

*Airpower in the Battle of the Bulge:
A Case for Effects-Based Operations?*

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It should ...be clearly understood that the conditions envisioned throughout are those of a campaign on land in which the primary problem at the time is the defeat of an enemy army in the field.¹

J.C. Slessor, 1936

These words were penned in the introduction to Wing Commander Slessor's work, *Air Power and Armies*, the published version of lectures he presented to his army brethren at the Staff College, Camberley in the mid-1930s. Like Slessor's work, this paper is focused historically on an air effort to defeat an enemy army, or in this case an army group—Field Marshal Walter Model's Army Group B, the operational formation to which Adolf Hitler entrusted his last, desperate gamble to win World War II—a campaign that became known in history as the Battle of the Bulge. But in keeping with the theme of "New Perspectives," it will relate the course and consequences of that campaign to an ongoing doctrinal debate in the American armed forces over a concept known as Effects-Based Operations, or EBO. The issue on the table is to determine the

¹ J.C. Slessor, *Air Power and Armies* (London: Oxford University Press, 1936), p. xi.

extent to which the evidence of using airpower in the Bulge confirms, qualifies, or refutes the tenets of EBO.

While this question may seem somewhat arcane, it is not without consequence. Man's long experience of war has repeatedly demonstrated that the ways in which men, weapons, and ideas are melded together can frequently mean the difference between victory and defeat. And while each of these elements is important and necessary, concepts about how to fight frequently emerge as the crucial element that binds men and weapons together. Thus, contrary to the shortsightedness of the "purely practical" warrior, ideas *do* matter.

The idea for EBO has a lineage that goes back too far to trace fully in a treatment of this length, but it found its first expression and most ardent advocacy in the life of an American airman who as a lieutenant colonel in the early 1990s was both a subordinate and an admirer of Colonel John Warden, a man of restless intellectual energy who is thought by some to have sparked a renaissance in airpower thinking in the late twentieth century.² That lieutenant colonel has now risen to the grade of lieutenant general—his name is David Deptula.

In August 1990, shortly after the Iraqi invasion of Kuwait, Deptula found himself as the principal ideas man in a facility known as "the Black Hole," a bunker in Riyadh where the design of air operations against Iraq was hammered out.³ As one of the architects of the stunningly successful application of airpower in the First Gulf War, Deptula penned a 1995 paper somewhat immodestly titled, "Firing for Effect: Change in the Nature of Warfare". Building on Warden's idea of parallel warfare, i.e., simultaneous, rather than sequential, attack of enemy targets, Deptula argued that airmen should concentrate on achieving effects, not merely destroying targets. His central proposition was that "Action to induce specific effects rather than simply destruction of the [enemy's] sub-systems making up each of these strategic systems or 'centers of gravity' is the foundation of the concept of parallel war."⁴ In an attempt to

² John Andreas Olsen, *John Warden and the Renaissance of American Air Power* (Washington: Potomac Books, 2007).

³ Edward C. Mann III, *Thunder and Lightning: Desert Storm and the Airpower Debates* (Maxwell AFB, AL: Air University Press, 1995), p. 46n.

⁴ David Deptula, *Firing for Effect: Change in the Nature of Warfare* (Arlington, Va.: Aerospace Education Foundation, 1995), p. 5.

broaden the concept and have it embraced by the other services as a joint construct, the paper was re-published in 2001 under the title, "Effects-Based Operations".⁵

The reaction of the other services was uneven. The Navy felt EBO fit nicely into its concept of "Network-Centric Warfare"; the Army, though skeptical, blended EBO into its artillery doctrine for a while; but the Marine Corps evinced a distrust bordering on hostility, deriding the airpower dominance theme of Deptula's work and deeply suspicious of its emphases on technological superiority and centralized control. These sentiments came to a head on August 14, 2008, when General James N. Mattis, USMC, from his position of commander, US Joint Forces Command, or JFCOM, directed that "Effective immediately US JFCOM will no longer use, sponsor, or export the terms and concepts related to EBO [and two additional constructs] in our training, doctrine, development and support of JPME [Joint Professional Military Education]."⁶ Effects-Based Operations are now in a sort of doctrinal limbo, with the Air Force continuing to argue for their utility and the joint doctrinal community, personified by JFCOM, which appears to consider itself to be in a post-EBO universe.

To assess the efficacy of EBO, we must now shift gears rather abruptly and go back to mid-December 1944 when Model's Army Group B was assembled on Germany's western border and poised to unleash one of the more dramatic strategic surprises in annals of twentieth-century warfare. We shall begin this analysis with a brief comparison of the contending air forces.⁷

The Contending Air Forces

Unlike the ground formations, in which one could argue there existed a rough parity with each side having offsetting advantages and disadvantages, the American

⁵ David Deptula, *Effects-Based Operations: Change in the Nature of Warfare* (Arlington, Va.: Aerospace Education Foundation, 2001).

⁶ J.N. Mattis, "MEMORANDUM FOR U.S. JOINT FORCES COMMAND, Subject: Assessment of Effects Based Operations," 14 August 2008, Internet, smallwarsjournal.com/documents/usjfbomemo.pdf, accessed 17 December 2009.

⁷ The historical analysis that follows is based on Harold Winton, *Corps Commanders of the Bulge: Six American Generals and Victory in the Ardennes* (Lawrence: University Press of Kansas, 2007), passim.

superiority in the air was simply overwhelming. The tactical forces were particularly impressive. Major General Hoyt Vandenberg's Ninth Air Force alone had some 1,000 medium and light bombers and roughly 1,700 fighters, mostly P-47 thunderbolts.⁸ The P-47's robust air-cooled engine, sturdy air frame, and substantial weapons-carrying capacity made it the fighter most loved by American pilots and GIs alike and most dreaded by the German soldiers who referred to it as the "Jagbo," short for "Jagdbomber," or hunter-bomber.⁹ Air Marshal Arthur Coningham's 2nd Tactical Air Force [TAF] was also formidable. His arsenal of nearly 1,300 planes, consisting of sturdy and capable Wellington medium bombers; fast, maneuverable Spitfire fighters; and rocket-firing Typhoon fighter-bombers made it a force to be reckoned with.¹⁰

Although the strategic air forces had been released from Supreme Allied Commander, General Dwight Eisenhower's control in mid-September, both General "Tooe" Spaatz, commander of the US Strategic Air Forces (USSTAF), and Air Marshal Arthur Harris, commander of the Royal Air Force (RAF) Bomber Command, would respond with alacrity to Eisenhower's calls for assistance. By December 1944, USSTAF strength had reached some 3,700 B-17s and B-24s.¹¹ Bomber Command had similarly grown to a strength of roughly 1,900 Lancasters and Halifaxes.¹² Furthermore, there was a growing disparity in pilot experience. By late 1944, American pilots were entering combat with an average of over 300 hours of flying experience, 170 of which had been in combat aircraft, while their German counterparts had averaged only 170 hours of total air experience, merely 40 of which had been in operational aircraft.¹³

The Luftwaffe was but an eviscerated caricature of its former self. By the fall of 1944, it had re-grouped east of the Rhine, re-established its chain of command, and

⁸ United States Strategic Bombing Survey (USSBS), *European War Report Number 61, Air Force Rate of Operations* (Washington: USSBS, 1947), Exhibits 1 and 2.

