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THE ROYAL AIR FORCE

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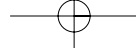
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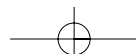
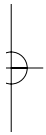
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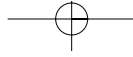




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## Foreword by Chief of the Air Staff

**Air Chief Marshal Sir Jock Stirrup**  
KCB, AFC, FRAeS, FMIC, RAF

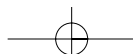
I am delighted to have the opportunity, early in my tenure as Chief of the Air Staff, to write the foreword for this latest edition of the Air Power Review. The Royal Air Force's professional journal, the Review has now been in existence for five years. During that time it has attracted contributions of the highest quality from the air power community world wide, and has reached and influenced a broad international audience. And all of this at a period when the development of air power and its contribution to military operations have gathered increasing momentum.

Let me illustrate with just two examples from the recent campaigns in Afghanistan and Iraq. In both theatres we were able, through the use of innovative technology and embryonic network capabilities, to use air power for strategic effect in ways not previously open to us. The networking of real-time intelligence, decision-making and precision weapons gave us the speed and responsiveness to be able to attack key command and control targets – a major factor in unhinging the enemy's defensive efforts. At the tactical level, air power was crucial to the successful conduct of operations on the ground. In Afghanistan, the positioning of the opposition groups forced the Taliban to concentrate in defence; the coalition then mounted precision air attacks that had a devastating and decisive effect. In Iraq, when the rapidly manoeuvring coalition columns met serious resistance,

precision air attack was again used to clear the way and restore the momentum.

Technology clearly played a key role in these campaigns. Precision weapons (70% of the effort in Iraq, as opposed to 7% in the 1991 Gulf War) were crucial. But it was the networking of information that gave us the speed and responsiveness to be able to hit the right targets at the right time – and we were only scratching the surface in terms of true network-enabled capabilities. Sensors, communications systems and weapon platforms with the right digital linkages are all part of this developing equation.

But in such an era of new and exciting opportunities, it is not technology alone that will dictate our effectiveness: our ability to innovate will be a critical factor. Throughout the history of warfare we see examples of technological opportunities that were frittered away by forcing them into the straitjackets of outmoded concepts and doctrine. For too often it has taken blood and defeat to make us change our thinking. We must not repeat that mistake. We need to question, to experiment, to learn. The intellectual development of air power is as important as the tools we use, and the need for innovation has never been greater. The Air Power Review provides an ideal forum for such a ground-breaking effort, and I encourage all of you to approach it with that end in view.



## Introduction

In his foreword the new Chief of the Air Staff, Air Chief Marshal Sir Jock Stirrup, makes clear the need for innovative and flexible thinking if we are to capitalise on technical developments and not repeat the mistakes of the past. In May of this year the 3 Heads of Defence Studies sponsored a joint conference to examine the concept of effects-based warfare from both historical and contemporary perspectives. The 2 papers which examined effects-based warfare from an air power perspective were particularly well received at the conference and are therefore being published here in the *Air Power Review*, as well as in the conference proceedings, to give them the widest possible airing. There is also a strong 'effects' theme in all the other articles in this edition.

In his history of effects-based air operations, Colonel Phil Meilinger USAF (Retired) makes very powerfully the point that airmen have always, perhaps instinctively, hoped to achieve effects-based operations, but it is only now that the technology and the intellectual tools are enabling them to do so. He also makes the point that there is a fundamental link between effects-based concepts and the primary principle of war – that of selection and maintenance of the aim, although of course it has to be the right aim as evidenced in the debate over the merits of oil versus rail targets in the run-up to D Day. Points about the concentration on the measurement of output rather than input and the need to select measures of effectiveness that are directly related to the effect sought are pivotal to the correct understanding and application of an effects-based methodology.

The companion article by Air Commodore, now Air Vice-Marshal, Stuart Peach, builds on the historical analysis to look at effects-based operations from a contemporary air perspective. He also contends that airmen have understood effects-based concepts since the earliest days of air warfare. However, he also argues just as there is a distinctive British 'way' in land warfare, there is also a distinctive British 'way' in air warfare which has been much to the fore in the deployment of British air power in the post-Cold War world.

The third article, by Richard Davis, is taken from a larger paper delivered to the Society of Military History. The article concentrates on the targeting policy of the US Eighth Air Force during the combined bomber offensive. Readers will find interesting parallels with recent conflicts in Afghanistan and Iraq when the aim was to make war on the regime, and not the people. However, Davis makes it clear that during World War II the Norden bomb sight was by no means a precision bombing system as we understand that term today, and that, as with the previous 2 papers, it is technology that determines what can physically be achieved.

By way of contrast the next article, by Thomas Withington, examines the future of the USAF heavy bomber fleet in the light of recent conflicts. He concludes that, far from being dinosaurs, 'strategic' bombers, with their attributes of payload, flexibility, reach, sustainability and cost effectiveness, offer a very effective way of delivering the United States 'global strike capability'. However, he does not address himself to the issue of how the required level of control of the air is achieved through a suppressive, or more likely destructive, counter air campaign to enable the use of relatively vulnerable aircraft to operate with the freedom he postulates.

Major 'Cricket' Renner's article was written whilst a student on the United Kingdom's Advanced Command and Staff Course. This article is a useful examination of the use of air power in a campaign that is less well known than those that preceded and succeeded it in North Africa and North West Europe respectively. At the tactical level the Italian campaign saw the maturation of forward air control procedures and the emergence of structures which predated the current joint co-ordination board and air tasking order. However, he rightly points out that interdiction is only decisive when it is a part of an integrated joint campaign.

The next article, by Lieutenant Colonel Ian Pickard RHF of the Joint Doctrine and Concepts Centre, is taken from the JDCC's recent Command and

Inform Paper which has been written to inform work across the equipment capability, procurement and force development areas. The article is very forward looking, seeking as it does to define a command philosophy for the United Kingdom in the network centric era and postulates a battlespace within which both information and command intent is broadly disseminated thus permitting the application of mission command in its purest form across all participants.

Dr Alfred Price's article, Pre-emptive Strike, looks at the operations by the Luftwaffe against the Soviet Air Force on the first day of their attack on the Soviet Union, Operation BARBAROSSA. At the tactical level, the value of offensive counter air, in the form of both airfield attack and aggressive fighter sweeps, is highlighted as a major reason for their success. What is pertinent in today's era of effects-based and information warfare is the value of a well-targeted deception plan, especially when the national leadership, in this case Stalin, did not wish to believe the truth when it was finally presented to him. Finally, though, for all their tactical and technical superiority, the Germans and indeed the Japanese were unable to gain their strategic goals before the 2 nascent super powers had transformed their entire economies into war-winning weapons.

Finally, an article from the January 1942 edition of Tee Emm which refers to the actions of the cruisers Goeben and Breslau in the Dardanelles in 1918 makes the point that whilst the Goeben was not sunk it was prevented from operating. This is then equated to the then current operations to prevent the Scharnhorst and Gneisenau from sailing into the Atlantic: an understanding of 'effects' is nothing new.

[D Def S \(RAF\)](#)



## Contributions to the Royal Air Force Air Power Review

The Royal Air Force *Air Power Review* is published quarterly under the auspices of the Director of Defence Studies (RAF) and has the sponsorship of the Assistant Chief of the Air Staff. It is intended to provide an open forum for study which stimulates discussion and thought on air power in its broadest context. This publication is also intended to support the British armed forces in general and the Royal Air Force in particular with respect to the development and application of air power.

Contributions from both Service and civilian authors are sought which will contribute to existing knowledge and understanding of the subject. Any topic will be considered by the Air Power Review Management Board and a payment of £200 will be made for each article published.

Articles should be original and preferably not previously published, although those of sufficient merit will not be precluded. Between 2,000 and 10,000 words in length, articles should list bibliographical references

as end notes, and state a word count. Lengthy articles may be published in instalments. Contributions from serving military personnel should be in accordance with DCI GEN 313 dated 26 November 1999.

Submissions can be sent in any IBM or AppleMac format, on floppy disk, Zip or CD, and should be accompanied by numbered page copy plus any photographs and illustrations. Digital pictures should be saved as TIFFs or JPEGs @ 300dpi.

Final design format for article presentation on the printed page will be at the discretion of the Editor.

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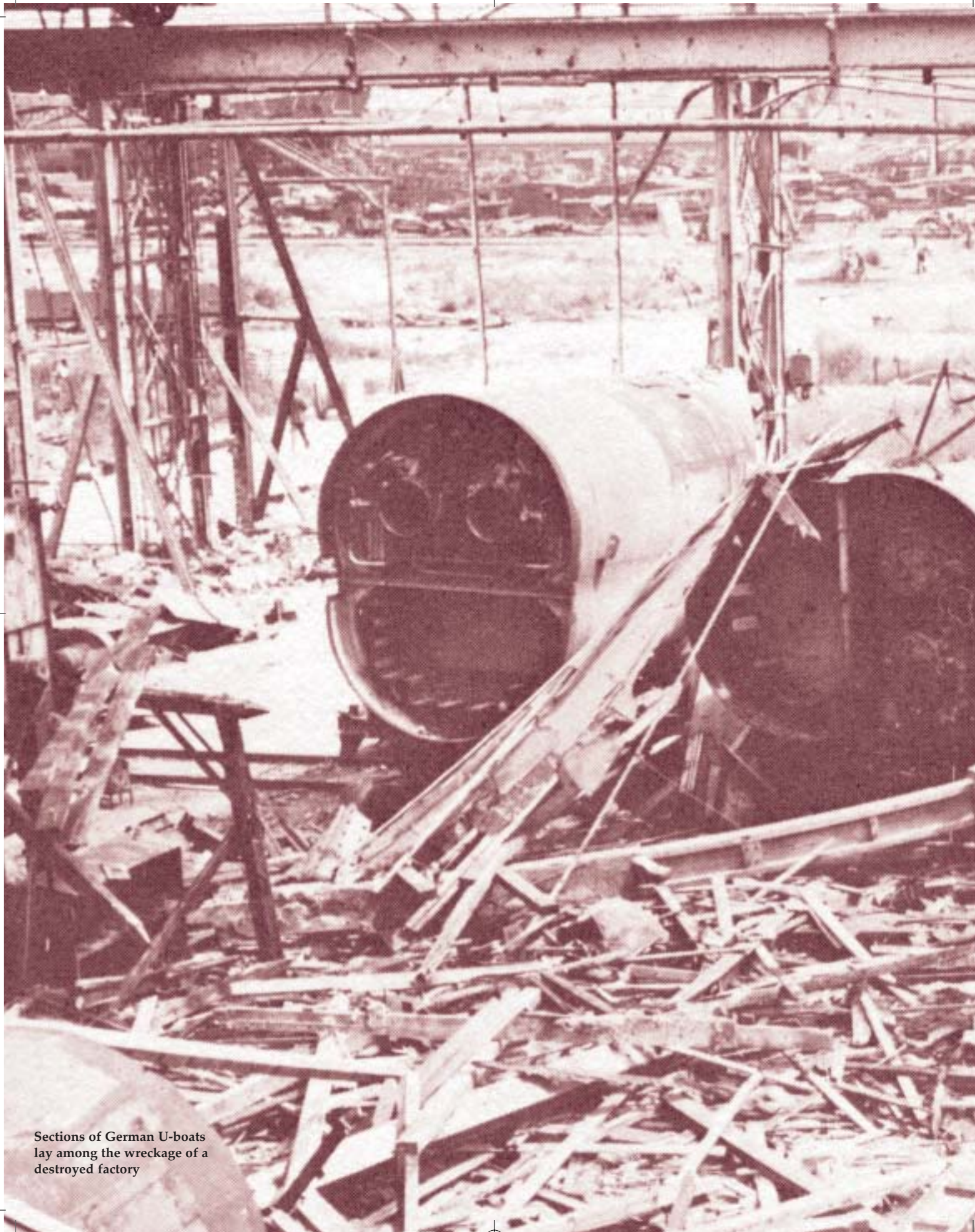
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Sections of German U-boats  
lay among the wreckage of a  
destroyed factory



# *A History of Effects-based Air Operations*

By Phillip S Meilinger

*Phillip S. Meilinger is a retired US Air Force colonel and command pilot with a PhD in military history. He is the author of 4 books and over 60 articles on military theory and operations. Currently he is the deputy director of the AEROSPACENTER at Science Applications International Corporation.*

**U**S Joint Forces Command defines effects-based operations (EBO) as follows: *'A set of actions planned, executed and assessed with a systems perspective that considers the effects needed to achieve policy aims via the*

*integrated application of various instruments of power.'* This is not the clearest definition I have ever read, but it does get across the basic thrust. The success of a military action must be defined by the results it achieves in furthering the political objectives of our leaders. EBO seeks to move away from the linear, attrition-based warfare of the past.

