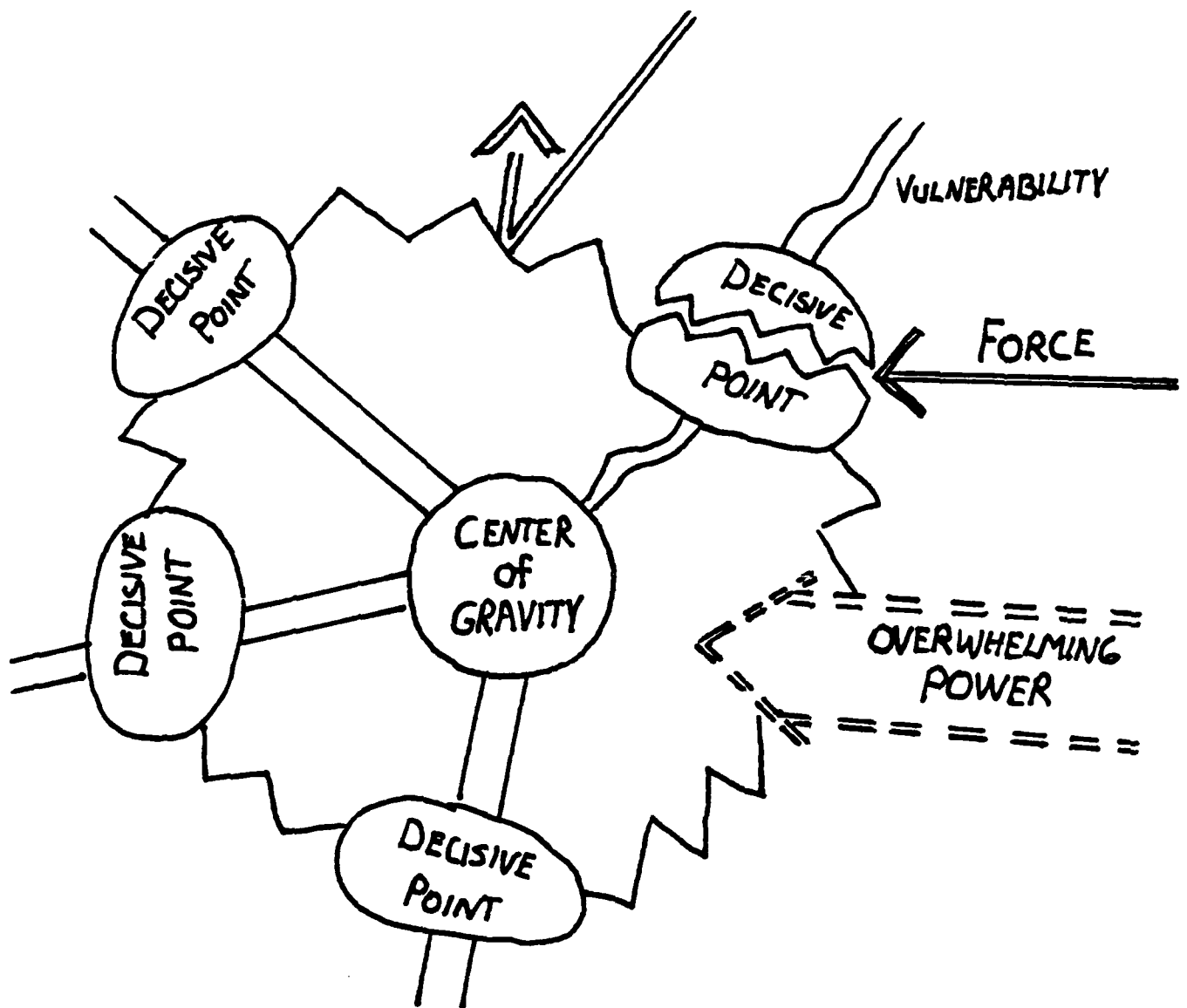
to maintain or secure his center of gravity.

Dr. James Schneider, School of Advanced Military Studies Professor of Military Theory, in his Theoretical Paper No 3: The Theory of Operational Art, further defines a decisive point as "any objective that will provide a force with marked advantage over his opponent."⁹ He also specifies that there are three kinds of decisive points--physical, cybernetic and moral. Physical decisive points would include Jomini's geographical decisive points plus other manmade objects such as bases of operations, bridges, buildings etc. Cybernetic decisive points might include communication centers or personalities, for example. The third type of decisive point, moral, concerns the will of the enemy or his morale.

Although the term center of gravity may be misleading for the tactical level of war, the concept is still valid. I believe the only way to attack a center of gravity is to attack it indirectly through decisive points. A commander must know what his opponent's center of gravity is so he can efficiently plan ways to attack it through its decisive points or vulnerabilities. His attacks must also be efficient because he cannot afford to waste combat power or other valuable resources on objectives that will not accomplish his or his

commander's goals. Just as important to the commander is being able to identify his own center of gravity. With this knowledge he can best protect himself and his most valuable resources and know when and where he can accept risk.