⁹ Technical description of the P-47 from W. A. Jacobs, "The Battle for France" in Benjamin Cooling, ed., *Case Studies in the Development of Close Air Support* (Washington: OAFH, 1990), p. 250.

¹⁰ 2nd TAF strength figures from Danny S. Parker, *To Win the Winter Sky: The Air War over the Ardennes 1944-1945* (Conshohocken, Pa.: Combined Books, 1994), p. 54.

¹¹ Richard G. Davis, *Carl A. Spaatz and the Air War in Europe* (Washington: Center for Air Force History, 1993), pp.624-25.

¹² Parker, *To Win the Winter Sky*, p. 59.

¹³ David R. Mets, *Master of Airpower: General Carl A. Spaatz* (Novato, Calif.: Presidio Press, 1988), p. 193.

begun putting into place a semi-functional flight-support infrastructure.¹⁴ Surging fighter production in the closing months of the year and dissolution of the bomber force allowed some 2,300 aircraft to be scraped together for the newly established Luftwaffe West.¹⁵ But there was more shadow than substance in this organization. The dearth of available fuel severely curtailed pilot training. The systematic Allied attacks on the German rail network delayed the delivery of both aircraft and spare parts to the widely dispersed fighter bases. And most significantly, a fractured German high command undermined its direction. The inspector of pilots, Major General Adolph Galland, envisioned husbanding the fighters for a “Great Blow” against the Allied bombers. Hitler, on the other hand, wanted them preserved to support the coming land offensive.¹⁶ Additionally, the remorseless attrition of fighter pilots in the month leading up to the offensive both drained operational effectiveness and precipitated a crisis of confidence between the cockpit force and the Luftwaffe high command.¹⁷ In sum, despite its strength measured in terms of “rubber on the ramp,” the Luftwaffe on the eve of the Ardennes assault was a nearly spent force, capable of at most one final, desperate effort. And here, one must also note an inherent anomaly in German operational planning: the huge disparity between the Allied air forces and the Luftwaffe demanded the attack be launched during a period of severely reduced visibility. Under such conditions, the German air arm could not hope to make a significant contribution.

The Battle of the Bulge can be usefully divided into three phases: a period of clear German initiative from 16-21 December 1944, a period in which the initiative was fiercely contested by both parties from 22 December 1944 to 4 January 1945, and a

¹⁴ Details of re-grouping east of the Rhine from Alfred Price, *The Last Year of the Luftwaffe May 1944 to May 1945* (Osceola, Wis.: Motorbooks International, 1991), pp. 97-99.

¹⁵ Adolph Galland, *The First and the Last: The Rise and Fall of the German Fighter Forces, 1938-1945*, trans. Mervyn Savill (New York: Henry Holt, 1954), pp. 288-89; Great Britain, Air Ministry, *The Rise and Fall of the German Air Force, 1933-1945* (1948; reprint, New York: St. Martin's Press, 1983), pp. 365-74.

¹⁶ Galland, *First and Last*, pp. 309-10.

¹⁷ For representative pilot losses in November 1944, see Werner Girbig, *Six Months to Oblivion: The Defeat of the Luftwaffe Fighter Force over the Western Front*, trans. David Johnston and Richard Simpkin (West Chester, Pa.: Schiffer Military History, 1991), pp. 28, 34, and 38. In January 1945, a delegation of fighter commanders sought an audience with Göring and openly expressed their profound reservations concerning the Reich Marshal's policies, leadership style, and advisors. This incident became known as the “mutiny of the fighter pilots.” For Galland's version of the events, see Galland, *First and Last*, pp. 315-17.

period of clear American initiative from 4-31 January 1945. We shall now assess the actions of German and American airpower in each phase.

German Initiative in Action

The German offensive launched on 16 December 1944 made multiple penetrations in the American front lines. In the initial days of the battle, the ground situation was desperate and the air situation bleak. As enemy spearheads advanced rapidly westward and Eisenhower's last reserves moved through the literal as well as the figurative fog of war to meet them, the weather was almost exactly what the German high command had hoped for. From 16-18 December, flying conditions were marginal, characterized by very low clouds, variable but generally low visibility, and light rain.¹⁸ From 19-21 December, however, the weather was absolutely atrocious. A deep, heavy fog hung over the entire Ninth Air Force, reducing visibility to less than a hundred yards.¹⁹ The effect of these conditions was palpable. Ninth Air Force was able to drop over four hundred tons of bombs on Trier and Duren in interdiction missions on 17 December; and on the 18th it put up over six hundred aircraft in the area ranging from Kaiserslautern to Malmédy and Stavelot.²⁰ IX TAC P-47s, operating under conditions of low ceiling and visibility, attacked the spearhead column for the 1st SS Panzer Division, commanded by Lieutenant Colonel Jochen Peiper.²¹ On the night of

¹⁸ United States Strategic Air Forces (USSTAF) A-2 [Air Intelligence], "Allied Airpower and the Ardennes Offensive," daily summaries for 16-18 December 1944. United States Air Force Historical Research Agency (USAFHRA) File 519.601C(S). All material in this file has been declassified.

¹⁹ USSTAF A-2, "Ardennes Offensive," daily summaries for 19-21 December, USAFHRA File 519.601C(S). All material in this file has been declassified.

²⁰ USSTAF A-2, "Ardennes Offensive," Statistical Annex, USAFHRA File 519.601C(S). All material in this file has been declassified.