A more coherent though unofficial definition is provided by a RAND analyst:

*Effects-based operations are operations conceived and*



*planned in a systems framework that considers the full range of direct, indirect, and cascading effects, which may—with different degrees of probability—be achieved by the application of military, diplomatic, psychological, and economic instruments.*

This is better because it alludes to indirect or cascading effects that may and usually do occur from the application of airpower. It is this characteristic that is so unique to the air weapon, while at the same time being so difficult to measure or even define.

It is my thesis that airmen have always hoped to conduct EBO, even if they didn't use that term, and they sought to do so at the strategic level of war. There's the rub, because up through most of World War II—and some would say even today—airmen did not yet have the analytical, cognitive or intelligence tools necessary to determine the effects or the effectiveness of their strategic air operations. As a consequence, airmen began doing what they *could* do: they began solving the hundreds of tactical and technical problems that

constantly cropped up, hoping that by doing things efficiently and competently they would also be doing them effectively. As a tool to achieve this hoped-for effectiveness they took to counting things, mistaking that practice for evaluation and measurement. In addition, airmen often mirror-imaged—they looked at their own complex systems and their vulnerabilities, and then assumed that an enemy's would be similar. Today we have more capable analytical tools to conduct and evaluate EBO, but we still lack a comprehensive and clear methodology for applying them.

Lieutenant Colonel Edgar S. Gorrell, a member of the US Air Service in France, wrote in late 1917 what is considered to be the first concept paper by an American military officer regarding strategic bombing. In many ways this was a remarkable document, and, although largely ignored for the next two decades, it was strikingly similar to what American air theorists would espouse up through World War II. More importantly, it touched upon the basic precepts of EBO.

*German artillery was continuously and mercilessly pounding Allied positions, but these millions of shells were produced in only a few specific, well-known factories. If these factories were destroyed, shell production would cease*



Allied bomb damage to a German munitions factory at Magdeburg

*In Britain, the RAF's 'War Manual,' AP 1300, stated that a nation was defeated when its people or Government no longer retained the will to prosecute their war aim — the desired effect*

Gorrell began by noting the ground stalemate on the Western Front that consumed lives to no real purpose. He argued that 'a new policy of attacking the enemy must be adopted.' German artillery was continuously and mercilessly pounding Allied positions, but these millions of shells were produced in only a few specific, well-known factories. If these factories were destroyed, shell production would cease. In other words, if the effect desired was to halt the German artillery attacks, it was not necessary to destroy or overrun all enemy artillery pieces on the Western Front. Rather, destroying the factory that made the guns would have the same effect, but could be achieved, presumably, more quickly and with less loss of life. The same was true of any number of critical war industries ranging from aircraft engines to steel mills.

Gorrell then looked at the German economy as a whole and argued that 'there are a few indispensable targets without which Germany cannot carry on the war.' Regrettably, Gorrell was disappointingly vague on just what those 'indispensable targets' were. Instead, he identified four major industrial *regions* in Germany: a 'Northerly group' comprised of Dusseldorf, Essen, etc; the 'Cologne group'; the 'Mannheim group' that contained Mannheim, Ludwigshafen and Frankfurt; and finally, the 'Saar Valley group' that housed munitions plants and steel works.<sup>2</sup> This was a bit general to say the least. Those geographic regions contained hundreds of potential targets. Which ones were to be attacked and in what order? Gorrell did not say. Unfortunately, those who came after him during the next two decades could do little better.

The American airman, Brigadier General Billy Mitchell, wrote in 1925 that air forces would strike the enemy's 'manufacturing and food centers, railways, bridges, canals, and harbors.'<sup>3</sup> Considering Mitchell's position as Assistant Chief of the Air Service, and also that this quote was from his most notable book, it is apparent that he had made little improvement on Gorrell's very general thinking of eight years previously.

Brigadier General Giulio Douhet, the Italian air theorist, was similarly indistinct in his seminal *The*

*Command of the Air*, first published in 1921 and revised in 1927. Douhet argued that the effect desired in war was the collapse of enemy morale, and this could be achieved through a bombing offensive. Regarding the proposed targets for such an offensive, Douhet identified 'peacetime industrial and commercial establishments; important buildings, private and public; and certain designated areas of civilian population as well.'<sup>4</sup> Realizing that this said very little, Douhet admitted that 'the selection of objectives, the grouping of zones, and determining the order in which they are to be destroyed is the most difficult and delicate task in aerial warfare, constituting what may be defined as aerial strategy.'<sup>5</sup> Indeed, this was where the air commander must prove his genius. What is maddening about these theorists was their absolute assurance that decisive effects would result from bombing key targets, without giving any real guidance as to what those key targets were or how their destruction would lead to the effects desired.

Unfortunately, the official doctrine with which the Royal Air Force (RAF) and US Army Air Forces (AAF) entered World War II offered little more than the standard laundry lists of broad categories. In the US, Army Field Manual 1-5, 'Employment of Aviation of the Army,' stated that 'important objectives may be found in the vital centers in the enemy's line of communication and important establishments in the economic system of the hostile country.' Besides concentrating on enemy forces, the manual suggested such targets as rail communications, bridges, tunnels, rail yards, power plants, oil refineries and 'other similar objectives.'<sup>6</sup>

In Britain, the RAF's 'War Manual,' AP 1300, stated that a nation was defeated when its people or Government no longer retained the will to prosecute their war aim—the desired effect. It would be achieved partly by strategic bombing, which would concentrate on what had then become the usual suspects: the enemy's industrial and economic infrastructure, which included such things as public utilities, food and fuel supplies, transportation networks and communications.<sup>7</sup> I would note that, adding to the confusion such generali-



ties invoked, popular and even professional publications of the time focused on the horrors of air warfare. A common depiction was how air bombardment would destroy whole cities and even civilizations.<sup>8</sup> One is also reminded of the desolation caused by the air attack depicted in the film version of the H.G. Wells novel, 'Things to Come.'

Granted, this is an almost childish example upon which to hang a theory of war, but there was more to it than that. During the 1930s the US, and indeed most of the world, was in the depths of the Great Depression. Businesses and banks, large and small, were closing their doors on an almost daily basis. The economy was a shambles. Great nations were brought nearly to their knees—and

*Great nations were brought nearly to their knees—and not a shot had been fired. It certainly seemed to air planners that economies were fragile instruments and that only a strong economy could build a strong military capability*

Theories and apocalyptic predictions of death raining from the sky perhaps had their place to inform or shock the public, politicians and even airmen themselves, but at some point airmen needed to put pencil to paper and devise actual plans. In truth, however, the doctrine manuals published before World War II that contained only vague references to 'vital centers' and 'key targets' were simply inadequate. Nonetheless, throughout the interwar period there were airmen in Britain and the US who began grappling with the problem of how they would actually go about conducting a strategic air campaign.

At the Air Corps Tactical School (ACTS) in Alabama, two events occurred, one admittedly minor that was blown out of proportion, but one that was not so minor. It is an oft-told anecdote that one day the instructors-cum-pilots of the Tactical School learned that they were unable to fly because all their planes were grounded. There had been a failure of a certain spring that went into the propeller assembly on the aircraft engines, but replacement parts were on back order. It seems the springs were manufactured at a factory in Pittsburgh, but due to recent floods, that factory was temporarily closed. No factory; no springs; no flying.<sup>9</sup> This seemed important. If an enemy wished to gain control of the air over the US, perhaps it wasn't necessary to attack every airfield or shoot down every plane. Perhaps it was only necessary to destroy one factory in Pittsburgh.

not a shot had been fired. It certainly seemed to air planners that economies were fragile instruments and that only a strong economy could build a strong military capability. If the desired effect was to render an enemy incapable of continuing a war, then perhaps airpower, in the form of strategic bombardment, could more directly destroy an economy, and could do so relatively quickly. Victory in war would then inevitably follow. But economies were very big things. One couldn't possibly expect to destroy *every* factory, power station, rail line, bridge, steel plant, etc. in an enemy country.

What targets were more important—or perhaps more vulnerable—than others? The propeller spring seemed to offer a clue, because it implied there were key nodes within an economic system that were more important than others, upon which the system itself tended to depend. All targets were not created equal. The propeller spring became a metaphor for a way of looking at air warfare—the search for the strategic bottleneck.

Before the war, it was extremely difficult for American airmen to obtain information on the economies of potential enemies. There was no funding for such an intelligence organization, and the US policy of isolation made such an endeavor inappropriate. Instead, the instructors at the Tactical School tried a different approach. They looked at ('examined' would be too grand a term)

the industrial northeast of the US. Via letters, phone calls and visits, the officers gathered information on how American power grids, steel mills, oil refineries and transportation systems worked. More importantly, they tried to deduce how those systems did *not* work.

for example, then they might place too much emphasis on that industry's role in the overall war economy, while at the same time overlooking the importance of another target system. Yet, it was a beginning.

*If planners had copious information on the German ball bearing industry, for example, then they might place too much emphasis on that industry's role in the overall war economy*

To summarize, going into World War II air leaders had an inherent belief in the importance, indeed the necessity (if partly for institutional reasons to justify an independent status), of EBO. They also had a rudimentary understanding of how such efforts needed to be measured and evaluated. They did not, however, have the analytical tools at hand to conduct that measurement and evaluation.

Once war broke out in Europe in September 1939, both the RAF and AAF expanded their efforts at EBO. For example, the AAF established an air war plans division in Washington and charged it with devising target sets for air attack should the US enter the war.

The initial steps were small and hesitant, but businessmen, engineers and bankers were contacted for information. In some cases this information concerned plants and factories in Europe that American banks had helped finance or that American construction companies had helped build. In other cases, these experts simply instructed the planners on how US systems and networks operated, assuming that those in Germany would be similar. This was very hit-and-miss, often dependent on who knew of someone in business, any business, and how much they were willing to help. There was an obvious danger here, what I call the 'blueprint availability syndrome.' The types of intelligence available and examined will necessarily shape one's view on how a system operates. If planners had copious information on the German ball bearing industry,

Three other organizations were established in Washington and London that devoted themselves full time to the study of vulnerabilities within the German economic structure. The first was formed by the British government prior to the war and was termed the Ministry of Economic Warfare (MEW). The second group, a collection of American businessmen, lawyers and economists, was called the Committee of Operations Analysts (COA). Finally, a third organization, also created in late 1942, was initiated by two AAF colonels who approached the Office of Strategic Services (OSS, the forerunner of the CIA), and asked for targeting assistance. The Enemy Objectives Unit (EOU) of the Economic Warfare Division in the American Embassy was the result. For the remainder of the war these three new and unusual intelligence and planning units—as well as various other intelligence agencies—would serve as advisers to Allied air leaders.