Enemy control of a decisive point can also be a vulnerability to a center of gravity, although decisive points themselves are not vulnerabilities. Since it is the hub of all power, a center of gravity can rarely be attacked directly. It can only be assaulted through vulnerabilities or decisive points. One would need overwhelming power to attack a center of gravity directly because it is likely to be strongly defended. For instance, the power posed by an operational level of war force could directly overpower a "hub of combat power." To help envision the relationship between centers of gravity and decisive points I have developed the following model.



A Model of Center of Gravity

Notice that the center of gravity or hub of combat power is surrounded by a shield that can only be broken in one of two ways. The first way the shield can be penetrated is by creating and exploiting vulnerabilities through control of decisive points. The second way to break the shield is by using overwhelming power or force. For instance, in the Battle of Britain, the British hub of combat power was its radar system. The radar system allowed the British to mass airpower at decisive times and places. They did not need to keep a roving cover airborne at all times. Therefore the British conserved fuel, minimized airframe maintenance and allowed their pilots valuable rest time. Also, a lot more of the German raids would have penetrated without being intercepted because of the inability of the British to anticipate attacks or cover the entire sky.

The decisive points around the radar system which the Germans needed to attack to reduce its effectiveness were the radar masts, the radar station houses, Fighter Command's Filter Room (which took cross bearings to "pinpoint" direction), Fighter Command Operations Room, the Observer Corps, and the associated airfields with their fighter aircraft. Obviously, the problem was not an easy one for the Germans. It is interesting to note that British radar interest had started in 1934 because

of the immense public alarm caused by the notion that bombers would always get through. Henry Tizard, a noted British scientist, headed a committee that asked Robert Watson-Watt if a "death ray" could be developed to destroy enemy aircraft. From the idea of a death ray, radar was developed. The British radar system was made up of 22 low (chain home low radar stations), 22 high (chain home radar stations) and 5 mixed low and high stations.¹⁰ Since the stations only faced out to sea, an extensive observer corps tracked invading aircraft through visual plots once they reached the channel coast.

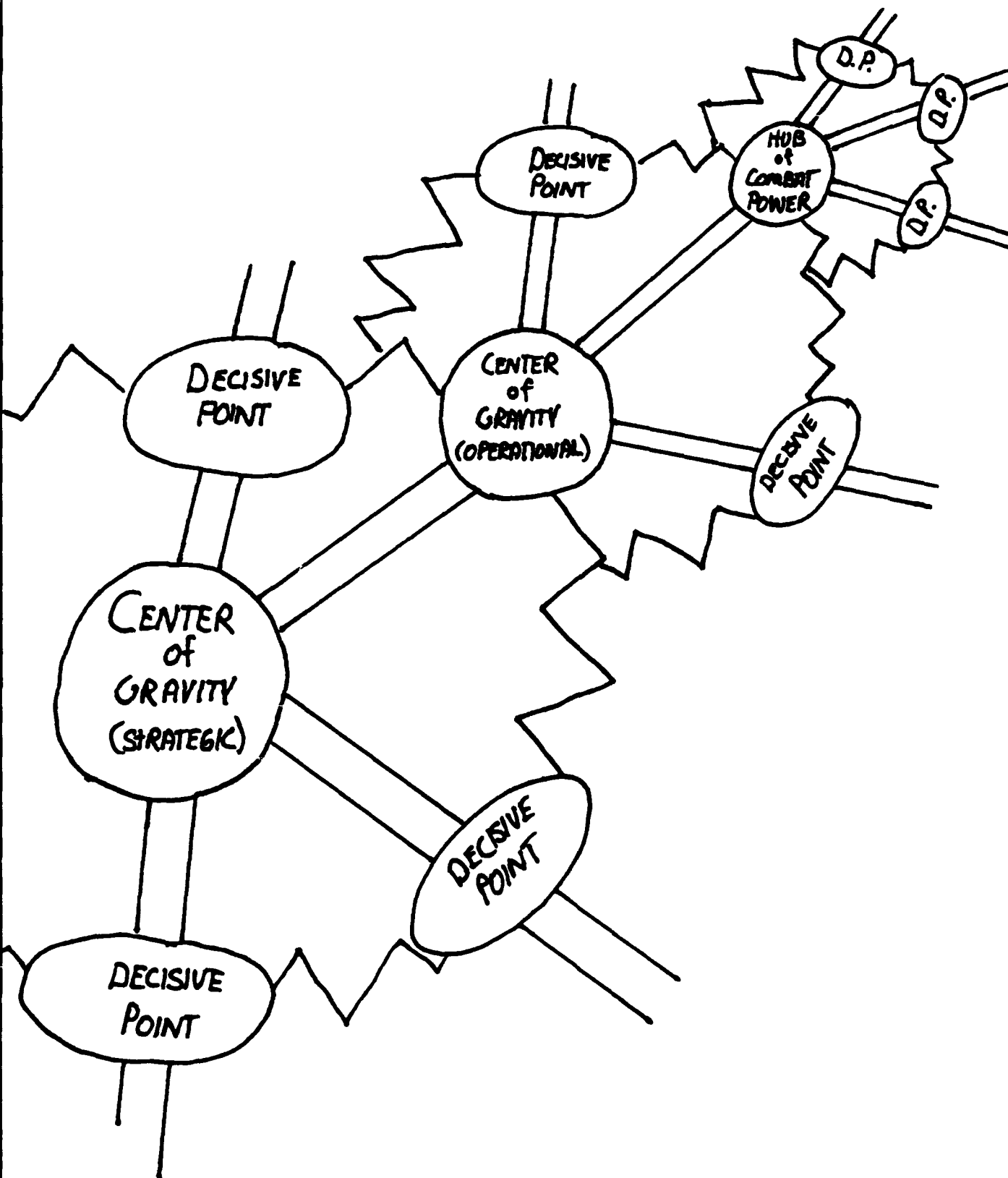
To destroy the hub of combat power completely would have required a massive effort by the Germans in terms of sorties and ammunition expended, and the destruction would have had to have been repeated often. During the war the longest period a station was down was two weeks, although the Germans had attacked several stations that were back up after only a few hours.¹¹