²¹ The precise results of these attacks are the subject of some dispute. In a letter of 7 January 1945, Spaatz told Arnold that the attack had destroyed "fifty to sixty tanks." Mets, *Spaatz*, p. 265. The official Air Force History credits the attack with the destruction of 32 armored 56 motor vehicles. Wesley Frank Craven and James Lea Cate, eds., *The Army Air Forces in World War II* (7 vols. Chicago: University of Chicago Press, 1948-1958; repr., Washington: Office of Air Force History, 1983), 3:688. The Army official history says that in the attack on the German forces at Stavelot "crippled a few enemy vehicles and drove the balance to cover." Hugh Cole, *The Ardennes: Battler of the Bulge* (Washington: Office of the Chief of Military History, 1965; repr., Washington: Center of Military History, 1988), p. 337. Peiper's account reads as follows: "...in the afternoon of 18 Dec 44 we had a bad break when the weather cleared and American fighter bombers came over. We lost two to three tanks and five armored half-tracks. The tanks

19/20 December, however, Ninth Air Force got up only two sorties; no tactical operations at all were conducted on the 20th or the night of 20/21 December.²²

Here, we must consider the extremely significant, though generally overlooked, air implications of Eisenhower's decision to give Field Marshal Montgomery, commander of the 21st Army Group, control of the northern half of the battlefield by shifting the boundary between his and Bradley's 12th Army Group far to the south, along an east-west line running from Givet to Prüm. The most immediate effect of this decision was the transfer of IX and XXIX Tactical Air Commands (TACs), which supported First and Ninth armies respectively, from Vandenberg's Ninth Air Force to Coningham's 2nd Tactical Air Force (TAF). Since this left Ninth Air Force with only XIX TAC and IX Bomber Division and because Vandenberg knew IX TAC would be backed up by aircraft from 2nd TAF, he transferred three fighter groups from IX to XIX TAC. Spaatz also boosted Ninth Air Force's combat power by placing under its control a P-51 Group and the entire 2nd Bomber Division from the Eighth Air Force.²³ But the most far-reaching air implication of Eisenhower's decision was to bring the entire RAF into the battle. For 2nd TAF, this would be no problem at all: Coningham's sympathies lay much more with Eisenhower than with Montgomery.²⁴ Furthermore, the 2nd TAF commander got along famously with both Vandenberg and the IX TAC commander, Major General Pete Quesada. Thus, Coningham dispatched his signal officer quickly to IX and XXIX TACs to ensure they were integrated into his command system and took control of these forces, secure in the knowledge that the TAC commanders could do their jobs and that Vandenberg would not resent his exercise of authority over them.²⁵ Harris, who had previously resisted any diversion from his ongoing efforts to "de-house" German factory workers, joined in enthusiastically as well. One of the few

blew up in the road, and the road was too narrow to by-pass them, thus causing additional delay." "Interview with Colonel Joachim Peiper, 1st SS Panzer Regiment in the Ardennes (11-24 December 1944)," FMS, European Theater Historical Interview (ETHINT)-10, 29, RG-338, National Archives II (NAII), College Park, Maryland.

²² USSTAF A-2, "Ardennes Offensive," Statistical Annex, USAFHRA File 519.601C(S). All material in this file has been declassified.

²³ Craven and Cate, *Army Air Forces*, 3:686.

²⁴ Vincent Orange, *A Biography of Air Marshal Sir Arthur Coningham* (London: Methuen, 1990; repr., Washington: Center for Air Force History, 1992), p. 121.

²⁵ Orange, *Coningham*, p. 226.

bright spots in this otherwise gloomy period was an attack on 19 December by RAF Bomber Command against Trier, a key road junction east of the Ardennes. The attack, which was carried out in spite of heavy fog over both the bases and the target, earned Harris a congratulatory telegram that Tedder dispatched at Eisenhower's request. When Harris replied that SHAEF could count on Bomber Command "...in any weather short of the impossible," Eisenhower noted to Tedder on the incoming message, "...they have already achieved the impossible."²⁶

Senior air commanders developed a straightforward operational concept to provide air support to the ground forces. Fighter-bombers were ordered to provide their normal close support to the armies as weather permitted; and fighter-bombers and medium bombers would interdict the movement of troop units and supply columns out to an inner ring of targets that followed the Rhine to Bingen, and then swung west to Saarburg. The heavy bombers were to attack interdiction to targets beyond the Rhine and southeast to Saarbrücken, while also being available to strike at closer targets as needed.²⁷

But the operative phrase for the tactical air support was "as weather permitted"; and its prolonged lack of permission caused Eisenhower "a special concern, even anxiety."²⁸ He was not alone. When the 12th Army Group air briefer informed Bradley on the 19th that weather was "hampering and preventing air operations," his aide, Lieutenant Colonel Chester Hansen, reported that Bradley "shook his head sadly."²⁹ The next day Hansen noted that "Air would seem to be the pivotal center of our

²⁶ Arthur William Tedder, *With Prejudice: The War Memoirs of Marshal of the Royal Air Force, Lord Tedder*, (London: Cassell, 1966), p. 627.

²⁷ Mets, Spaatz, 264; Craven & Cate, *Army Air Forces*, 3: 691.

²⁸ Dwight D. Eisenhower, *Crusade in Europe* (Garden City, N.Y., 1948), p. 345.

²⁹ Chester Hansen diary, 19 December 1944, Hansen papers, U.S. Army Military History Institute (MHI), Carlisle, Pennsylvania. Reflecting Bradley's despondency over the lack of air support, Hansen ended his entry for the 19th with a long peroration on the air situation and its adverse implications for the 12th Army Group. "Moreover, weather is once again our undoing. Had the weather been suitable for proper Tac R[econnaissance] it might have been possible for us to detect his large scale movements of troops and supplies to the concentration areas for his jumpoff. Our air effort today has been negligible. Fighter bombers were either closed on their fields or compelled to attack enemy ground installations almost without a ceiling. Heavy enemy motor movements would have given him bumper to bumper targets for many miles along the road. The mediums bombed but without observed results and there is no evidence they obtained any. Meanwhile he [the enemy] is redeploying his strength to exploit this attack while we have moved to contain [sic] it, possibly prepare a dmaging [sic] counterblow."

counterattacking force....So far the air contribution has been negligible. All because of the weather. The German appears to have picked his time for a strike carefully and once again weather is fighting on his side.”³⁰ At First Army headquarters, Hodges’s aide, Major William Sylvan, penned a similar lament on the 21st: “The third successive day that the weather is bad. With good weather we could stop this....If only a break should come.”³¹

Initiative in Dispute

Two days later, the desperately hoped-for break finally arrived; and despite the limited ground options for eradicating the Bulge, the Allied air effort contributed substantially to the reversal of German fortunes in the transition phase of the campaign. On 23 December, an eastern high pressure area, known as a “Russian High,” moved to the west over the Ardennes, providing nearly picture-perfect flying conditions for the next five days.³² This resulted in both the Allied air forces and the *Luftwaffe* surging to their full capacities. Given the disparities in strengths, however, good flying weather provided the British and American forces a substantial advantage that significantly influenced the course of the battle and accelerated the shift of tactical and operational initiative to the Americans.