The objective of all these economic analysis groups was similar. As General 'Hap' Arnold phrased it in his charter to the COA: 'Prepare a report analyzing the rate of progressive deterioration and what should be anticipated in the German war effort as a result of the increased operations we are prepared to employ against its sustaining resources.'<sup>11</sup> Nonetheless, although their goals were similar, these three agencies did not always work in harmony. When Colonel Guido Perera, head of the COA, arrived in England he encountered resistance not only from Eighth Air Force headquarters, but from the EOU and MEW as well. For its part, the EOU encountered resistance from the MEW

and the Air Ministry. As the official history phrased it: 'Capt. Barnett, with ineffable tact, probed the resources of the somewhat reluctant Air Ministry intelligence.' Basically, the Air Ministry felt itself continually 'harassed' by visiting officers bothering them with questions.<sup>12</sup> Relations improved over time, but a degree of competition and friction always remained.<sup>13</sup>

All three of these organizations, as well as the air war plans division on the American air staff, suffered from similar problems. They did not have access to the types of information necessary to make reasoned judgments on the German economy. As the AAF official historians eloquently phrased it:

*But there existed in almost every instance a serious shortage of reliable information, and the resulting lacunae had to be bridged by intelligent guesswork and the clever use of analogies. In dealing with this mass of inexactitudes and approximations the social scientist finds himself in a position of no special advantage over the military strategist or any intelligent layman; and an elaborate methodology may even, by virtue of a considerable but unavoidably misdirected momentum, lead the investigator far afield.<sup>14</sup>*

To overcome the impediments hinted at here, the analysts initially looked for information in published German magazines and newspapers—hardly likely to be very revealing during wartime—as well as the types of industrial and financial contacts who were located in the US or Britain as noted above.<sup>15</sup> Such poor sources led to one of the greatest misconceptions made by all of these groups for most of the war: that the German economy was drawn taut and therefore susceptible to attack with devastating results. For most of the war the German economy actually contained a surprisingly great deal of slack. Because the economies of the Allies were on a wartime footing, it was simply assumed that Germany's was as well. This was not the case. In fact, the Allies' economies were far more mobilized for war than was Germany's.<sup>16</sup> As an example, the German automobile industry, the largest sector of the economy in the 1930s, was utilized at barely 50 percent of its capacity during the war.<sup>17</sup> On the other

hand, some air planners believed that oil offered a special case.

Germany had extremely limited oil reserves within her boundaries; only about 7 percent of her peacetime needs were met by domestic sources. As a consequence, she either had to import this vital commodity, gain access to oilfields and refineries through conquest or alliance, or come up with a substitute. In peacetime, Germany imported virtually all of her oil needs—most of it from Venezuela and the US—but once war broke out, the British blockade removed this option. In 1940, Germany therefore formed an alliance with Rumania to gain access to her vast oilfields, which then supplied her with 60 percent of her crude oil supplies.<sup>18</sup> At the same time, German scientists perfected a method of producing oil from coal in a process called hydrogenation. This process was, and indeed still is, inefficient and expensive.<sup>19</sup> Allied air planners thus saw Germany as highly vulnerable in the area of oil. It was not known, however, how much oil Germany had in reserve when entering the war, nor how much it produced or consumed since then. Indeed, based on little more than guess work, in 1942 the COA estimated that Germany had somewhere between 2.4 and 6.0 million tons of oil in reserve. That's quite a range.

The MEW, for its part, put the figure at 3 million tons.<sup>20</sup> Because there was no agreed upon formula for determining which group's methodology was superior, the issue was decided by simply splitting the difference between the two estimates—the Germans were deemed to have 4 million tons of oil reserves on hand. As a result, when air planners met at Casablanca in January 1943 to determine targets for the Combined Bomber Offensive (CBO), oil was placed fourth on the list—Germany had so much oil in reserve it did little good to make it a high priority. This decision, at least as far the Americans were concerned, would later be seen as an error.

As time went on the COA, EOU and MEW became increasingly more capable in achieving EBO. To a great extent this was due to their formulation of criteria and methodologies for gathering information on the German economy, accessing it, and





Allied attack on a German oil refinery

*German aircraft were used up very quickly in combat; there was no real pool to draw from. In this case, destroying the factories would have a significant and almost immediate effect on the Luftwaffe's combat status*

then looking closely at the targets themselves. The economists, engineers and mathematicians who comprised the bulk of the three organizations defined their field as they went along. They looked at such issues as the indispensability of the product to the enemy war economy, total production of a given commodity, minimum operational requirements, surplus capacity, ability to substitute other materials, the time needed to repair damaged facilities, the actual degree of damage sustained, and the ratio between 'pool and production.'<sup>21</sup>

This last was important because it identified the distinction between some commodities that could

be stored, stockpiled or simply used for an appreciable length of time, versus a commodity where such activities were impractical. Thus, for example, the oil reserves noted above were seen as a large 'pool,' and destruction of production would have little immediate effect; hence, the initial decision of the air planners to give it a low priority. Similarly, U-boat production was slow, most submarines were actually in service or in port, so hitting the factories building the boats would have little immediate effect on operations. On the other hand, German aircraft were used up very quickly in combat; there was no real pool to draw from. In this case, destroying the factories would have a significant and almost immediate effect on the *Luftwaffe's* combat status.<sup>22</sup>

Eventually, the EOU became adept at examining various industries in detail and preparing 'aiming-point reports' that gave specific instructions on how best to destroy those industries. This was a major accomplishment.<sup>23</sup> Once planners had determined which nodes, industries, systems or commodities were more important than others, they had to ascertain whether or not their bombing operations were actually working. There were two fundamental questions to be answered. First, were air strikes actually destroying or neutralizing their intended targets, and second, if they were tactically successful, was that destruction or neutralization having the intended ripple effect throughout the German economy or war machine that had been predicted?

The first question, were the bombers actually hitting and destroying their targets, did not have an obvious answer. The inaccuracy of early bombing efforts as detailed in the Butt Report of 1941 is well known.<sup>24</sup> Two years later the COA formed a subcommittee on 'Probabilities' to determine the accuracy of Eighth Air Force strikes. The task was not easy. Eighth Air Force headquarters was protective of its data regarding bomb accuracy, probably because it revealed that its accuracy was not very good. When the COA finally obtained the data they decided the numbers were 'too pessimistic as a criterion for the future.'<sup>25</sup> This was not a helpful start. In addition, the related question of how much damage was achieved even if the bombs did hit the target was not obvious either. Then, as today, bomb damage assessment was as much an art as a science. Post-strike photographs showed, for example, that the bombing strikes against the ball bearing factories in Schweinfurt in 1943 caused extensive damage. After the war it was discovered, however, that many bombs detonated upon hitting the factory roofs. This collapsed the roofs and such damage appeared impressive in photos, but in reality the machines on the floors below had been largely untouched—less than 5 percent were damaged and most of those were quickly repaired.<sup>26</sup>

Beyond this first level of analysis, the three agencies noted above had to confront the subject of sec-

ond and third order effects. In truth, all military actions have such indirect effects—some are anticipated and some are not. Identifying these indirect and secondary effects was crucial. To do this it was necessary to identify measures of effectiveness (MOE).<sup>27</sup> Although this is a new term popularized by the Total Quality movement of a decade or so ago, the concept was well understood in World War II. Fundamentally, MOEs link objectives to targets. The analysts realized this and stressed that air targeting boiled down to three basic questions: 1) will damage to the target hurt the enemy? 2) can you hit it and at what cost? and 3) can you damage it if you hit it?<sup>28</sup> Of these, the first was crucial and hinged on what type of evidence, specifically, should analysts look at to determine if their chosen targeting strategies were actually working and achieving the political goals established. The answer to this question was not obvious, and there were several instances during World War II air campaigns when it caused argument.

One example of when this problem became apparent was in the oil plan versus rail plan controversy of spring 1944. The origins of the argument over the most appropriate targets for the heavy bombers traces back to the Casablanca Conference of January 1943. At that conference Roosevelt and Churchill had agreed to a directive that was to be the guiding charter for the heavy bombers. The Casablanca Directive stated that the objective of the Combined Bomber Offensive was 'the progressive destruction and dislocation of the German military, industrial and economic system, and the undermining of the morale of the German people to a point where their capacity for armed resistance is fatally weakened.'<sup>29</sup>

Unfortunately, this was a highly ambiguous directive, perhaps deliberately so, that allowed the reader to take from it whatever he wished. For ACM Arthur Harris at Bomber Command, he saw the order to 'undermine the morale of the German people' as a vindication of his night area-bombing strategy. To Lieutenant General Carl Spaatz, the senior American air commander in Europe, the operative phrase concerned 'the progressive destruction and dislocation of the German mili-



B-24s on bombing mission over Germany

*As the AAF official history phrased it, the RAF/AAF bomber offensive was to be a combined effort—the RAF bombing strategic city areas at night, the American force striking particular targets by daylight. In other words, it would not be much of a combined effort at all*

tary, industrial and economic system’—the mission of his daylight bombers and their precision bombing campaign. On the other hand, General Dwight Eisenhower, who would eventually be named Supreme Allied Commander for OVERLORD, would focus on the need for an invasion. In his view, the bombers’ main function was to support that inevitable assault on the French coast—to ensure that ‘armed resistance was fatally weakened.’

In June 1943 the objectives of the CBO were for-

malized in what was called the POINTBLANK Directive. As the AAF official history phrased it, the RAF/AAF bomber offensive was to be a combined effort, ‘each operating against the sources of Germany’s war power according to its own peculiar capabilities and concepts—the RAF bombing strategic city areas at night, the American force striking particular targets by daylight.’ In other words, it would not be much of a combined effort at all. Yet, POINTBLANK also underscored that the CBO in its most basic sense was to ‘prepare the way for the climactic invasion of



*In Harris's words: 'Had I paid attention to the panacea-mongers who were always cropping up and hawking their wares, Bomber Command would have flitted continually from one thing to another during the whole period of my command'*

Europe.<sup>30</sup> In short, the problem of Casablanca was still unresolved: differing objectives or effects desired would mean differing strategies, which in turn would mean a different set of targets. Would these varied strategies work in harmony or at cross-purposes?

One other note on POINTBLANK: it stated that an 'intermediate priority second to none in importance' was the gaining of air superiority. As we shall see, how to achieve this effect and how it was to be measured, and, indeed, precisely what the term itself meant, were not obvious to all observers.

By early 1944 planning for the Normandy invasion was in full swing, and the question of how best the CBO could complement the landings was discussed. By this point, American analysts had revised their estimates of the German oil situation and decided the reserves available were not as great as originally thought. If true, then oil should become a crucial and perhaps top priority for Allied bombers. If the oil refineries in Rumania were knocked out, along with the hydrogenation plants in Germany itself that produced synthetic fuel from coal, the vital 'black gold' that propelled the German war machine would be halted—one of the stated goals of POINTBLANK.

Other air planners focused on the German rail network. Troops, supplies, equipment and raw materials all moved around the *Reich* primarily by train—although road and river traffic were also significant. If the rail lines could be cut and the trains stopped, so this argument went, the German war machine, indeed, the entire German economy, would stop as well.

This debate tended to break along national lines with the American airmen pushing for the oil plan and most British airmen—notably ACM Arthur Tedder the Deputy Supreme Allied Commander—advocating the rail, or as they called it, the 'communications' plan. Recall, however, that the Directive was interpreted by Bomber Command to

mandate the undermining of German morale. According to this requirement, Harris thought that both oil and rail systems were 'panacea targets' that were distractions from his primary task of area attacks. In Harris's words: 'Had I paid attention to the panacea-mongers who were always cropping up and hawking their wares, Bomber Command would have flitted continually from one thing to another during the whole period of my command.'<sup>31</sup>

The question of oil versus rail was finally resolved on March 25, 1944, when General Eisenhower opted for the rail plan.<sup>32</sup> The critical factor that decided the issue was time. Eisenhower's MOEs were very specific: he wanted Allied air superiority that would then be used to isolate the beach-head area from German reinforcements. He wanted that done *for* the invasion, not sometime in the weeks and months to follow. Although he agreed with the Spaatz faction that the collapse of the oil supply would have a catastrophic effect on the German war machine, such a collapse would not be expected to occur until the fall. That would be too late for his troops in Normandy. The rail plan of Tedder won the day for the quite logical reason that it promised a solution to Eisenhower's immediate problems—it promised the effects that he desired.