Another part of my model is the requirement for overwhelming power to directly attack a center of gravity (hub of combat power). There are only two instances I can foresee that a center of gravity could be attacked directly. First, by the massing of all or most of one combatant's forces against a segment of the other's forces. Second, where the nations at war are so

mismatched that one has overwhelming forces at each level.

In the last example, a massive attack against the radar system might have taken the form of a combined and coordinated naval, air and ground attack (commando raids), or, in other words, a strategic level attack to neutralize it. A well planned and executed bomber attack involving all aircraft concentrated against the radar stations (operational level) could have neutralized it as well.

The third part of my model is the interaction between the centers of gravity at the different levels of war. It is possible that the hub of combat power (tactical level) could be a decisive point for the operational level of war, and the operational level of war's center of gravity could be a decisive point for the strategic level of war. The following diagram expands my original model to show this relationship.



Center of Gravity at the Levels of War

If the British tactical hub of combat power was the radar system, then the operational center of gravity for the British may have been Fighter Command. Decisive points and vulnerabilities for the Germans to attack in order to weaken the center of gravity would include the radar system, fighter aircraft, the airfields, command and control systems, and fighter production factories. It could be argued that the strategic level center of gravity for the British was the Empire. Some decisive points around this center of gravity include alliances, lines of communication, naval forces, and sources of supply.

Center of gravity is an important idea to keep in mind when devising plans to attack the enemy. It is quite easy to misdirect one's effort by not attacking decisive points or areas which are not directly related to the enemy's center of gravity. This would be a waste of combat power. It is also important to realize that the center of gravity may change over time because of losses incurred or significant changes in strength, technology or other outside forces. When trying to identify the center of gravity, ask the following questions; 1) Is this the center of all power? or 2) Is this a vulnerability? This is extremely important because if you say, "all I have to do is destroy the

'such and such', and I've beaten the enemy," then you have identified a vulnerability and not the center of gravity. It is also important to identify your own center of gravity and decisive points (or vulnerabilities) in order to protect them or at least know what risks they are being exposed to. Now let us examine what the Germans did during the Battle of Britain about the British center of gravity.

BRITAIN PREPARES FOR WAR

Several key developments occurred before the outbreak of war that allowed Britain to win the Battle of Britain. Previously I explained the fortunate and timely development of radar. Much of the credit for its development into a radar chain must go to Sir Hugh Dowding, Fighter Command's Commander-in-Chief, and to Henry Tizard. Besides the radar system, other key elements were the development of the Spitfire fighter aircraft and the fighter control system, and Britain's ability to maintain a high aircraft production rate.

The design and subsequent production of the Spitfire was the direct result of civilian interest. After World War I and until the beginning of World War II, British strategy was based upon the belief that the bomber would

always get through. This belief can be traced to two sources: first, the writings of Giulio Douhet and Billy Mitchell; and second, reactions based on the bombing of London by the Germans at the end of World War I. Also playing an important role was the fact that initially the bomber was just as fast, if not faster, than the fighters of the time, and that there was not any reliable means to intercept bombers. In addition, fighter development after World War I was very slow. Bi-planes were the norm; in fact the British had several squadrons of bi-planes, the Gloster Gladiator II, in the Battle of Britain.¹² They suffered devastating losses. Engine development was very slow and was the limiting feature of the high speed fighter.