The first manifestation of this shift was resupply of the soldiers of the 101st Airborne Division, who were surrounded at Bastogne.³³ On 21 December the division supply officer sent an urgent request for aerial replenishment of artillery ammunition to VIII Corps. This request was relayed through Third Army and Supreme Headquarters Allied Expeditionary Forces (SHAEF) to IX Troop Carrier Command. Bad weather on the 22nd prevented the mission from being flown; and the beleaguered airborne troops

³⁰ Hansen diary, 20 December 1944, Hansen papers, MHI.

³¹ William Sylvan diary, 21 December 1944, 145, U.S. Army Center for Military History (CMH), Washington, D.C. An edited version of Major Sylvan’s diary was recently published. The referenced citation is found there in John T. Greenwood, ed., *Normandy to Victory: The War Diary of General Courtney H. Hodges and the First U.S. Army [by] Major William C. Sylvan and Captain Francis G. Smith Jr.* (Lexington: The University Press of Kentucky, 2008), p. 226.

³² Craven & Cate, *Army Air Forces*, 3:689.

³³ Except as otherwise noted, what follows is based on Thompson, “Air Supply,” pp. 64-138.

began to wonder who was going to get into Bastogne first: the aerial resupply, Major General John Millikin's III Corps, or the Germans. When the weather broke on the 23rd, the answer became the resupply. Army Air Forces pathfinders landed in mid-morning and quickly established liaison with the division headquarters. Before noon, twenty-one C-47s put their loads squarely onto the 101st drop zone. By the end of the day, 249 C-47 loads had been dropped, providing the surrounded garrison with 230 tons of ammunition, medical supplies, and rations. Eight planes were lost to enemy action. On the 24th the division received some 240 tons dropped by 160 aircraft. Christmas Day, however, was bleak. Bad weather in England grounded the transports; artillery ammunition for the 155-mm howitzers was almost depleted; small arms ammunition was a problem as well—in one battalion, most of the front-line soldiers were down to a single bandolier; medical supplies were reaching critical levels as the number of casualties escalated from determined German attacks; and Millikin's relief forces were discovering the German resistance to be very tough indeed.³⁴

The 26th, however, was a *dies mirabilis*. The weather over England broke, and the airflow provided a veritable cornucopia to the GIs on the ground. One glider landed with surgeons and medics, and others brought in nearly three thousand gallons of gasoline. This manna was supplemented by 169 tons of supplies delivered by 269 C-47s. And the best news of all was that a tank-infantry task force from the 4th Armored Division, aided by timely and well-coordinated assistance of P-47s from XIX TAC, broke through to Bastogne.³⁵ On the 27th, the narrow corridor leading into Bastogne was widened sufficiently for a truck convoy to get through; and the last day of aerial resupply brought in another 126 tons of ammunition, with a number of the gliders delivering ammunition directly to the 155-mm howitzer firing positions. Though the heaviest fighting for Bastogne was still to come, it was no longer an isolated outpost.

³⁴ The battalion low on small arms ammunition, which was probably typical for the division, was 2nd Battalion, 506th Parachute Infantry Regiment. Its executive officer, Captain Richard Winters, noted with a bit of typical infantry humor, "This keeps up, we can challenge the Germans to a Christmas Day snowball fight. That's all we'll have." Larry Alexander, *Biggest Brother: The Life of Major Dick Winters, the Man Who Led the Band of Brothers* (New York: NAL Caliber, 2005), p. 143.

³⁵ Lewis Sorley, *Thunderbolt: General Creighton Abrams and the Army of His Times* (New York: Simon & Schuster, 1992), pp. 76-81.

While the relief of Bastogne occupied the world's attention, the skies over and beyond the Ardennes were filled with Allied aircraft.³⁶ On 24 December, Eighth Air Force put up over eighteen hundred bombers and nearly eight hundred fighter escorts to bomb communication centers in the tactical area. On the 28th, it launched nearly twelve hundred bombers escorted by over five hundred fighters to pound marshaling yards and railways again. RAF Bomber Command participated in this effort as well. On the night of 22/23 December it attacked marshaling yards at Coblenz and Bingen with 283 aircraft. And on 26 December, it delivered a devastating attack on St. Vith with 274 Lancasters. Ninth Bomber Division attacked transportation centers on the inner ring with 670 mediums on the 23rd and 814 on Christmas Day. On 23 December, XIX TAC flew 374 missions in direct support to corps, fighter sweeps, and armed reconnaissance; and another 109 directed against the Bonn airfields and Prüm. The British tactical air forces also participated, with 2nd TAF flying ninety-one sorties over in the northern sector of the Bulge on the night of 24/25 December and another 294 on the 27th.

There were several discrete, though interconnected, effects of this onslaught of Anglo-American airpower. The first was the establishment of air superiority over the battlefield. In the first period of the battle, the *Luftwaffe* had been very aggressive despite the adverse weather. Although this aggressiveness had not significantly aided the German advance or contributed to the dissolution of the ground defense along the American front, it had, particularly on 16 and 17 December, forced American pilots to jettison their bombs and go after the *Luftwaffe*.³⁷ On the 23rd, when the weather broke, the *Luftwaffe* launched nine hundred sorties but was forced to allot roughly half of them to defending its own forces. The overall number of sorties declined steadily until by the 30th *Luftwaffe* West was able to get up only two hundred aircraft. The over four thousand tactical and strategic sorties launched by the American and British air forces that day made it abundantly clear that the Allies were masters of the skies.

The second effect was to impede the forward flow of fuel and ammunition to the Germans. This is an issue of some complexity because many forces were acting in concert to degrade the German supply effort. The huge traffic jams on the northern

³⁶This paragraph from USSTAF A-2 "Ardennes Offensive," Statistical Annex, USAFHRA File 519.601C(S). All material in this file has been declassified.