To illustrate how much of this was groping in the dark, the US Strategic Bombing Survey later discovered that there actually was a bottleneck—similar to the ACTS propeller spring—that Allied analysts missed. Tetraethyl lead (TEL) was a chemical that when added to gasoline raised its octane level. This additive, discovered in the 1920s, was used routinely by World War II to raise the octane level of gasoline from 87 to 100. This high performance fuel was crucial to aircraft like the Spitfire, P-51 and FW-190. In Germany, there were, literally, only a handful of plants that produced TEL, and all were highly vulnerable to attack. Had the Allied bombers destroyed these plants, German aviation gasoline would have been

rendered nearly useless.<sup>33</sup>

Similarly, another one of the difficulties often experienced in such targeting debates was that of mirror imaging. Time and again Allied air planners and analysts, in the absence of hard data or credible intelligence, made decisions based on their own experience or their own common sense. Sometimes this worked, but on other occasions it induced major errors into their calculations. For example, it was assumed that German hydrogenation plants were built and operated similar to Allied oil refineries. This was not so. The Germans, in an effort to consolidate several processes in the interests of efficiency, tied the production of rubber and chemicals into their hydrogenation plants.

Thus, an air strike on one of these plants affected not only gasoline production, but that of rubber and chemicals as well. In turn, these chemicals (notably methanol and synthetic nitrogen) were often used in other applications so there was a corresponding cascading effect in, for example, the German explosives industry. Allied planners were not aware of this relationship until after the war.<sup>34</sup> This is precisely the type of cascading effect pre-war planners had hoped to achieve. Had this information been available in 1944 (along with the importance of TEL noted above), it would no doubt have moved the synthetic fuel plants and oil targets in general higher up the priority list.

Even within the rail plan there was a strenuous debate that is also relevant to our discussion here. If the effect desired was to halt rail traffic, then what specific parts of that rail system should be targeted? There were numerous possibilities: rail cars, locomotives, repair facilities, round houses (switching mechanisms), marshalling yards in general, and rail bridges.

Solly Zuckerman, a British anatomist and primate specialist at Oxford before the war, worked on Tedder's staff in the Mediterranean Theater. Applying himself to the question of what precisely was the best part of the rail system to hit, Zuckerman studied the results of Allied bombing of rail bridges versus marshalling yards in Sicily and Italy during 1943. He concluded that

marshalling yards were far more desirable targets simply because they were larger. Given the accuracy of Allied bombers at the time, bridges were so small that it would take a disproportionate tonnage of bombs to knock one out. Because marshalling yards were so expansive, however, Allied bombers were far more likely to hit *something* of value when the yards were targeted. Zuckerman concluded, based on the accuracy argument, that bombing marshalling yards was more *efficient* than was an attempt to bomb bridges.<sup>35</sup> Tedder agreed with this reasoning and directed his planners to concentrate on marshalling yards.

When Tedder and Zuckerman left the theater several months later, the new commander, Lieutenant General Ira Eaker, reviewed the rail decision. His analysts concluded Zuckerman had been mistaken. Using the data from many more air operations than Zuckerman had used in his sample, Eaker's analysts discovered that bridges were not as difficult to hit as previously thought—especially when medium bombers were used rather than heavy bombers like B-17s or B-24s flying at high altitude. In addition, the analysts determined that the results of the bridge bombings were more lasting than were those of the marshalling yards. In the latter case, repairs were often effected within days, but when a rail bridge was dropped, it generally took several weeks to repair it.<sup>36</sup>

This discovery became important as planners grappled with the same issue as they prepared for the invasion of Normandy. If it was desired to isolate the beachhead by preventing German reinforcements from reaching the area—which Eisenhower's decision of 25 March made clear—then how best could airpower achieve that goal? Tedder and Zuckerman, now in London, dusted off their analysis from the year before and once again pushed for marshalling yards. Other analysts in London, led by Charles Kindleberger and Walt Rostow in the EOU, begged to differ. Referring to Zuckerman's analysis as 'tart and turgid,' they sniffed that his 'main conclusions did not, in fact, flow from the mass of appended evidence.'<sup>37</sup> Using the more recent analysis obtained from the Mediterranean, EOU argued for a bridge campaign.

*There was enough Allied airpower by mid-1944 to follow a number of different targeting strategies. In this regard, it is always useful to remember that by D-Day, the US Ninth Air Force, which consisted of over 4,000 aircraft, was larger than the entire combat strength of the Luftwaffe*

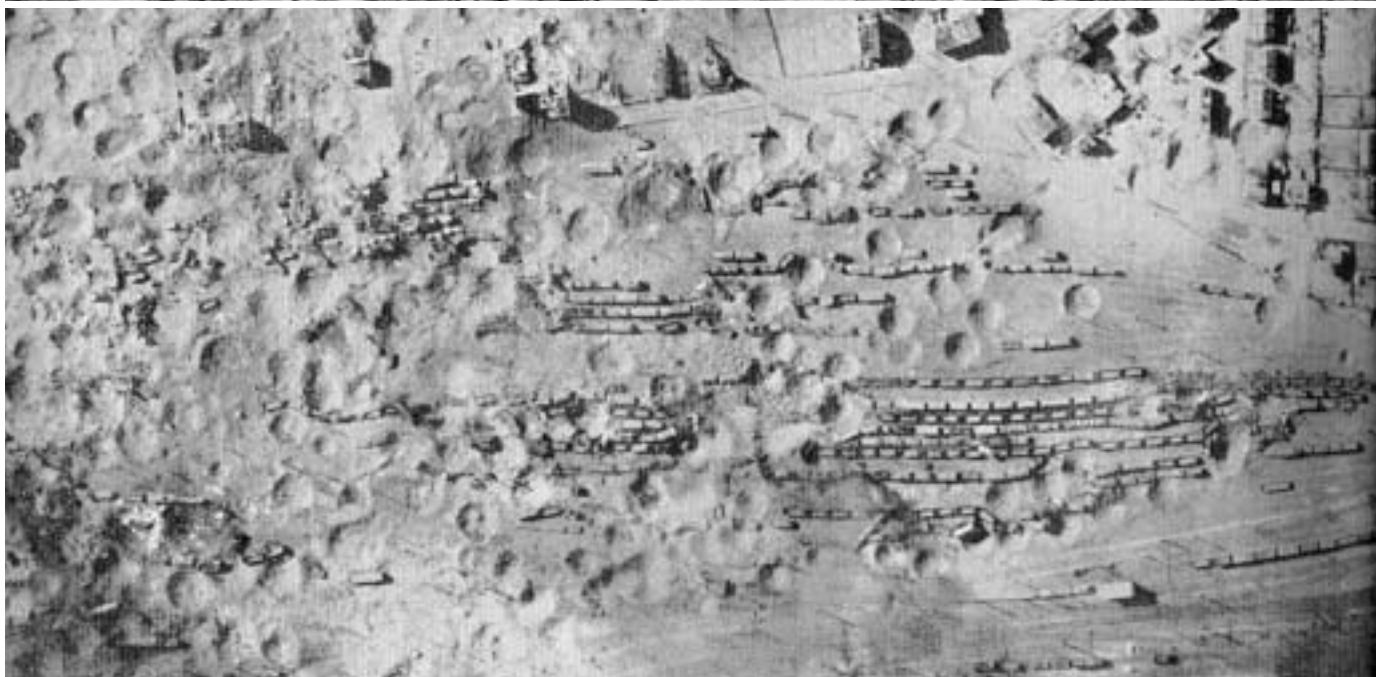
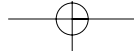
As with the broader question of oil versus rail, this more specific question of ‘what rail’ broke down by nationality and generated bitter debate—for the next four decades.<sup>38</sup> In the event, air leaders resolved the question of what to strike in their usual manner—they bombed *both* marshalling yards and bridges. There was enough Allied airpower by mid-1944 to follow a number of different targeting strategies. In this regard, it is always useful to remember that by D-Day, the US Ninth Air Force, which consisted of over 4,000 aircraft, was larger than the entire combat strength of the *Luftwaffe*. Moreover, the Allies also had the British 2<sup>nd</sup> Tactical Air Force and the US Twelfth Air Force in Europe to support the invasion. And of course, from March until September 1944, Eisenhower could also employ the heavy bombers in both Bomber Command and the Eighth Air Force. Given this abundance of air, questions of whether it was better to bomb rail bridges or marshalling yards became almost academic—as for that matter was the question of whether it was wiser to bomb rail or oil. There was more than enough air available to hit all of the above—as well as submarine pens, V-1 and V-2 launching sites, airplane and engine factories, and the enemy front lines.

It would be unwise, however, to pass over this question too quickly. It was and indeed still is of more than academic interest to determine whether Zuckerman was right or if on the other hand the analysts at EOU were correct. Air planners will not always have unlimited air assets at their disposal—even if, as we have seen over the past decade, those assets are limited by political considerations and not due to lack of airframes available. In such circumstances, air planners should know where to get the most bang for their buck. They should know precisely what to hit in order to achieve the greatest effect, and this effect should fulfill policy objectives.

I mentioned that the debate over rail bridges versus rail yards carried on for four decades. That was a good thing, because it allows us today to revisit the methodology and assumptions used by the analysts and planners at the time. In 1970 Solly Zuckerman, by then Lord Zuckerman, published his memoirs in which he once again laid out the arguments for striking marshalling yards. Never a man to mince words, he was somewhat less than charitable to those who had disagreed with him. Not surprisingly, his old antagonists, Kindleberger and Rostow from the EOU, rose to the challenge and there ensued a series of increasingly nasty exchanges in the journal *Encounter*.<sup>39</sup> This exchange of letters to the editor drew out another contestant, Henry D. Lytton, an economist who had worked on the US War Production and Economic Warfare Boards during the war. He sided with his countrymen in a strident article in *Military Affairs*.<sup>40</sup> What are interesting about Lytton’s article are not just his conclusions regarding the relative importance of bridges versus marshalling yards—which is perhaps predictable given his background—but his insights into the methodology and assumptions used by the respective protagonists.

Basically, Lytton revealed, using the words the proponents had written in 1944, what were then being used as measures of effectiveness. Zuckerman was interested in the density of the bomb patterns within the designated target area. Marshalling yards were large; thus, a far higher percentage of bombs landed within that area than was the case when the target was a small rail bridge. Kindleberger and Rostow, on the other hand, were less concerned with bomb density than they were with rail movement. If only one bomb in 1,000 hit the bridge—and dropped it—that was preferable to having all 1,000 bombs landing within the confines of a marshalling yard, if even one rail line was left intact in that yard, which allowed





Before and after photographs of a marshalling yard at Juvisy near Paris, destroyed by RAF bombers

*It took, on average, five times more bomb tonnage to stop trains by hitting marshalling yards than it did by hitting rail bridges*

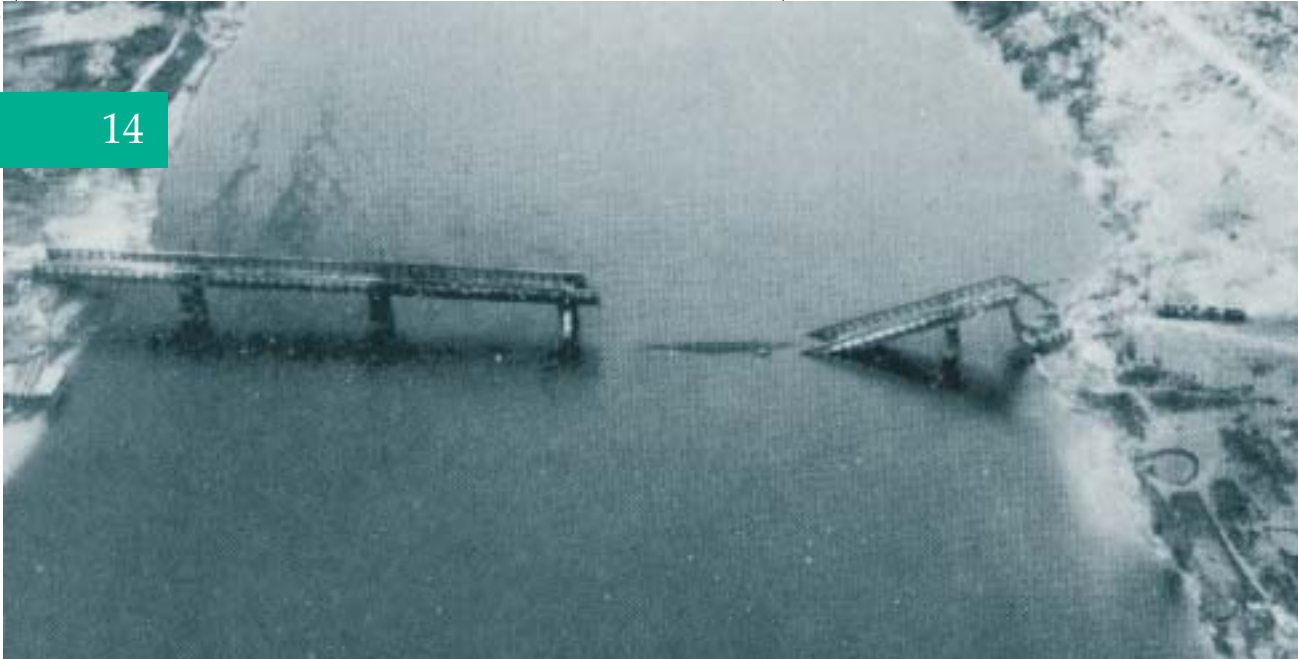
the traffic to keep flowing. It seems the Germans agreed: the officer in charge of the Italian Transport System later stated that marshalling yard attacks tended to destroy goods and rolling stock, but not the tracks themselves, which in any event were quickly repaired. The trains continued to run.<sup>41</sup>

In short, the desired effect was to stop trains, not put a certain percentage of bombs within a particular grid. Choosing the wrong measure of

effectiveness (MOE) will defeat an EBO strategy. Although seemingly a fundamental consideration, it is regrettable how often such basics have been forgotten in air warfare.