The great turnaround for the British after the First World War came in its competition for the Schneider Trophy. The Schneider Trophy race series began in 1912 between amphibious aircraft over a 150 mile course. The first race after the war was in 1919. New designs and engines were constantly being tested during the races. From 1922 to 1931 the average speed increased from 146 miles per hour to 340 miles per hour. Britain won the race in 1929 and 1930.¹³ It was only because of private capital that the British won the trophy for the third time in 1931, becoming its permanent holder.¹⁴ The

aircraft that won that race was the Mitchell designed SG-6 airframe, with a Rolls-Royce engine, the forerunner of the Spitfire. Reginald Mitchell began design of the Supermarine Spitfire in 1933 to fulfill the Air Ministry's specification F7/30.¹⁵ In 1935, after an initial failure with a prototype, the Spitfire as we know it was designed around the Rolls-Royce PV-12 engine.

Spitfire and Hurricane production before and during the Battle of Britain was the direct result of the hard work and innovative thinking of newspaper tycoon, Lord Beaverbrook. At this time he was the head of the newly established Ministry of Aircraft Production and it was his direct intervention that increased production of fighter over bombers in the summer of 1940.¹⁶ Another of Beaverbrook's ideas was the purchase and ferrying of aircraft across the Atlantic from the United States. Before this, the aircraft were sent by ship, which took a considerably greater length of time. He also contracted for American Packard to produce Rolls-Royce Merlin engines after Ford refused to become involved in the war effort.¹⁷ Under his tutelage monthly fighter production rose from 155 in the first quarter 1944 to 340, 563, and 420 aircraft in the following quarters.¹⁸ On the other hand, German aircraft production was only 156 per month.¹⁹ These differences would later prove to

be critical.

The excellent fighter control system owed its existence to the extraordinary organizational skills of Sir Hugh Dowding. Dowding served in the Royal Flying Corps in World War I. He was a Squadron Commander in 1915 and rose to the rank of Brigadier by 1918 and subsequently transferred to the new Royal Air Force upon its formation. It was on his authority that the first radar tests were carried out.²⁰

After becoming Commander-in-Chief of Fighter Command, Dowding continued working on the defensive aspects of his command. He was instrumental in husbanding several squadrons of fighter aircraft from employment, and probably kept them from becoming lost during the latter stages of the Battle of France. He was constantly having to fight with the Air Ministry over his defense systems--including his plan to convert grass runways to concrete.²¹

His defense system also included identical operations rooms in Fighter Command headquarters, in the groups and in the sectors. This system allowed for the initially outnumbered fighters to be passed efficiently from sector to sector and group to group. The operation rooms were also linked to the radar chain and the Observer Corps.

One of Dowding's more far-reaching ideas was to send only limited numbers of fighters to intercept incoming German raids. His primary concern was to keep Fighter Command alive to do its job, using the center of gravity to strike the enemy while protecting it from destruction. He was constantly hounded by the "Big Wing" advocates who insisted that several fighter squadrons and groups should be gathered to strike at the enemy formations.²² The greatest drawback to this scheme was that it required a considerable time to gather the forces and get them to altitude to face the German armadas. The fledgling radar chain did not allow for the necessary warning time to make this feasible. Another measure Dowding used to conserve his fighter force was to insist that his fighters only attack German bombers and not get into aerial duels with fighters.

THE BATTLE OF BRITAIN

The Luftwaffe of the 1930's and 1940's can be likened to the phoenix; it rose from its ashes of World War I. With the signing of the Versailles Peace Treaty after World War I, heavy restrictions were placed on the Germans, preventing them from developing a military air fleet. However, they were able to evade the restrictions

by cultivating highly trained air crews through civil aviation.²³ Germany's civil aviation program was larger than the international systems of Britain and France combined.²⁴ Germany also had large air sporting clubs that doubled in size from 1926 to 1929 (50,000 members).²⁵

The Luftwaffe had several glaring weaknesses which were exposed during the Battle of Britain. It was designed as a short range tactical air force, with excellent air-ground coordination, but lacked a strategic bomber. Their chief long range bomber advocate, General Weaver, the Luftwaffe's first Chief of Staff, was killed in an air crash in 1936.²⁶ Kesselring and Goering did not think much of big expensive bombers so the strategic bomber program did not get off the ground after they took over. Other deficiencies of the Luftwaffe were that it did not have adequate reserves and that it did not keep pace with technological change.²⁷ The early aircraft were well suited for war in 1939 and 1940, but fighter development did not keep pace with the faster and more agile fighters the allies were producing. Production rates were also meager for a country embarking upon war. Hitler had a strong desire to keep the "bread and butter" industries at full strength instead of devoting production to "bullets."