³⁷Craven & Cate, *Army Air Forces*, 3:687.

shoulder, which took place in and behind the narrow corridor between the Elsenborn Ridge and St. Vith had a very significant impact on the critical opening days of the battle. With the lead elements of I SS Panzer Corps confined to this constricted area, the motorized impedimenta of artillery, engineers, other support troops, and supply columns constipated the already inadequate road network from the assembly areas to the line of contact. The snow and rough terrain that had delayed the strategic concentration remained significant factors in impeding a supply effort that had now had to meet the greatly demands of a large-scale offensive for fuel, ammunition, spare parts, rations, and individual replacements.

It is clear, nevertheless, that the Allied air threat acted in three significant ways to slow both the movements of combat formations and their requisite sustenance. First, during periods of clear weather and at times even in periods of marginal weather, it confined road and rail movement to the hours of darkness, roughly 4:30 p.m. to 8:30 a.m., sixteen hours per night, of which several were frequently required for snow removal.³⁸ Second, the attacks on the German rail system west of the Rhine, especially along the line Cologne—Karlsruhe, significantly degraded the ability of the *Reichsbahn* to support the advancing armies.³⁹ Finally, the air attacks on cities west of the Rhine slowed the operational re-deployment of units, degraded tactical mobility, and impeded supply movements.

The effects of bombing significant road junctions are clearly illustrated in the attacks on Bitburg, St. Vith, and Houffalize. In its post-battle assessment of German unit movement by road into the Ardennes, the USSTAF A-2 determined that Bitburg was clearly the point with the highest volume of traffic, with some units that had de-trained as far north as Remagen swinging through this critical Rhenish road junction.⁴⁰ It was

³⁸Lieutenant General Richard Wirtz, "Army Group B Engineers (January 1-25, 1945)," Foreign Military Studies (FMS) B-172, 8, RG 338, NAIL.

³⁹Alfred Mierzejewski, *The Collapse of the German War Economy, 1944-1945: Allied Air Power and the German National Railway* (Chapel Hill: University of North Carolina Press, 1988), pp. 131-32. Mierzejewski argues that these attacks also degraded the *Reichsbahn's* ability to deliver coal to German industry. Thus, the Allies were achieving a dual effect: their concentration on the German rail net south of the Ruhr and immediately east of the Rhine was not only helping Eisenhower halt the German offensive; it was also abetting the strategic bombing effort. To the extent that it was done by design, it represented sophisticated targeting on the part of the Allied air leaders.

⁴⁰USSTAF A-2, "Ardennes Offensive," 47, USAFHRA File 519.601C(S). All material in this file has been declassified.

attacked by B-17s of the Eighth Air Force on 23 December, 2nd TAF aircraft on the night of 24/25 December, and B-26s of the IX Bomber Division on Christmas Day.⁴¹ According to General Brandenberger, traffic through the city was delayed for a week following these attacks.⁴² In the wake of the withdrawal of the 7th Armored and 106th Infantry Divisions from St. Vith salient, medium bombers from the IX Bomber Division attacked the city on 25 December with 137 tons of bombs.⁴³ This attack merely slowed traffic for a few hours, but things soon got much worse for the Germans, denying them much of the ability to exploit their hard-won prize. On the day after Christmas, nearly three hundred Bomber Command Lancasters and Halifaxes plastered St. Vith with 1,140 tons of heavy bombs, virtually rubbleing the entire city and blocking all its major roads. This apocalyptic destruction completely halted traffic for three days, reduced the town's throughput capacity by 50% following the repairs, and required the construction of major detours along unimproved roads and across fields.⁴⁴ Further south, Houffalize was attacked four times by medium bombers of IX Bomber Division and twice by Bomber Command Lancasters and Mosquitoes. Traffic was completely blocked for two days, and capacity was reduced by roughly 25% after clearing operations had taken place. The timing, however, was not as propitious as it was in St. Vith because the RAF attacks did not come until 30/31 December and early January when the German attack had already been halted. Nevertheless, they were sufficiently severe and accurate to

⁴¹USSTAF, A-2, "Ardennes Offensive," Statistical Annex, USAFHRA File 519.601C(S) all material in this file has been declassified; Craven & Cate, *Army Air Forces*, 3:693-94.

⁴²General Erich Brandenberger, "Comments on Lieutenant General Richard Wirtz, 'Army Group B Engineers (January 1-25, 1945)," FMS B-172a, 2, RG 338, NAIL.

⁴³Details of attacks on St. Vith and Houffalize from USSTAF A-2, "Ardennes Offensive," pp. 53-54, USAFHRA File 519.601C(S) all material in this file has been declassified; Arthur Harris, *Bomber Offensive* (New York: Macmillan, 1947), pp. 253-54; and Martin Middlebrook and Chris Everitt, eds., *The Bomber Command War Diaries: An Operational Reference Book, 1943-1945* (London: Penguin, 1990), pp. 637, 640, and 648.

⁴⁴ The adjective "apocalyptic" comes from an account of the bombing by John Toland based on a description given him by Private Hans Ulrich Leske, a member of the rocket-launcher battalion of the Hitler Youth Division, who was about a mile from St. Vith when the attack occurred. "Three hundred British Lancasters and Halifaxes dumped their loads. The ground shook, like an earthquake. Fir trees toppled down. To Leske's horror St. Vith seemed to rise in the air to meet the planes....Leske shakily got to his feet. A vast red cloud was drifting westward from St. Vith, a cloud of dust lit by the dying rays of the setting sun. He was transfixed. It was apocalyptic." John Toland, *Battle: The Story of the Battle of the Bulge* (1959; reprint, Lincoln: University of Nebraska Press, 2001), pp. 286-87.

cause Manteuffel to note that they “greatly disorganized the march forward as the damage had been done all in one place at a spot where a detour was impossible...”⁴⁵

Although it is difficult to assess relative values to effects on German supply produced by ground defense; clogged roads; terrible weather; close terrain; and air attacks on railways, bridges, road junctions, and roads themselves, the cumulative effects were noted by almost all major German participants in the battle. And airpower was frequently mentioned as what can probably best be described as the catalytic ingredient in the supply friction formula. Jodl said, “The crushing attacks on transport installations...had the consequence that the difficult transportation situation which had been in existence already for a long time could not be improved in spite of every kind of auxiliary service and repair and restoration work.”⁴⁶ Manteuffel declared that the activity of enemy air “controlled the supply routes, railways, and roads completely. The efficiency of the railways sank and was only a fraction of the original one. There was not enough room for road transportation. Continuous breakdowns by air attacks increased this lack, which industry could not make up any more to an adequate extent.”⁴⁷