I would also note, and this aside will no doubt resonate with modern air campaign planners, that the analysts at the EOU also argued that the bridges, usually located outside of urban areas, were less heavily defended and thus were less risky to the Allied aircrews attacking them. Moreover, this





*In order to deliver a deathblow to German industry, and thus German military capability, the Allies had to stop the flow of coal. The best way to do this was by stopping the trains*

location also meant there would be fewer civilian casualties and less collateral damage than if the bombers were going after marshalling yards—almost always located in city centers. Given that most rail targets—either bridges or marshalling yards—being struck in the months preceding and following OVERLORD were located in France, this was a major consideration. In fact, around 10,000 French civilians were killed in the marshalling yard strikes. At the same time, nearly 300 Allied bombers were lost attacking them. In contrast, Lytton argues that Allied losses were light when hitting bridges, as were casualties incurred by the French on the ground—although, suspiciously, he does not provide the statistics to back this up. Finally, it took, on average, five times more bomb tonnage to stop trains by hitting marshalling yards than it did by hitting rail bridges.

It would therefore seem that measures of effectiveness were crucial in determining targets for Allied bombers in World War II. If the goal was to put bombs efficiently on a target, then marshalling yards made a great deal of sense—it was difficult not to destroy *something* when 500 bombers dropped their loads on such a complex. On the other hand, if the objective was to stop trains, while also limiting casualties—both in the air and on the ground—then bridges made more sense, even if less efficient when measured in terms of bombs actually placed on target.

But the story is not quite over. To relieve some of the duplication and competition between the various groups of economic analysts, in October 1944 a new organization was formed, the Combined Services Targeting Committee (CSTC), which contained representatives from the RAF, AAF, MEW, EOU and COA. The benefit of creating yet another intelligence/planning agency was questionable. As the official history noted dryly: 'Neither of the two commanders [Spaatz and Harris] was prepared to accept the advice of the Committee except when he agreed with it.'<sup>22</sup> Nonetheless, ACM Tedder hoped to use this new analysis unit to help prod Spaatz—whose heart still belonged to oil—into a greater emphasis on rail targets. Although he had won the earlier battle over the oilmen, Tedder had seen his influence slipping ever since 14 September when the heavy bombers passed from Eisenhower's control (and hence his own) back to that of Harris and Spaatz. Initially, the bomber barons were not conducive to Tedder's urgings. After the first of the year, however, Tedder received unexpected support.

The Allies' breaking of German codes, transmitted by Enigma machines and whose products were referred to as Ultra intelligence, had been a fact since early in the war. We all know the vital importance of this special intelligence source. However, in January 1945 the German railroad system, which had been using its own teletype

network or telephone for transmitting its status reports, now began using Enigma. Hitherto, signals intelligence personnel had largely ignored rail traffic messages, believing them of little import, but when it began to use Enigma, they began to pay more attention—perhaps this was useful information after all.<sup>43</sup> By February 1945 the Enigma traffic finally revealed the crucial role that coal played in the German economy, powering virtually all industrial production. Indeed, 90 percent of all Germany's energy derived from coal: without coal, there was no German economy.

More to the point, this coal was moved around the *Reich* almost exclusively by train ever since Bomber Command had so thoroughly and effectively mined German rivers and canals, thus essentially eliminating all barge traffic.<sup>44</sup> Since the rail plan had been in effect, the movement of coal had slowed, causing serious negative effects on German production. The implication was clear. In order to deliver a deathblow to German industry, and thus German military capability, the Allies had to stop the flow of coal. The best way to do this was by stopping the trains.<sup>45</sup>

In essence, Tedder had been right all along, only for the wrong reasons. Neither he nor his planners had identified coal as the key commodity that made the *Reich* function. His plea in October 1944 for a major campaign against German rail lines (as opposed to those in France that had been the essence of the pre-invasion bombing plan) emphasized disrupting the flow of German reinforcements and supplies. The goal of this expanded rail campaign was to 'rapidly produce a state of chaos which would vitally affect not only the immediate battle on the West Wall, but also the whole German war effort.'<sup>46</sup> Coal was never even mentioned. Tedder was not, therefore, interested in studying intelligence related to its shipment. When his planners finally did so, almost by accident in February 1945, coal's importance quickly became apparent. But the evidence had been there all along. It merely required someone to establish coal as the crucial link, and then to identify the effect desired with an appropriate MOE—the halting of its movement by rail. Once this key relationship, desired effect, and metric were articulat-

ed, the bombing campaign could be focused on its achievement.

To illustrate the complexity of all this, let me add here that German coal officials apparently *welcomed* the Rail Plan that saw the focus of the Allied bombers move from targeting the Ruhr coal and steel district to marshalling yards in France and then Germany. Indeed, they saw the Rail Plan as a 'respite' that allowed them the opportunity to catch up in their coal *production* goals.<sup>47</sup> Of course, their objective was to produce coal, not to move that coal to where it could be used.

I would note one further item on this issue, one that highlights the serendipitous nature of war in so many instances. As mentioned above, the German rail system switched from its own teletype network and the use of telephones to the Enigma coding machine in early 1945, but this was not because anyone in the *Reich* hierarchy thought such information needed to be secured at such a high classification; rather, simply because Allied bombers had knocked out the teletype network, as well as most telephone lines and postal service. Had this not been the case, it is probable Enigma would never have been used, and the Allies would not have been curious enough to finally look into the movement of coal by rail.

Regarding the importance of an appropriate MOE, let me give another example from the World War II airwar. It was a prime dictate of airpower that air superiority was an absolutely crucial objective, and, indeed, soldiers and sailors realized this as well. As mentioned earlier, the gaining of air superiority prior to OVERLORD was an 'intermediate objective of overriding priority.' As General Eisenhower himself remarked, without air superiority there would have been no invasion.<sup>48</sup> But how does one measure air superiority? There are several possibilities: the number of enemy aircraft destroyed, on the ground or in the air; the number of Allied bombers shot down; the ability of the bombers to penetrate to their targets and effectively hit them; the number of enemy aircraft produced; the number of German aircraft operational at any given time; or the number of enemy sorties flown. All of these are useful and perhaps even



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important data points, but what was the appropriate MOE to measure air superiority?

A common criticism of the CBO and the air superiority campaign in particular was to note that the production of German single-engine fighters continued to rise throughout 1944, this despite the growing intensity of Allied bombing. If one were to use German production figures as the MOE for achieving air superiority, it would be logical to conclude that the air offensive was a failure. But was that the appropriate MOE?

We now know that there were large discrepancies between the numbers of aircraft allegedly produced and those actually delivered to operational *Luftwaffe* units.<sup>49</sup> In addition, the losses suffered by the *Luftwaffe* were so enormous, even increased production could not keep pace. As a consequence, by D-Day there were a mere 300 German fighters in France to oppose the 12,000 aircraft of the invading Allies. On the Eastern Front, *Luftwaffe* strength stood at 500 fighters, versus the Soviets' 13,000. Another 500 German fighters remained in Germany itself for air defense.

Did this connote Allied air superiority? In the first 24 hours of OVERLORD the Allies flew 12,015 sorties to 319 for the *Luftwaffe*.<sup>50</sup> Despite the statistics showing increasing fighter production, it was obvious that by D-Day the Allies controlled the skies. Clearly, German aircraft production figures were an inadequate test for determining the effectiveness of strategic bombing in general or the air superiority campaign in particular.

Let me add one other point here to further muddy the water. One of the key theorists and planners in the AAF was Brigadier General Haywood S. Hansell. He had been an instructor in the Bombardment Section at the Tactical School in the 1930s, had helped write AWPD-1, the AAF's first airwar plan for Germany, and had also participated in writing the Casablanca Directive. Hansell

was not just a desk general. In 1942 and 1943 he served as a bomb wing and then bomb division commander in the Eighth Air Force; the following year he was given command of the B-29s in the XXI Bomber Command based on Guam. More than two decades after the war Hansell wrote of his experiences and, buttressed by the US Strategic Bombing Survey, opined that the Allied bombers made a mistake in not attacking German electricity.

Although this was always seen as an important aspect of the German industrial infrastructure, it was also seen as a poor target because of its small and dispersed nature. Not so, said Hansell in 1972. If 72,000 tons of bombs had been directed at the 65 targets comprising the German electrical power-generating network, that power grid would have been irreparably damaged. This tonnage, Hansell added, would have been in addition to that dropped on oil, which he also regarded as crucial. In short, if our intelligence had been better, 'the destruction of power generating and switch installations would have had a catastrophic effect on Germany's war production.'<sup>51</sup>

Who was correct in all of this? Was there a key node that should have been concentrated on by the heavy bombers? At various times there were several contenders for this magic bullet: oil, coal, rail lines, electricity, and ball bearings. Were these truly key, or were they mere 'panacea targets' as Arthur Harris suggested? In his view, the Germany economy was so large, so complex, and so redundant that only a wholesale destruction of the *entire* economy would bring Germany to its knees. In this view, strategic bombing was a *process*, not an event—persistence was essential.

It is useful to ask what the Germans thought of the Allied air offensive's importance. Albert Speer, the German Minister of Armaments and War Production later wrote:

*I shall never forget the date May 12, [1944] . . . On that day the technological war was decided. Until then we had managed to produce approximately as many weapons as the armed forces needed in spite of their considerable losses. But with the attack of nine hundred and thirty-five daylight bombers of the American Eighth Air Force upon several fuel plants in central and eastern Germany a new era in air war began. It meant the end of German armaments production.*<sup>52</sup>

On the other hand, that same November he wrote Hitler regarding the bombing attacks on the Ruhr that focused on rail lines:

*We are on the verge of the most serious coal production crisis since the beginning of the war. . . . For more than six weeks now, in the matter of transport the Ruhr has become more and more cut off from the areas it supplies. . . . It is clear from Germany's overall economic structure that in the long run the loss of the industrial area of Rhineland-Westphalia would be a mortal blow to the German economy and to the conduct of the war.*<sup>53</sup>

To confuse things further, when Speer was interrogated on July 18, 1945, he stated that the crucial targets the Allies should have bombed more vigorously were chemicals, ball bearings and electrical power, implying these target systems were more important than either oil or coal.<sup>54</sup>

It would seem that not only were Allied planners and analysts uncertain as to what was going on in the German economy, but the head of German armaments production was similarly confused regarding the status of his empire. I would add on a lighter note that Speer was often surprised by the Allies' inability or unwillingness to follow up on air attacks that he thought had been particularly devastating: 'We have a powerful ally in this matter, that is to say that the enemy has an Air Force general staff as well.'<sup>55</sup>

To summarize the World War II experience: although EBO was at the root of what airmen hoped to achieve through airpower, going into the war air planners had no real precedents for determining appropriate objectives, targets and MOEs for strategic bombing. At the same time, they had almost no experience with gathering the types of

intelligence necessary to conduct such a campaign. These two processes, both of which required massive resources and conceptual skill, had to be created from scratch. Because targets and intelligence had a symbiotic relationship to each other, it was an unusual phenomenon that at times the intelligence gathered shaped the choice of targets; whereas, on other occasions the opposite was true. Many mistakes were made along the way, but we should not underestimate the importance and difficulty of conceptualizing and then creating not only an entire economic intelligence apparatus that had not previously existed, but also a methodology and process—though rudimentary by today's standards—on how to plan and conduct an economic warfare air campaign.