The greatest advantage the Luftwaffe had going into World War II was a large force of highly skilled pilots with combat time acquired during the Spanish Civil War.²⁸ Initially, the Luftwaffe had little problem over the skies of Poland in support of the Army's quick victory. However during this short campaign the Luftwaffe lost 285 aircraft and expended half of its stockpile of bombs.²⁹ Also, when Germany invaded Belgium, the Dutch and Belgian air forces were destroyed in a matter of hours, and during the battle of France, the French air force did not fare much better. Most of its aircraft were destroyed on the ground in preemptive strikes. The Luftwaffe's attacks in support of the German advance to the Atlantic were well coordinated. Besides the losses inflicted upon the Dutch, Belgian and French air arms, the British lost over 1,000 aircraft, 50% of those being fighters.³⁰ German morale was at its highest. Hitler had still not decided on his plans for an invasion of Britain. He hoped that the losses the British had incurred and the devastating power he had showed them would be enough to force the British to capitulate.

Hitler was also concerned about the threat to the east that the Russians imposed. On 2 June Hitler said, "Now that Britain will presumably be willing to make peace, I will begin the final settlement of scores with

bolshevism."³¹ Contingency plans were still made in case an invasion of Britain was necessary.

Germany's campaign against Britain can be divided into three phases. In looking at these three phases, we can see how the misapplication of forces and the misidentification of an enemy's center of gravity can cause an entire operation to misfire. Indeed, we can also recognize that even though the center of gravity is properly identified, if the proper resolve is absent or if all resources are not concentrated against the decisive points, the result will also be failure.

Three of Hitler's directives had an impact upon phase I. Operations against Britain can be traced back to Hitler's Directive No. 1 issued on 31 April 1939. In this directive, Hitler wanted the Luftwaffe to "take measures to dislocate English imports, the armaments industry, and the transport of troops to France."³² He insisted that no attacks be made against the island, but marine type targets could be struck.

It was Directive No. 9 that emphasized the importance of defeating Britain so that a "full victory" could be achieved.³³ As in the previous directives, maritime targets were of primary concern. Before a full campaign could be waged against the British it was imperative that the channel coast be occupied so that the

mainland would be within easier striking distance.

In Directive No. 13 Hitler laid out his plans for the Luftwaffe mission against the British homeland.³⁴ The Luftwaffe began its campaign against Britain on 5 June 1940. In this first phase, the Germans directed their attacks against merchant shipping, naval vessels, harbours and ports. The overall strategy was still to gain air supremacy over the Channel and southeastern England. Goering hoped when he issued his General Directive for the Operation of the Luftwaffe against England that he could coax the British to defend in the air and therefore destroy the British fighters.³⁵

Hitler did not have a plan for the invasion of Britain until 13 July. Operation Sealion was originally slated for mid-August but was postponed until 17 September.³⁶ Kanalkampf was launched to set the conditions needed for the invasion on Britain. Although the coastal attacks had occurred for several weeks, 10 July was the day officially nominated as the start of the Battle of Britain. Kanalkampf was characterized by many fighter sweeps with and without the accompaniment of bombing raids. Mostly the sweeps came out empty handed, and the operation was a failure. The navy was harassed, but only a few thousand tons of shipping was sunk.³⁷ The fighter sweeps were not having the desired results.

Fighter Command was avoiding the BF-109s and attacking the lightly armed bombers. Throughout the first phase, 1 July-11 August, British losses were 186 while the Luftwaffe lost 320 aircraft.³⁸

We can see that the objectives in Phase I were to attack "strategic" targets such as hitting coastal targets and cutting supplies to and from England. Why then was it Goering's main aim to lure fighters into the air? What we see is an obvious lack of coordination and massed effort against one type of target. Detailed planning and execution were not evident. What about the British radar chain? The Germans were aware of the masts and their purpose. They had done experiments with radar themselves (and were to build some sites near Calais before D-Day). In early July several raids were made on radar sites but the results were inconclusive. The attacks lacked weight and were poorly planned and therefore the results were poor.³⁹ There were even reports suggesting that the radar sites should not be attacked. Perhaps Fighter Command would then be encouraged to intercept the bomber raids and enable the Luftwaffe to "destroy" them in the air.⁴⁰

On 1 August, Hitler finally gave his authorization for the Luftwaffe to begin preparation for the full scale attack of Britain that was to precede the cross channel

invasion. Thirteen August was picked as Adlertag--Eagle Day--because of favorable weather forecasts.⁴¹

Eagle Day continued the confusion and poor planning that characterized the first phase, but it came within weeks of accomplishing the results Hitler needed to set the conditions for the invasion of Britain. The Adlerangriff (Eagle Attack) plan called for the destruction of the Royal Air Force. The 2nd and 3rd Luftflotten were to attack Fighter Command through its airplanes, airfields, radar stations, and command and control system.