Lieutenant General Karl Thoholte, Model’s senior artillery advisor for the Ardennes offensive, painted a virtual tapestry of ways in which Allied airpower affected artillery support.⁴⁸ According to Thoholte, the Allied air forces negated the use of German rail artillery; seriously impeded the forward movement of ammunition and fuel to support the artillery battle; prevented the artillery from determining the depth of American defenses beyond the immediate line of contact; provided the American artillery a significant advantage in target location, which was particularly important in the counter-battery duel; and in overall terms reduced the effectiveness of German artillery to 50 or 60 percent of its potential. These effects, he maintained, were particularly felt in the lack of effective artillery support for the attacks against the Elsenborn Ridge and Bastogne. While there is some requirement for caution in assessing

⁴⁵ General Hasso von Manteuffel, “Comments on Lieutenant General Richard Wirtz, ‘Army Group B Engineers (January 1-25, 1945),” FMS B-172b, 2, RG 338, NAI.

⁴⁶ Field Marshal Wilhelm Keitel and Colonel General Alfred Jodl, “Answers to the Questionnaire on the Ardennes Offensive,” 3, FMS A-928, RG 338, NAI.

⁴⁷ Manteuffel, “Fifth Panzer Army (Ardennes Offensive),” FMS B-151a, 125, RG338, NAI.

⁴⁸ Lieutenant General Karl Thoholte, “Army Group B Artillery (Ardennes),” FMS B-311, 6-11, RG 338, NAI.

the validity of Thoholte's analysis because it fails to take into account the effects of the traffic jam on the northern shoulder of the penetration, it is, nevertheless, an illuminating description of the indirect effects of air superiority on land warfare.

Tactical air forces contributed to defeat of the German offensive in a very direct way on 25 and 26 December.⁴⁹ On the 24th, reconnaissance elements of the 2nd Panzer Division had arrived at Celles, a small town four miles east of the Meuse, virtually out of gas and cut off from the remainder of the division. They were met the next day by Major General Ernest Harmon's 2nd Armored Division (AD). While the almost continuous coverage of American Thunderbolts prevented the 2nd Panzer Division's main body from advancing to join its forward unit, the lead combat command of the 2nd AD attacked into Celles. In one engagement enroute to the village, American tanks were engaged by German tanks concealed near a farm. The P-47s then rolled in and flushed four Panthers into the open where they were destroyed by tanks and tank destroyers. On the morning of the 26th, a German relief force that had moved up to the outskirts of Celles during the night was attacked by British rocket-firing Typhoons directed in by an American artillery spotter. A follow-on group from Panzer Lehr met the same fate.

As the battle for the Meuse reached its denouement, eleven hundred sorties of C-47's augmented Eisenhower's strategic reserve by shuttling the newly arrived 17th Airborne Division from England to Rheims in just six days.⁵⁰ From this staging area, the division was trucked to a position just west of Bastogne where it was quickly thrown into the fray. On the return trips, the Gooney Birds evacuated over five thousand casualties to hospitals in England. Although the medical evacuation did not directly influence the outcome of the Bulge, it was undoubtedly a moral tonic for the wounded soldiers; and, by preserving the American fighting strength, it would affect battles still to come.

⁴⁹This account of the action at Celles is based on Charles B. MacDonald, *A Time for Trumpets: The Untold Story of the Battle of the Bulge* (New York: William Morrow, 1985), pp. 582-83.

⁵⁰Air operations described in this paragraph from, USSTAF, Battlefield Studies World War II, "Air Resupply Ardennes Counter-Offensive, 16 December 1944 - 16 January 1945," n.d., 5-6. USAFHRA File 519.042. This very brief synopsis, with little documentation, is not to be confused with the earlier-referenced USSTAF A-2 analysis of airpower in the Bulge.

The only sour note of the period was two incidents involving friendly air attacks on American soldiers and Belgian civilians at Malmédy on 23 and 25 December.⁵¹ On 23 December, six B-26s of the of the 322nd Bomber Group, IX Bomber Division, part of a twenty-eight-plane strike on the town of Zulpich, mistakenly dropped their eighty-six-bomb load of 250-pounders on Malmédy, some thirty-three miles short of the intended target. On 25 December, four B-26s from the 387th Bomber Group dropped sixty-eight 250-pound bombs on Malmédy in lieu of St. Vith, about twelve miles to the south. These erroneous attacks, which occurred in conditions of good-to-excellent visibility, were verified by IX Bomber Division photographic reconnaissance. According to the Army official history, they killed thirty-seven soldiers of the 120th Infantry Regiment and nearly panicked the town's civilian population.⁵²

To welcome in the New Year, the Germans demonstrated they had one more surprise in store. Galland's idea of the "Great Blow" was to make itself manifest, but in a completely different form than he had intended. Toward the end of December, Major General Dietrich Peltz, commander of *Jagdkorps* II, received instructions to prepare plans for a massive attack on Allied airfields with all available daylight aircraft.⁵³ Code-named Operation *Bodenplatte*, or "Baseplate," the objective of this attack was to create conditions that would allow the *Luftwaffe* to fight the Allied bombers on a more even footing and thus be able to mount an effective defense of German airspace. In order to catch the British and Americans by surprise, which was the *sine qua non* of the attack, the plan called for all fighter formations to maintain complete radio silence and fly at tree-top level under Allied radar coverage, guided by Ju-88 night fighters along their routes up to the German front lines. To make this attack, the Germans were able to

⁵¹This account based on Royce Thompson, "Malmedy Belgium Mistaken Bombing, 23 and 25 December 1944" (Washington: OCMH, 1952), pass. U.S. Army Center for Military History File 2-3.7 AE.P-17, copy also at Air University Library (AUL) File M-U 44112-2. Thompson's study includes typed extracts of the IX Bomber Division summaries of the missions flown on 23 and 25 December. The author verified the accuracy of these extracts against the actual mission summaries found in USAFHRA File 534.333. The operative statements were, "6 a/c bombed the town of Malmedy, 1/2 mile W of bomblines, due to misidentification of target." (23 Dec.) and "The leader of one flight misidentified primary. This a/c plus 3 others dropped 64x250 GP at Malmedy - friendly territory." (25 Dec.).