Following World War II things at once both got better and worse for EBO advocates. Strategic Air Command (SAC) and its bomber fleet carrying nuclear weapons, eventually joined by nuclear-tipped ICBMs, formed an enormous organization, the Joint Strategic Target Planning Staff (JSTPS), to study the Warsaw Pact's economic and military structures. This highly secretive body, most of which operated several floors below the ground at SAC headquarters at Offutt AFB, Nebraska, had access to the sensors, intelligence sources and analysts to conduct an in-depth study of the Warsaw Pact. It was the EOU and COA writ very large. Unfortunately, the emphasis on the Soviet Union, as well as the reliance on nuclear weapons, made the JSTPS of limited utility when conventional wars broke out in Korea and Vietnam.<sup>56</sup>

When the US entered the Korean War, air planners were intent on repeating their success of World War II in Europe. Although true strategic targets in China and the Soviet Union were off limits, rendering the detailed nuclear studies irrelevant, airmen believed they could at least so isolate the North Koreans (and later Chinese) forces as to make them harmless. As a consequence, the USAF launched a series of interdiction campaigns with impressive codenames like STRANGLE, STRANGLE II, and SATURATE. An enormous amount of effort was funneled into these campaigns—around 50 percent of all USAF combat sorties during the war were interdiction.

*The divided responsibility for selecting, planning, and conducting operational air strikes meant that targets, at least as far as the airmen were concerned, were divorced from the political and military objectives sought*

When Navy and Marine sorties are included, the US flew over 320,000 interdiction sorties during the war—on average nearly 9,000 per month.<sup>57</sup> What were the results of this massive effort? If the effect desired was destruction of enemy equipment, then the results were impressive indeed. By the end of the war airmen of all three services claimed they had destroyed or damaged a total of 5,087 bridges, 2,345 locomotives, 41,882 rail cars, and 111,623 vehicles.<sup>58</sup> Even assuming there was a certain amount of exaggeration in these claims, one could certainly expect that the communist forces would have been virtually immobilized if not completely disarmed by such destruction. The actual results were different. In July 1951 the enemy fired around 8,000 artillery rounds at United Nations forces; less than a year later—after ten months of concentrated air interdiction—they were able to fire over 100,000 rounds.<sup>59</sup>

Clearly, something was very wrong. The old bugbear of the previous war—determining a reliable and useful measure of effectiveness—had returned with a vengeance. If the MOE was destruction of equipment, the number of sorties flown, or the tonnage of bombs dropped, then air interdiction was a tremendous success. If the MOE was, however, the ability of the enemy to fight, the conclusion was far different. This same problem continued throughout the next ‘minor war’ in Asia.

During the Vietnam War it was common to criticize the US Army for its ‘body count’ mentality. This was the epitome of an MOE gone wrong. But airmen were just as guilty. Vietnam became an exercise in counting—sorties, bomb tonnage, jungle trails cut, trucks destroyed, bridge spans dropped and water buffalo killed—water buffalo could be used for transport. As so often occurs in such situations, the drive to gather data and indeed to *generate* data became an end in itself. As a result, although there was a severe bomb shortage in the early years of the airwar, planes were sent out anyway, sometimes with only one or two

bombs. A sortie was, after all, a sortie, and The Graph must not show a decline—especially relative to the US Navy.<sup>60</sup>

Virtually all targets struck by air in South Vietnam were selected by the staff at Military Assistance Command Vietnam (MACV). This largely US Army organization had only token USAF representation, despite the fact that the Seventh Air Force commander, a USAF four-star general, was nominally designated MACV’s ‘deputy for air.’ Because the Army selected all targets based on a ground situation they alone saw, the MOEs for the air strikes were not clear. Airmen therefore invented their own: the army wanted a target struck, and if it was, the mission was declared a success.

Key yardsticks were aircraft readiness rates, tons of ordnance dropped, the rapidity of response, and sortie rates. In essence, the task of the USAF was merely to service a list of targets for the Army. The MOE thus became a determination of how quickly, effectively, and efficiently airmen were able to service that list. The divided responsibility for selecting, planning, and conducting operational air strikes meant that targets, at least as far as the airmen were concerned, were divorced from the political and military objectives sought. If such a causal link was actually made, it was done by MACV, the keeper of the target list, not Seventh Air Force. EBO was non-existent. As one historian phrased it: ‘An enormous quantity of data described the Air Force’s effort, but little its progress, in South Vietnam.’<sup>61</sup>

The problem of counting things and mistaking that for effectiveness was true regarding the airwar over North Vietnam as well. For example, after the Linebacker II strikes of December 1972, the USAF stated that the North Vietnamese rail yards had suffered the greatest amount of damage of all the targets struck: ‘a damage level of 60 percent or better was achieved against two-thirds of the railroad yard targets representing damage to





USAF B-52 bomber

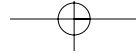
*Today, the USAF has over 2,500 fighter planes, but only 208 bombers; moreover, it is likely the number of bombers will decrease further in the years ahead*

the most important rail facilities, other than bridges, in North Vietnam.' The study is mute, however, on whether or not this level of damage had any effect on the shipment of supplies or armaments to North Vietnamese forces. Moreover, the study also notes that because of earlier air strikes most traffic had already been moved from rail to roads.<sup>62</sup> In short, what was the effect desired—to limit movement of military supplies, or simply to destroy marshalling yards and rolling stock? If the former, then the air strikes were ineffective, regardless of the amount of damage allegedly produced. Just because you can count something does not mean it is important.

The core issue, as it had been in World War II, revolved around MOEs. The real goal of the US was to stop the communist insurgency in the South and to ensure a safe and democratic regime there. In order to accomplish these goals the Viet Cong insurgents had to be eradicated and/or their

supply of troops, ammunition and equipment from the North must be eliminated. If those were the military goals that would fulfill the political mandate, then all of the data points noted above seemed to have some relevance, but as always, the key question remained: which MOE(s) was the true criterion that would indicate if the American strategy was succeeding or failing? SAC's targeting body might have been able to shed some light on this, but as noted, they were preoccupied. Even so, it is unfortunate that at least some of the processes, methodologies and models used at Offutt were not adapted for use in a conventional war.

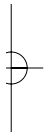
Following the Vietnam War the US Air Force underwent a fundamental reorientation. The doctrine of strategic airpower, at least as represented by nuclear weapons, increasingly receded to the background. So too did the bomber pilots who had held most of the key leadership positions



within the service for several decades. Fighter pilots, who had borne the brunt of the war in Vietnam, now took over most of the top slots in the USAF. The backbone of the air fleet, which had been the heavy bombers and ICBMs of SAC, similarly decreased dramatically in numbers and importance. Today, the USAF has over 2,500 fighter planes, but only 208 bombers; moreover, it is likely the number of bombers will decrease further in the years ahead.<sup>63</sup>

strategy introduced new problems. A leadership or coercive strategy is far more dependent on cultural, psychological, religious or political factors than one that is focused on the economy. If the goal is to shut down an economy, then it is possible, sometimes, to measure the results of an air strike on a power grid, rail network or communications system. But how does one measure the coercive effect of hitting such targets—or any others—on the mind of a nation's leaders? The main problem with EBO in World War II, and to some

*The lights were out in Baghdad, and indeed throughout most of Iraq. Wasn't that the effect desired? What did it matter how many smoking holes there were across Iraq? Clearly, the bombing of electricity had been virtually 100 percent effective*



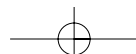
One of the important results of this fundamental organizational, structural and doctrinal shift was the recognition of the importance of strategic conventional air operations. Airpower's unique ability to operate at the strategic level of war immediately upon the outset of hostilities was still a fact, even if airmen had given it little thought for the previous three decades. Two men, both USAF fighter pilots, led the intellectual journey back to serious thinking about air strategy.

It is not my place here to discuss either the lives or theories of John Boyd and John Warden; rather, it is to point out that both men moved away from a concept of air strategy that had focused on an enemy's economy, but instead to focus on his leadership. This is not to say that either man eschewed the targeting of an enemy's industrial or economic infrastructure—there were often sound reasons to continue to neutralize such targets. Instead, the focus was to be on the leadership—what made them capable of coercion? In some cases the attack against a particularly important industry might have a powerful impact on the mind of the leadership. In other cases, an attack on the leaders themselves, even if unsuccessful, might still prompt a desirable change in behavior. For advocates of EBO, this shift in targeting

extent today, lies mainly in the realm of predicting human behavior in a crisis. EBO had tremendous difficulty in dealing with uncertainty, randomness, chance, and the non-linear and often seemingly irrational thinking of human organisms. Quite simply, different people don't respond the same way to the same stimuli. In fact, some people respond differently to the same stimuli at different times.

This may perhaps be due to the learning of lessons, fatigue, or a host of other circumstances that have subtly yet decidedly changed the equation in that individual's mind. In any event, human behavior, especially when under pressure or when operating from a different cultural mindset, is incredibly difficult to predict. Remember too that our adversaries at the same time are doing everything in their power to mask their true intentions from us. In short, EBO moved into an even more nebulous and complex area than it had been in previously, and yet, we have not completely solved the problems of measuring effects in an economic model!

By the Persian Gulf War in 1991, EBO had become increasingly ingrained in the minds of key airmen. Then-Lieutenant Colonel Dave Deptula tells of



how initial air plans called for each Iraqi air defense sector control center to be targeted by eight F-117s to ensure their destruction. This would have required a great deal of sorties for the high-demand stealth fighter-bombers. Deptula then postulated that a single bomb would no doubt shut down operations physically, while also causing any technicians still alive inside to flee. The number was then reduced from eight sorties per facility to two.<sup>64</sup> The desired *effect* was to shut down the air defense system; total destruction was therefore not necessary.

Not well known nor reported is that EBO was the underlying basis for the design of the entire Gulf War air campaign. Deptula built the air attack plans for each 24-hour period of the war. He established desired effects criteria for each of the designated 12 target sets and formulated each day's air attack plan on the basis of progress measured in achieving those effects for each target set; he then watched to ensure the plans and the attacks were interacting properly to accomplish the overall campaign objectives. Not everyone was on board, however.

John Warden tells the story of talking to intelligence analysts who assigned BDA figures to specific target sets. Regarding the strikes against electricity during the first few days of the war, the analyst gave a BDA assessment of 10 percent effective—not an impressive figure. When Warden asked why he had given such a low estimate, the analyst replied that there were a specified number of electrical power plants in Iraq, and Coalition bombs had only destroyed 10 percent of them. The arithmetic was pretty simple. Warden demonstrated that the lights were out in Baghdad, and indeed throughout most of Iraq. Wasn't that the effect desired? What did it matter how many smoking holes there were across Iraq? Clearly, the bombing of electricity had been virtually 100 percent effective! The analyst hung up.<sup>65</sup>

At the broadest sense, the primary objective of the Coalition was to liberate Kuwait quickly and with minimum loss of life. Regrettably, the MOE for this desired effect rapidly devolved down to counting tanks and artillery pieces destroyed from the air. Debates still rage over how much Iraqi

equipment was actually destroyed and by whom, but this fuss misses the point. The objective was to get the Iraqi army out of Kuwait: because of the air campaign, over 80,000 Iraqi soldiers deserted and a like number surrendered virtually without a fight. Coalition losses were 240 killed and less than 800 wounded.<sup>66</sup> This was EBO at its most impressive.