On 13 August Adlerangriff was launched. The weather forecast that morning called for low clouds, mist, and drizzle, so Goering ordered a postponement.⁴² But not all squadrons were reached, and several squadrons proceeded on the attack only to suffer heavy losses. Later that day the weather improved and Adlertag was back on. The British flew 700 sorties and lost 13 fighters. The Germans flew 1485 missions and lost 34 aircraft.⁴³ Due to poor intelligence and an inability to concentrate forces, little damage was done. Airfields were hit that housed few aircraft, and the important airfields and factories were bypassed. The Luftwaffe claimed it had destroyed 134 British aircraft.⁴⁴ They also claimed the destruction of eight major fighter bases.⁴⁵

As could be seen in the first phase, the Luftwaffe continued to strike at targets that had no direct bearing on the planned target, in this case Fighter Command. Bomber bases were hit. "Nine attempts were made to bomb the Westland, Rolls-Royce and Closter works, but only twice did the bombs fall within five miles of the target."⁴⁶ Losses from 13 to 18 August were 350 aircraft lost for the Luftwaffe and 171 for Fighter Command.⁴⁷

On 15 August Goering held a conference for his commanders and insisted that no more attacks would be wasted on British radar stations.⁴⁸ He felt the attacks so far had had no effect upon the network. This was a fatal mistake. Five Stukas damaged Ventnor radar so badly that it was off the air for a week.⁴⁹ The radar station on the Isle of Wight was heavily damaged. Another outcome of the meeting was that Luftwaffe tactics were changed so that fighters flew with the bombers to give them immediate support, instead of "free ranging top cover."⁵⁰ Weather and the Luftwaffe's reorganization allowed the British a breather from the 19th to the 23rd of August. Several fighter groups were moved to Pas de Calais so that they would be closer to England and therefore allow them to range farther.

The second phase was much better planned compared

with the first phase; some forces were massed to strike directly at Fighter Command, its airfields and aircraft production facilities. In this phase, Fighter Command came the closest to being destroyed. Britain lost 273 fighters to the Germans 308 aircraft.⁵¹ The ratio was nearly one to one. The British also had a significant shortage of pilots caused by the loss of men who were shot down and the length of time required to bring a new pilot up to full mission ready status. Since July, Fighter Command had lost 11 of 46 squadron commanders and 39 of 97 flight commanders. If the pace could have been kept up for 4 to 5 weeks more, the conditions would have been met for the invasion of Britain.⁵²

The German pilots were becoming more and more discouraged. They were told that they were destroying significant numbers of the enemy's fighters. Why was it then, they asked themselves, that the numbers of aircraft intercepting them were not different? Time was running out for Goering. Autumn's poor weather would force the postponement of Operation Sealion indefinitely.

One of the fortuitous accidents of war occurred for the British on 24 August 1940. A German night bomber attack overshot their target and bombed London by accident. The following night the British retaliated by sending eighty-one bombers against Berlin and

subsequently bombed Berlin three more nights in the next week.⁵³ Before this, Hitler had forbidden the Luftwaffe from bombing London for political and military reasons.⁵⁴ He did not want international outrage to be focused against him any more than it already was. But he could not allow the British attacks to go unanswered. These events led to the third phase of the Battle of Britain--the Blitz. More significantly, it gave Fighter Command a reprieve.

On 7 September, Goering launched 680 bomber sorties against the London docks. This was the first strike of an effort designed to bring Britain to her knees by attacking the will of the people. With the focus now on London, Fighter Command was able to rebuild its runways, replenish its resources, and allow its pilots a measure of relief from the constant attacks on their bases. Their job was not over, but at least now they were not the main target for the Luftwaffe. In addition, the weather started to play into their hands. Autumn, with its unfavorable flying weather, was rapidly approaching, and the Germans were finding it difficult to keep a concentrated effort in effect.

We can see that many factors allowed the British to hold off Operation Sealion--the invasion of Britain. Air supremacy for the Germans, their primary prerequisite for

invasion, had not been met.

Hitler was indecisive during the first phase: he wavered between invading or seeking a political solution. He had hoped that a continued attack against British shipping, harbours and ports would bring Britain to the bargaining table. Hitler knew the British were stubborn but was not ready for how stubborn they could really be. It was also in this first phase that Goering hoped that he could lure Fighter Command to attack his fighter sweeps and bomber raids, so that his fighters could attack the intercepting fighters.

Dowding displayed operational vision and strength of will and did not allow his Fighter Command to fall for the German tricks. He insisted that his fighters only attack the bombers, and that they attack only in small groups. His major concern was to keep Fighter Command alive and able to continue the fight. He was successful.