⁵²Cole, *Ardennes*, p. 377.

⁵³What follows is based on Girbig, *Six Months to Oblivion*, pp. 107-67. Girbig's painstaking research provides a very detailed account of Operation *Bodenplatte*. For another extended account, see Parker, *To Win the Winter Sky*, pp. 373-449. A concise summary can be found in Air Ministry, *Rise and Fall*, pp. 379-81.

assemble nearly eight hundred fighters organized into thirty-three groups from ten different *Jagdgeschwader*. Everything looked good on paper, and there was a feeling of confidence among many of the pilots as they prepared for takeoff on the morning of 1 January 1945.

Fortunately for the Allies, *Bodenplatte* broke down significantly in execution. The stringent security arrangements taken to protect the secret of the attack led to late, incomplete, and inadequate briefings that ranged from sparse details to heroic exhortations. The information that *Luftwaffe* planes would be flying at low level over the German front lines was received by only very few of the anti-aircraft batteries. Although there are no firm figures for how many German planes were downed by their own flak, estimates run up to one hundred, or 12.5% of the force. Furthermore, the radio silence, while superb for security, created all sorts of doubts in the minds of inexperienced pilots in formations whose internal cohesion was problematic at best. Thus, when squadron leaders were shot down or disappeared from view, the formations tended to become scattered and disoriented. In a few cases, Allied aircraft were already airborne and able to break up the German formations before they reached their targets. And of course, Allied antiaircraft weapons played a role in blunting the attack.

As a result, of the some seventeen Allied (predominantly British) airfields targeted, only four were attacked successfully; five were bombed with moderate success; three were struck intermittently or not at all; and five were either hit by mistake or as targets of opportunity, with no effect. Altogether, the Germans destroyed some 120 RAF and thirty American aircraft. Figures on the German losses vary wildly, but the most probable number is about three hundred, or an adverse ratio of 2:1. But *Bodenplatte's* worst effect on the German fighter force was the devastating toll on its pilots: 214 total losses, with 151 killed or reported as missing and 63 taken prisoner. It was a blow from which the *Luftwaffe* never recovered; and it ceded to the Anglo-American coalition absolute and total command of the air.

New Year's Day 1945 found American air force leaders dodging bullets from the ground as well as the air. On a flight visiting various installations, Spaatz and Eighth Air Force commander, Lieutenant General James Doolittle were in one plane with

Vandenberg flying behind them when they were engaged by Third Army air defense gunners, perhaps made somewhat trigger happy by the unusual number of *Luftwaffe* aircraft in the sky.⁵⁴ Both planes dove quickly to tree-top level and escaped harm, but this incident illustrates still another advantage of air superiority: the potential for ground-air fratricide increases when the enemy air force is able to operate over friendly ground formations. Notwithstanding this near miss, with the German Air Force neutralized, weather again became the most significant impediment to Allied air operations.

After the relatively clear conditions of 1 January, fog and snow again blanketed the Ardennes. On 3 January, for example, conditions in the battle area were limited to ceilings of two hundred – three hundred feet and visibility ranging from fifty – fifteen hundred yards, with similar conditions obtaining on the next day as well.⁵⁵ This effectively shut down the Allied air effort. Nevertheless, the cumulative support given during the brief period of flyable weather had helped significantly to turn the tide; and unlike the ground action, which was almost entirely American, the air effort during the transition phase of the Bulge was clearly Allied, with the British fully participating in an integrated air effort.

American Initiative in Action

With one major exception, Allied air action did little to interfere with the German withdrawal. From 6-9 January, fog and snowstorms, which severely limited both operating ceilings and visibility, prevented the Ninth Air Force TAC's from getting off a single sortie.⁵⁶ And while it was possible for planes to fly above the storms, the nearly blinding conditions on the ground made close air support all but impossible. This meant that the bulk of the air effort went to interdiction. On 14 January, XIX TAC hit Houffalize and St. Vith with six hundred aircraft to impede the withdrawing German

⁵⁴Mets, *Spaatz*, p. 268 and Phillip S. Meilinger, *Hoyt S. Vandenberg: The Life of a General* (Bloomington: Indiana University Press, 1989; repr., Washington: Air Force History and Museums Program, 2000), p. 56.

⁵⁵USSTAF A-2, "Ardennes Offensive," daily summary for 3 January 1945, USAFHRA File 519.601C(S). All material in this file has been declassified.

⁵⁶ USSTAF A-2, "Ardennes," Statistical Annex, USAFHRA File 519.601C(S). All material in this file has been declassified.

forces; and on the 15th it reached out to Mainz, Bad Kreuznach, and Wiesbaden in a much deeper interdiction pattern, apparently filling in for the heavies that had reverted to their strategic strikes.⁵⁷

The 16 December linkup at Houffalize between the First and Third Armies set the stage for the final air-ground engagement of the campaign.⁵⁸ On 22 January, the weather broke again, producing a bright sun on new-fallen snow. Four groups of P-47's from XIX TAC quickly got airborne to support Major General Manton Eddy's XII Corps. They found the roads below thick with German soldiers, trucks, armored cars, tanks, and horse-drawn transport. Some of the units involved were elements of Fifth Panzer Army moving east toward Dasburg; others were from the LIII Corps of General Erich Brandenberger's Seventh Panzer Army withdrawing to the northeast in a frantic effort to beat Eddy's XII Corps to crossing sites over the Our River at Vianden; and still others were elements of the 2nd Panzer and Panzer Lehr Divisions cutting against the grain of the withdrawal to help the Seventh Army stave off defeat. This confluence of cross purposes and movements created a monumental traffic jam, which B-26's of IX Bomber Division compounded by dropping ninety-six tons of bombs around the bridge at Dasburg. Although they did not destroy the bridge itself, they damaged the approaches sufficiently to impede enemy movement. This set up a turkey shoot for twenty-five squadrons of the XIX TAC that flew over six hundred sorties against the congealed mass below, inflicting one last, punishing blow on the withdrawing German forces.⁵⁹

⁵⁷ USSTAF A-2, "Ardennes," Statistical Annex, USAFHRA File 519.601C(S). All material in this file has been declassified.