The debate over air strategy today remains what it has been for the past century, an argument over targeting. The main thrust of air theory over that period focused on an economic theory of war. Airpower was seen as a more direct and more rapid form of traditional sea power—although I doubt if many airmen or sailors would ever admit that. This concept is still with us. For example, General Michael Short, the air commander in the airwar over Serbia in 1999, has argued that air strikes on the first night of the war should have concentrated on the critical infrastructure of Belgrade: the power grid, bridges over the Danube, and key factories.<sup>67</sup> These targets should have been quickly and precisely destroyed. An instructor at the Air Corps Tactical School or the RAF Staff College in 1935 would have said much the same thing.

There have been, however, important variations over time. Some, like Arthur Tedder in World War II, focused on an enemy's transportation system so as to produce paralysis. More than a decade ago John Boyd and John Warden instead looked at leadership. In a sense, their goal was also paralysis. In addition, some, like political scientist Robert Pape and non-airmen like US Army generals Wesley Clark and Gordon Sullivan, have argued that wars are won the old fashioned way—by killing armies; only today airpower can kill armies faster and with less risk than armies can kill armies.<sup>68</sup>

In sum, the natural tendency of planners and analysts to count things, although necessary at the tactical level, has severe limitations as a strategic MOE and can indeed distort the entire strategy/planning process. There must be a method of translating 'statistical destruction' into a broader strategic context. If such a method is not devised, then it will be easy to fall into the trap of



being efficiently ineffective—of destroying targets that don't matter.

The linchpin of EBO revolves around developing the most appropriate MOEs. The combatant commander and his component commanders must think this issue through and must do so with open minds. They must also recognize that EBO is an iterative process—desired effects and MOEs selected one day may be wrong or may change later in the war as conditions or intelligence appraisals change. Unfortunately, there is a tendency in war either to select MOEs based on traditional methods of war that may no longer apply—an attrition-based model; or, MOEs are allowed to become fossilized and unchangeable—to adjust an MOE or a strategy signals that mistakes were made earlier. No one wants to admit they made potentially serious errors. But when this happens, it's best to recall the old saying: when you find yourself in a hole, stop digging.

EBO is an inherently rational way to approach war. Yet the barriers to making it work are formidable. Although our analytical tools have improved dramatically over the years, it often seems as if we are peeling an onion; as we remove one layer of problems and questions, it merely leads to several more layers. Many challenges still remain: the need for adequate intelligence of various kinds, our distressing lack of cultural sensitivity regarding potential adversaries, the dangers of studying inputs rather than outputs, and the need for models and simulations that adequately account for cognitive, cultural, political and social factors. These are serious problems, but for too long military commanders and planners have hidden behind the 'fog of war' argument—that war is so imponderable and freighted with friction and uncertainty we cannot hope to rationalize it.

Such an attitude is no longer acceptable. The bar has been raised not only for airmen, but for soldiers, sailors and marines as well. To borrow a metaphor from music, the modern strategist who understands and masters EBO has the potential of being a conductor: orchestrating a complex symphony of actions that achieve the desired effects of harmony and music—success in war—rather than the noise of wanton violence.

Airmen have always hoped to achieve EBO. For

much of the first century of air warfare that goal was beyond their reach, due both to the technological limitations of aircraft and weapons, but also because of inadequate intelligence and analytical tools. The tools and technology are catching up. Think of the possibilities.

Notes:

- <sup>1</sup> Paul K. Davis, *Effect-Based Operations: A Grand Challenge for the Analytical Community* (Santa Monica: RAND, 2001), 7.
- <sup>2</sup> Maurer Maurer, *The U.S. Air Service in World War I*, 4 vols. (Washington: Office of Air Force History, 1978), II, 141-57 reprints the Correll memo in its entirety.
- <sup>3</sup> William L. Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power, Economic and Military* (NY: Putnam's, 1925), 126-27.
- <sup>4</sup> Giulio Douhet, *The Command of the Air* (NY: Coward-McCann, 1942; reprinted by the US Air Force History Office in 1983), 20.
- <sup>5</sup> *Ibid.*, 50.
- <sup>6</sup> US Army Field Manual, 1-5, 'Employment of Aviation of the Army,' April 15, 1940, 11, 36.
- <sup>7</sup> Royal Air Force Manual AP 1300, 'War Manual,' February 1940, chap. 6, p. 12.
- <sup>8</sup> Two examples from many: J.F.C. Fuller, *The Reformation of War* (London: Hutchinson, 1923), 150; and L.E.O. Charlton, *War from the Air: Past, Present, Future* (London: Thomas Nelson, 1935), 172-73.
- <sup>9</sup> Thomas H. Greer, 'The Development of Air Doctrine in the Army Air Arm, 1917-1941.' Air Force Historical Study No. 89, Maxwell AFB, 1955 (reprinted by the Office of Air Force History, 1985), 81.
- <sup>10</sup> Stephen L. McFarland, *America's Pursuit of Precision Bombing, 1910-1945* (Washington: Smithsonian Institution Press, 1995), 93-98.
- <sup>11</sup> Guido R. Perera, *Leaves from my Book of Life, Vol. II: Washington and War Years* (Boston: Privately Printed, 1975), 71.
- <sup>12</sup> 'War Diary,' R&A Branch, OSS London [Enemy Objectives Unit], 1945, AF Historical Research Agency (AFHRA) file 520.056-167, 42; 'History of the Committee of Operations Analysts,' 1945, AFHRA file 118.01, 35.
- <sup>13</sup> Perera, 99. Perera states that he met his coldest reception from the AAF intelligence section in Washington. Upon paying a courtesy call to the Director, Major General Clayton Bissell, he was quickly informed: 'I have quite a file on you here in my desk, and I want you to understand that I don't want any nonsense in the future.'
- <sup>14</sup> Wesley Frank Craven and James Lea Cate, *The Army Air Forces in World War II*, 7 vols. (Chicago: University of Chicago Press, 1948-58), II, 369.
- <sup>15</sup> F.H. Hinsley et. al. (eds.) *British Intelligence in the Second World War*, 5 vols. (London: HMSO, 1970-1990), III/1, 54; COA History, 28, 52.
- <sup>16</sup> Alan S. Milward, *War, Economy and Society, 1939-1945* (Berkeley: University of California Press, 1977), 298.

- <sup>17</sup> Richard J. Overy, *Why the Allies Won* (London: Jonathan Cape, 1995), 203.
- <sup>18</sup> Craven and Cate, II, 358.
- <sup>19</sup> US Strategic Bombing Survey (USSBS), 'Over-All Report (European War),' February 1947, 39-40. Another process, Fischer-Tropsch, was also used, but hydrogenation remained by far more important while also providing all of the *Reich's* synthetic aviation gasoline. Indigenous sources plus synthetic fuels still only provided Germany with about 1/3 of its necessary fuel supplies.
- <sup>20</sup> Stephen Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca: Cornell University Press, 1991), 161-63. USSBS, 'Over-All Report,' 39, states that Germany had only 1.6 million tons of fuel in reserve at the start of the war—less than six months supply of wartime requirements. However, this figure actually grew over the next several years despite the demands of military operations, because Germany captured more refineries and hence more fuel than they consumed.
- <sup>21</sup> COA History, 43; EOU 'War Diary,' 36-37. The EOU diary also includes the factor of risk to Allied aircrews—an important consideration, as planners would certainly attest today. See also Walt W. Rostow, *Pre-Invasion Bombing Strategy* (Austin: University of Texas Press, 1981), 99-104; Mancur Olson, Jr., 'The Economics of Target Selection for the Combined Bomber Offensive,' *Royal United Services Institute Journal*, CVII(November 1962): 308-14.
- <sup>22</sup> EOU 'War Diary,' 43-46. Nonetheless, sub pens were a top priority for the CBO, largely because the Battle of the Atlantic was so crucial to Allied success. All efforts, even those of marginal utility, had to be expended to reduce the U-boat menace. For its part, the AAF saw the sub pen missions as relatively easy—almost training missions—because the location of the pens along the French coast allowed fighter escort.
- <sup>23</sup> EOU 'War Diary,' 22-33.
- <sup>24</sup> Sir Charles Webster and Noble Frankland, *The Strategic Air Offensive Against Germany, 1939-1945*, 4 vols. (London: HMSO, 1961), IV, 205-13.
- <sup>25</sup> COA History, 20. In Britain, RE 8, a department in the Ministry of Home Security, handled the bomb damage assessment task. For the fairly dismal accuracy of the Eighth Air Force, although it did improve greatly over time, see USSBS, 'Bombing Accuracy, USAAF Heavy and Medium Bombers in the ETO,' January 1947.
- <sup>26</sup> Perera, 139; USSBS, 'The German Anti-Friction Bearings Industry,' November 1945, I, 31, 38.
- <sup>27</sup> For an excellent discussion of how the formulation of measures of merit can affect strategy, see Scott S. Gartner, *Strategic Assessment in War* (New Haven: Yale University Press, 1997).
- <sup>28</sup> EOU 'War Diary,' 39.
- <sup>29</sup> Craven and Cate, II, 305.
- <sup>30</sup> Craven and Cate, II, 665.
- <sup>31</sup> MRAF Sir Arthur Harris, *Bomber Offensive* (London: Collins, 1947), 223. See his entire chapter 10 for a spirited denunciation of 'panacea targets.'
- <sup>32</sup> Much has been written on the oil/rail plan controversy. For the official histories see Craven and Cate, III, 42-64; Webster and Frankland, III, 42-64; Lord [Arthur] Tedder, *With Prejudice* (Boston: Houghton Mifflin, 1966), 513-24; Solly Zuckerman, *From Apes to Warlords* (NY: Harper & Row, 1978), chapter 12; and, Rostow, 88-98, which includes the complete minutes of the climactic meeting of 25 March.
- <sup>33</sup> USSBS, 'Oil Division Final Report,' August 1945, 2, 43-46. Of interest, the COA submitted a report in December 1943 identifying the five TEL plants in the *Reich*, concluding: 'It is believed they are good targets.' Apparently, their suggestion was ignored. COA History, Tab 7.
- <sup>34</sup> USSBS, 'Oil Division Final Report,' 1, 3; Burton H. Klein, *Germany's Economic Preparations for War* (Cambridge: Harvard University Press, 1959), 226; Rosen, 165.
- <sup>35</sup> Zuckerman, 209-10, 220-23.
- <sup>36</sup> Craven and Cate, III, 371-73; James Parton, 'Air Force Spoken Here': *General Ira Eaker and the Command of the Air* (Bethesda: Adler & Adler, 1986), 380-83; MRAF Sir John Slessor, *The Central Blue: Recollections and Reflections* (London: Cassell, 1956), 567-77. Slessor was Eaker's deputy in the Mediterranean Allied Air Forces.
- <sup>37</sup> EOU 'War Diary,' 101.
- <sup>38</sup> For a thorough discussion see Zuckerman, chapter 12; Rostow, chapter 8; and Richard G. Davis, *Carl A. Spaatz and the Air War in Europe* (Washington: Smithsonian Institution Press, 1992), 403-08. For the caustic response of Harris to Zuckerman's plan see Henry Probert, *Bomber Harris: His Life and Times* (London: Greenhill, 2001), 291-92.
- <sup>39</sup> This exchange of letters appeared in three issues of *Encounter*: 51(November 1978): 39-42; 52(July 1979): 86-89; and 53(August 1980): 100-02.
- <sup>40</sup> Henry D. Lytton, 'Bombing Policy in the Rome and Pre-Normandy Invasion Aerial Campaigns of World War II: Bridge-Bombing Strategy Vindicated—and Railyard Bombing Strategy Invalidated,' *Military Affairs* 47(April 1983): 53-58. Lytton's title pretty much says it all.
- <sup>41</sup> F.M. Sallagar, 'Operation 'STRANGLE' (Italy, Spring 1944): A Case Study of Tactical Air Interdiction,' RAND Study R-851-PR, February 1972, 33.
- <sup>42</sup> Webster and Frankland, III, 216.
- <sup>43</sup> Alfred C. Mierzejewski, *The Collapse of the German War Economy, 1939-1945: Allied Air Power and the German National Railway* (Chapel Hill: University of North Carolina Press, 1988), 167-69.
- <sup>44</sup> Around 60 percent of the oil from Rumania was transported to Germany via barge on the Danube River. When the RAF mined the Danube it brought this traffic to a halt. When it is realized that one barge of oil was equivalent to a 100-car train, it is obvious how important these mining operations were in throttling Germany's oil supply. Robert Goralski and Russell W. Freeburg, *Oil and War: How the Deadly Struggle for Fuel in World War II Meant Victory or Defeat* (NY: Morrow, 1987), 271; Ronald

C. Cooke and Roy C. Nesbitt, *Target: Hitler's Oil, Allied Attacks on German Oil Supplies, 1939-1945* (London: William Kimber, 1985), 70.