In the second phase the Luftwaffe came the closest to reaching its goal of air supremacy. Goering realized that Fighter Command (as one British center of gravity) must be destroyed in order for the Germans to have air supremacy, but most importantly they would need to attack the British airfields, the fighters on the ground, the command and control centers and the fighter production factories to meet his ultimate goal. Goering had

correctly identified one British center of gravity and its decisive points. But there were two problems with his campaign. First, after getting reports of poor results he did not continue a concentrated effort against the radar stations (Hub of Combat Power). If Fighter Command could have been blinded or if fighters could have been caught on the ground, the Germans would not have suffered as many losses. Second, he did not concentrate all his efforts against Fighter Command. His night bombers attacked airfields, cities, and secondary industries that had nothing to do with Fighter Command. He did not pick the correct decisive points or vulnerabilities for Fighter Command. The decisive points he did correctly identify did not get the concentration of combat power they needed to be incapacitated.

The third phase of the Battle of Britain had little effect upon Fighter Command. In fact, Fighter Command was able to rebuild. All these factors played a major part in the Luftwaffe's failure to gain air supremacy and without air supremacy Hitler would not allow the invasion of Britain.

CULMINATING POINT

Had the Germans reached their culminating point? What is a culminating point? Clausewitz described the culminating point as "the point where the remaining strength is just enough to maintain a defense and wait for peace."⁵⁵ FM 100-5 explains it further. "Unless it is strategically decisive, every offensive operation will sooner or later reach a point where the strength of the attacker no longer significantly exceeds that of the defender, and beyond which continued offensive operations therefore risk overextension, counterattack, and defeat."⁵⁶

We can see then that materially the Luftwaffe had not reached its culminating point. It could and did continue to fight in other theaters. But it could be said that its leadership (Hitler) had reached its culminating point and had been persuaded to seek other strategic goals.

Culminating point is a very important idea for Air Force commanders to understand. When an Army unit reaches its culminating point, the commander can do one of two things. He can stop and defend or he can accept a high degree of risk and continue the attack. To prevent the culminating point, the commander should create a

pause in his attack in order to replenish his supplies and to confirm his intelligence and battle plans. Either case can change his requirements for air power. If he has anticipated his culminating point then there will be no need for changes, but if he has not anticipated all the factors affecting his progress then his requirement for air power will change dramatically. More importantly, an Air Force commander must recognize that he too has a culminating point. It could be based upon fuel, munitions, airframes, pilot exhaustion or crew duty hours. He should also realize that a mere over-extension is not a culminating point. An over-extension can be recovered from without the need to go on the defense.

FOG AND FRICTION

Fog and friction are two more Clausewitzian terms which address the problems that occur in combat and can turn a simple activity into a mammoth task. Clausewitz described friction as "countless minor incidents--the kind you can never foresee--[that] combine to lower the general level of performance, so that one always falls far short of the intended goal."⁵⁷ Friction must be accounted for, not the specific frictional events, but as a whole in the amount of forces and time needed to

overcome it. All friction cannot be taken out of a military action, but some events can be planned for and their effect reduced.

An example in which a major source of friction had cascading results upon the Battle of Britain was the accidental bombing of London by the Germans. Because the Germans mistakenly bombed London, the British increased the ante and bombed Berlin several times in retaliation. These bombings caused the Germans to stop their Phase II operations at the brink of success and initiated the Blitz on London. Weather was another frictional problem for the Germans. It prohibited them from concentrating over several days on the targets they needed to have the desired effect upon Fighter Command.

The "fog of war" tends to have the same effects upon organizations and plans that friction does, but it is impossible to foresee. "Fog in war is the obscuration of reality.....it hides the true nature of the battlefield."⁵⁸ In the Battle of Britain there are a couple of good examples of fog; both have to do with incorrect intelligence the Luftwaffe had about the British. First, throughout the Battle of Britain the Luftwaffe based all its figures about production rates of the British aircraft factories on 150 to 190 fighters per month. As previously stated, Lord Beaverbrook was able

to coax British factories into a production rate of well over 400 aircraft per month. Also German figures did not consider aircraft the British were able to repair. These two incorrect judgments by the Luftwaffe led them to make "false" claims to their own pilots and to Hitler. Pilot morale was low because they expected to encounter decreasing numbers of British aircraft but this expectation was never realized. In addition, the Germans had no idea of "the brilliant British fighter direction system." They thought the British system was inflexible and poorly managed.