⁵⁸ What follows is based on Charles B. MacDonald, *The Last Offensive* (Washington: OCMH, 1973), p. 51 and USSTAF, "Battlefield Studies World War II, Air Force Participation in the Battle of the Ardennes, 16 December 1944 - 16 January 1945," n.d., USAFHRA File No. 519.042

⁵⁹ The undocumented USSTAF study referred to above listed claims for the air as destruction or damage of thirty-six armored vehicles, fifty-nine horse-drawn vehicles, and over seventeen hundred motor vehicles. This level of claims led the Army official historian to comment, "For various reasons, claims of enemy losses from air action were almost always high." MacDonald, *Last Offensive*, 51n. The statement by the Air Force official historian that the damage "far surpassed destruction in the Falaise Gap of August 1944" (Craven and Cate, *Army Air Forces*, 3:705) is manifestly inaccurate even if one accepts the figures of the USSTAF study referenced above. In this sense, it is unfortunate that the very detailed and well-documented USSTAF A-2 study of March 1945 does not extend beyond 16 January 1945. Magna Bauer's report on the withdrawal, which is based on a close reading of the records of the German units involved, states only that the Germans "were easy targets for the Allied air forces which inflicted heavy losses in

Historical Summary

Like a “fleet in being,” the vast Allied air armada exercised a powerful influence over the campaign even when not directly engaged.⁶⁰ It set the terms of the German attack, forcing Hitler to choose the sub-optimal location of the Ardennes based primarily on ability to conceal the strategic concentration in the Eifel region, immediately to the east. The punishing attacks on Germany’s rail system throughout the autumn of 1944 significantly hampered the assembly of the attacking formations, delaying the offensive some three-four weeks. This, in turn, reduced the period of poor visibility during which the attacking spearheads would be free from direct air attack. In the first phase of the campaign, things worked largely as the Germans had anticipated; and both Bradley and Hodges were much distraught by the lack of air support. Nevertheless, a few interdiction attacks against rail facilities in the Rhineland provided an earnest of things to come. With only a brief period of clear weather, airpower contributed significantly to turning the tide of battle. The strikes against the 2nd Panzer Division at Celles were only the most visible manifestations of this contribution. Interdiction attacks against rail facilities and the Rhine River bridges continued apace, seriously hampering German supply efforts; C-47’s in abundance dropped vital ammunition and medical supplies to the defenders of Bastogne; an entire airborne division was flown to France; and life-saving medical evacuation sped wounded soldiers to England. The weather in the final phase of the campaign again generally precluded air operations. But one clear day on 22 January, combined with Eddy’s flushing attack across the Sûre River, provided a fully exploited opportunity for significant damage to the retreating German formations. In short, although weather frequently impeded the effectiveness of air operations, as the German planners had hoped it would, Allied air superiority and a wide range of air capabilities exerted a far greater effect than they had anticipated and contributed materially to German defeat.

personnel and materiel and caused numerous vehicles to burn out,” thus confirming the general story without providing any statistical detail. Bauer, “The German Withdrawal from the Ardennes (15 January – 31 January 1945),” May 1955, 59, R-59, CMH.

⁶⁰ For an insightful elaboration of the “fleet in being” concept in naval theory and practice, see Julian Corbett, *Some Principles of Maritime Strategy* (1911; reprint, Annapolis: Naval Institute Press, 1988), pp. 209-27.

Conclusions

But what does all this mean for EBO? Taking Clausewitz's assertion that strategy is "the use of an engagement for the purpose of the war," we can conclude that air operations in the Bulge definitely contributed to the purpose of the war a) by helping to frustrate Hitler's attempt to rend asunder the Anglo-American alliance and b) by pummeling the Wehrmacht and Waffen-SS formations that had to concentrate to make the desired breakthrough.⁶¹ When the Allied armies crossed the Rhine in early 1945, their drive to the heart of Germany was made much easier by the punishment that had been meted out to the German formations in the Ardennes from both the ground and the air. Thus, EBO's emphasis on creating useful consequences, rather than merely producing immediate effects, is a constructive notion. But this observation must be laced with a fair amount of caution. *As a general rule, EBO's viability varies in inverse proportion to the logical and temporal separation between the immediate effects produced and the downstream consequences desired – the less the separation, the greater the viability of the construct; the greater the separation, the less the viability of the construct.* In the Bulge, a campaign that played out over the roughly six weeks from December 16, 1944 to January 31, 1945, there was a fairly direct causal and temporal connection between air interdiction attacks against formations, bridges, rail lines, marshalling yards, and major road junctions, and the momentum of the German offensive. This connection was further tightened by the rough terrain of the Ardennes, which limited much of the resupply and almost all of the major troop movements to either roads or rail lines. Furthermore, senior air and ground commanders were poignantly aware of this connection and had a well-developed intuition for how it operated based on over six months of campaigning in Western Europe.⁶² Thus, they did not require a bevy of staff officers briefing them with multiple charts depicting the rise and fall of arcane "metrics," which became a fashionable, one might even say faddish, feature of EBO.⁶³

⁶¹ Carl von Clausewitz, *On War*, ed. and trans. by Michael Howard and Peter Paret (Princeton: Princeton University Press, 1976), p. 177.

⁶² See, for example, Omar N. Bradley, *A Soldier's Story* (New York: Henry Holt, 1951), pp. 479-80.

⁶³ The infatuation with metrics evinced by some of the more schematic and ardent proponents of EBO was one factor leading General Mathis to proscribe its further use within Joint Forces Command. See J.N. Mattis, "MEMORANDUM FOR U.S. JOINT FORCES COMMAND, Subject: Assessment of Effects Based Operations," 14 August 2008, Attachment, "USJFCOM Commander's Guidance for Effects-Based Operations," 1. Internet, smallwarsjournal.com/documents/usjfcomebomemo.pdf, accessed 17 December 2009.

This leads to a second observation about EBO – *much greater effort should be placed on developing informed intuition about cause-and-effect relationships in war than on developing elaborate metrics and mechanisms that purport to make martial calculation a science, rather than an art.*

In sum, what does the employment of airpower in the Battle of the Bulge say about EBO? It suggests that the basic concept can indeed offer leaders and planners a useful construct. But the evidence here examined also indicates that EBO's utility is accentuated when its parameters are relatively bounded and that EBO's processes should rely much more on the intuition that flows from broad education and observant experience than it should on the discrete measurement of finite indicators.⁶⁴

⁶⁴ The link between a comprehensive education and military intuition was explored in Harold Winton and John Sheldon, "Thinking Broadly: Educating Airmen to Understand War in Any of Its Forms," Presentation to the USAF Air Education and Training Command Symposium, "On Learning: The Future of Air Force Education and Training," San Antonio, Texas, 16 January 2009.