ATTACK AND DEFENSE

Clausewitz believed that, all things being equal, the defense was the stronger form of war.⁵⁹ Does this apply to air warfare? Dr. Schneider said that defense was the stronger form of war because "the defender is at rest, he is not subject to the exhausting forces of friction as is the attacker."⁶⁰ In aerial combat the defender is not at rest, therefore he does not have the advantages a ground defender would have. However, in the Battle of Britain, Fighter Command was able to remain on the ground and thereby conserve and prevent pilot over-taxation until a raid was positively identified, and then

launch to attack the enemy. Strategically, they may have been on the defensive, but tactically they were on the offensive. Dr. Schneider also notes that the defender has the advantage of being deployed and has knowledge of the terrain.⁸¹ The sky shows no favor. There is no terrain to contend with and, therefore, all combatants are treated equally. The only advantage for the British or Germans was who was at altitude, had time on station, or who could attack from out of the sun. The Germans had the advantage of altitude. They took time to climb to altitude before transiting the channel. The British, on the other hand, only had limited warning to climb to altitude before the raid was over England. Clausewitz would call this a tactical defense because "a battle is defensive if we await the attack--await that is, the appearance of the enemy in front of your lines and within range."⁸²

The British did have the major advantage of being closer to their home bases. Dr. Schneider maintains that the defender has logistical support close at hand.⁸³ But in tactical aerial combat, fighter against fighter, flight versus flight, it is the attacker, the aggressor, who will win the dog fight. Clausewitz went on to say "tactically every engagement, large or small, is defensive if we leave the initiative with our

opponent..."⁶⁴ Therefore, we are not defensive if we take the initiative.

I believe that aerial combat, relative to the offense or defense being the superior form of war, is like a pendulum. When aerial combat was plane versus plane, the offense was the stronger form of war. As technology has advanced to ground to air weapons becoming involved, the defense has been the stronger form of war. As we advance to weapons that will decoy, spoof or render less effective ground weapons, the pendulum will swing again. In the Arab-Israeli war of 1967, the air attacker had the advantage. In 1973 the defense was superior for the Egyptians until the Israelis were able to use ground units to destroy the air defenses, so the air force could continue its support of the army. The pendulum swings. For the British in the Battle of Britain, the defense was the stronger form of war overall.

CONCLUSIONS

At the beginning of this paper I presented a model to make it easier to understand the idea of center of gravity and decisive points. Center of gravity will be used more and more in Army writings and plans as they

become more familiar and at ease with it. Therefore, for that reason alone, Air Force officers should become more familiar with it and be able to understand and apply it. Most importantly, it is a concept that can apply to Air Force operations. There is also a distinct relationship between decisive points and the center of gravity. A center of gravity can rarely be struck directly. It is only through decisive points or other vulnerabilities that it can be reached. It is very important that effort and combat power not be wasted on non-decisive points or on attacks that will not help the commander reach his objectives.

As we saw in our review of the Battle of Britain, in Phase I Germany mistakenly attacked targets that did not help them towards their primary goal of air supremacy over England. The hub of combat power, the British radar chain, should have been destroyed through a concentrated effort. Once the radar system had been rendered impotent, the Germans would have had a shortcut to Fighter Command and air supremacy could have been realized. Only the operational or strategic levels of war forces had the overwhelming combat power available to destroy this hub of combat power.

During Phase II, the Germans correctly identified Fighter Command as their main obstacle for air supremacy

(center of gravity) and they came very close to reaching their objective except for two main problems. First, as in Phase I, they did not concentrate (mass) their effort. They also had poor intelligence about British fighter production rates causing them to make false estimates on the completion time of their effort. Although the Luftwaffe had not reached its culminating point, their political leader had. Hitler's concern had turned toward Russia. The fortuitous accidental bombing of London led to the Blitz, the end of Phase II and the near conquest of Britain.

Fog and Friction will always be present, but that does not mean we cannot try to plan for it or try to overcome it. It is only through excellent planning that its effect can be lessened. Dr. Schneider would say that extra combat power must be planned for and expended to overcome friction.⁶⁵ Of all the theories and their terms I have studied, the idea that the defense is the strongest form of war has been the hardest to apply to air warfare. By its nature, I feel that airpower is an offensive tool and stronger in the attack. During the Battle of Britain, the defensive use of airpower proved to be the strongest form of war, but it would be easy to "what if" the German side, to suggest the opposite. Technology has been the pendulum that controls, for

airpower, whether the attack or the defense is the stronger form of war. Measures and counter measures control airpower's destiny. A force on the defense meets the attacker when and where the attacker chooses. The defender has the easier job since he has only to frustrate the attacker.

I chose the Battle of Britain for my application of land warfare theories and terms because it was unique. Does that mean that there will be no more "battles" like the Battle of Britain? Yes and no. Yes, the Battle of Britain was unique because no more will an entire campaign be fought between two air armadas to determine the outcome of the campaign. But for the fleetest of time in all future wars there will be a battle to determine air supremacy, and thereafter the air war will be fought in conjunction with a ground campaign. For that reason alone it is important for Air Force officers to understand the theories and terms that will be used to describe the ground war since we will work closely with the Army to win it. We have seen that center of gravity, fog, friction and culminating point apply to air warfare.

ENDNOTES

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