<sup>45</sup> This entire argument is spelled out in detail in Mierzejewski.

<sup>46</sup> Webster and Frankland, IV, 290-92, contains the entire text of Tedder's 'Note on Air Policy to be Adapted with a View to Rapid Defeat of Germany,' dated October 25, 1944. It is also interesting that in neither the COA nor EOU histories is coal ever once mentioned as a possible target.

<sup>47</sup> John Gillingham, *Industry and Politics in the Third Reich: Ruhr Coal, Hitler and Europe* (NY: Columbia University Press, 1985), 113. Contrary to Mierzejewski, Gillingham (pp 124-29) argues that the real problem with the German coal industry during the war was a severe labor shortage in the mines: coal production was collapsing long before the railroads were disrupting its distribution. This is just another example of how the sources a historian examines will, to a great extent, determine his conclusions.

<sup>48</sup> Before Congress in 1945, Eisenhower stated that undertaking OVERLORD without air superiority 'would have been more than fantastic, it would have been criminal.' Testimony of Gen Dwight D. Eisenhower, to Senate, Departments of Armed Forces and Military Security, *Hearings Before the Committee on Military Affairs*, 1945. 79<sup>th</sup> Congress, 1<sup>st</sup> session, 1945, 360.

<sup>49</sup> US Strategic Bombing Survey, 'Over-all Report (European War),' 18-22.

<sup>50</sup> Overy, 124; John Keegan, *Six Armies in Normandy* (NY: Viking, 1982), 143.

<sup>51</sup> Haywood S. Hansell, Jr., *The Air Plan that Defeated Hitler* (Atlanta: Higgins-McArthur, 1972), 286-97; USSBS, 'German Electric Utilities Industry,' October 1945, 1-3.

<sup>52</sup> Albert Speer, *Inside the Third Reich* (NY: Macmillan, 1970), 346.

<sup>53</sup> Webster and Frankland, IV, 349-56, has the complete text of Speer's letter to Hitler of November 11, 1944. Note that Speer refers to a coal production crisis, not a coal transportation crisis. Is he implying it was not a rail problem after all?

<sup>54</sup> Webster and Frankland, IV, 384.

<sup>55</sup> Klein, 119.

<sup>56</sup> One of the classic examples of EBO air operations during the Cold War was the Berlin Airlift. The Allied goal was to save West Berlin from starving, freezing, or caving in to communist aggression. The 11-month Airlift to deliver food and coal to the beleaguered Berliners was enormously successful at achieving those policy goals, and did so without firing a shot.

<sup>57</sup> Edmund Dews and Felix Kozaczka, 'Air Interdiction: Lessons from Past Campaigns,' RAND Note N-1743-PA&E, September 1981, 49-51.

<sup>58</sup> *Ibid.*, 55. One of the reasons for the disconnect between the supposed destruction results and the enemy's actual military capability was due to mirror imaging. A US Army division required around 500 tons of supplies daily to sustain itself: a Chinese or North Korean division required only 48 tons. Even if interdiction was stopping 90 percent of supplies flowing south, the 10 percent that got through was enough to keep the

enemy going. Gregory A. Carter, 'Some Historical Notes on Air Interdiction in Korea,' RAND Note P-3452, September 1966, 4.

<sup>59</sup> Dews and Kozaczka, 57.

<sup>60</sup> John Schlight, *The USAF in Southeast Asia. The War in South Vietnam: The Years of the Offensive, 1965-1968* (Washington: Office of Air Force History, 1988), 69, 78, 154, 190.

<sup>61</sup> *Ibid.*, 290.

<sup>62</sup> Pacific Air Forces, 'Linebacker II USAF Bombing Survey,' April 1973, 5-6.

<sup>63</sup> 'World Military Aircraft Inventory,' *Aviation Week & Space Technology*, January 13, 2003, 274-75.

<sup>64</sup> Brig Gen David A. Deptula, 'Effects-Based Operations: Change in the Nature of Warfare,' Aerospace Education Foundation paper, 2001, 12.

<sup>65</sup> John Warden, 'The Enemy as a System of Systems,' presentation to the Swedish National Defence College, Stockholm, January 27, 2003.

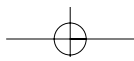
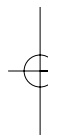
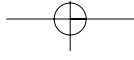
<sup>66</sup> Eliot Cohen (ed.) *Gulf War Air Power Survey*, 5 vols. plus Summary (Washington: GPO, 1993), Summary, 105-06; Lawrence Freedman and Efraim Karsh, *The Gulf Conflict, 1990-1991: Diplomacy and War in the New World Order* (Princeton: Princeton University Press, 1993), 409.

<sup>67</sup> Interview with General Michael C. Short, 'War in Europe: NATO's 1999 War against Serbia over Kosovo,' PBS, February 2000, website:

<http://www.pbs.org/wgbh/pages/frontline/shows/kosovo/>.

<sup>68</sup> Robert Pape, *Bombing to Win: Air Power and Coercion in War* (Ithaca: Cornell University Press, 1996), passim; Gen Gordon R. Sullivan, 'Lessons That Still Apply,' *Washington Times*, March 3, 2001, A31; Gen Wesley K. Clark, *Waging Modern War: Bosnia, Kosovo and the Future of Combat* (NY: PublicAffairs, 2001), passim, but especially 221, 241-42, 425.









## *Effects-based Operations: The Contemporary Air Perspective*

**By Air Commodore Stuart Peach**

*'Of all men's miseries the bitterest is this: to know so much and have control over nothing'*  
(Herodotus 484 to 424 BC)

**T**his article discusses effects-based operations from the air perspective. Warfare waged from the air has been a factor in war for a century. Since the earliest days of air warfare, air-

men have attempted to define and measure the success of operations conducted in the air in terms of the effect achieved on the enemy. Thus, an obvious starting point is that the study of effects-based operations is not a new concept for warfare waged from the air. In this, the centennial year of the first powered flight, the report card for aerial warfare shows early promise, a steady improve-





A precision hit on one of Saddam's palaces

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ment with potential to do more and better in the future. But, success in recent operations is mixed with the baggage of history: the oft-held fallacy that air warfare equals the strategic bombardment of the enemy.<sup>1</sup>

Some argue that war has changed, and that modern technology, specifically the communications networks of the information age, with or without a revolution in military or strategic affairs, have enabled 'near perfect' knowledge and situational awareness.<sup>2</sup> This knowledge enables the enemy's every move to be predicted, spotted, and analysed for his intent so that the generic 'Coalition' can respond immediately. In this generic world, our forces strike swiftly with great precision, hitting just enough of the things that the enemy holds dear without collateral or unintended damage that will turn public support (our Achilles' heel) against us. In turn, the enemy will comply with the course of action that 'our' form of warfare has mapped out for him. Of course the real world is more complicated than that: the axioms of war over the centuries have not changed. War remains as it always has: brutal and violent, riddled with

the unexpected or unpredicted. People die; some rise to heroic acts; some muddle through; some surprise; some disappoint. The crucial factor, however, is that war remains an interaction between people. Machines enable, networks allow interaction and interoperability, but the human factor prevails. Therefore, any study on effects-based operations in the air environment should focus upon human factors and the interactions between people in the realm known as command and control rather than on machines and their possibilities.

We study military history and define a military doctrine to teach the current generation of warriors how to wage war. Almost by definition, as Sir Michael Howard has pithily observed: 'Whatever doctrine the armed forces are working on, they have got it wrong...it does not matter that they have got it wrong. What matters, is their capacity to get it right quickly when the moment arrives. It is the task of military science in peace to ensure it is not too badly wrong.'<sup>3</sup> Of course there are trends in war, glimpses from operations and lessons identified, which point to new futures and

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new doctrines. But, predictive doctrine is very hard. Conceptual models can be offered, as they are by the Director General of the UK Joint Concepts and Doctrine Centre elsewhere, providing a useful shorthand route to avoid the charge that our doctrine is constantly fighting the last war. But, the interaction of humans and the fog of memory tend towards 'that which is taught'.

The historiography of war is enriched by the 'battles of the memoirs' that tend to follow each conflict.<sup>4</sup> Memoirs help to explain human interaction up to a point. Inevitably, however, the perspective is skewed either by the view up or down the 'straw' of the individual to enhance or protect his reputation or, by the received wisdom of the victors, more often than the vanquished.<sup>5</sup> Thus, despite the rapid publication, even plethora, of information on war, determining how good 'we' were at effects-based operations through the study of war remains difficult.

When a war is raging across great distances across the grand strategic, strategic, operational and tactical levels, involving different sovereign nations with their own ways in war and own motivations regarding 'best' outcomes, dispassionate analysis becomes even more elusive.<sup>6</sup> Clausewitz's truism on war that 'in war, even the most simple thing is difficult' is arguably more true now because of the complexity surrounding decision-making and the many streams of information, than it was when written two hundred years ago. War, therefore, generates friction between the opposite sides and amongst allies in coalition. Despite this inherent friction inside the military machine, each side is attempting to achieve an effect on their respective enemy.

Air power has been employed to create and sustain such an effect since the very first days of war in the air in 1914. In much writing on the effects achieved, the taxonomy can be loose and the language imprecise. In his excellent work, *Paths to Heaven*, Phil Meilinger shows how thinking and words on air power grew in stridency and volume throughout the 1920s, preventing the emergence of international doctrines. Instead each nation went its own way.<sup>7</sup> For the purposes of this brief study,

the definition employed is the one offered by the UK Joint Doctrine and Concepts Centre:

*Operations designed to influence the will of an adversary, own forces or neutrals through the co-ordinated application of military capability, in order to achieve the desired strategic objectives.*

Once the lexicon is tightened, a method to explain why we have 'ways' in air war and 'how' we have measured effect in air warfare so far could be of use. The method offered is to examine effects-based air operations from the UK's historical experience (to complement Phil Meilinger's study of US experience), build into a strengths, weaknesses, opportunities and threat analysis for air power from a British perspective, concluding with key challenges and emerging issues for further study.

#### **British Air Power Perceptions**

In Britain, the potential of aircraft to achieve an effect on an enemy was understood well before the First World War. Balloons operated by the Royal Engineers had been deployed to offer a wider perspective of the battlefield in order to enhance the accuracy and hence destructive effect of artillery. Aerial photography from balloons was employed by the British Army during the Boer War in South Africa to make artillery more accurate and offer a perspective of what Wellington called 'the other side of the hill'.<sup>8</sup> The early potential of the aeroplane for military operations was clearly understood by many of the military thinkers in the UK. Lieutenant (later Lord) Brabazon received Royal Aero Club Pilot Licence Number One in 1911 and lobbied the War Office hard to take aeroplanes seriously. Winston Churchill qualified as a pilot in the same year. Overseas, air bombing began by the Italians in Libya in 1911 with – according to contemporary accounts – a dramatic effect on the enemy.<sup>9</sup>

By the start of World War One, all the protagonists could boast some form of air force or another. Few individuals could have predicted the spurt that total industrial war between industrialised nations would bring to this new form of warfare. By 1918, all of the roles and missions conducted by

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An RAF S.E.5

aeroplanes to this day had been tried. Some, such as aerial reconnaissance and air-to-air fighting had become extremely sophisticated. As early as 1916, both Germany and France realised that a decisive point in the campaign for victory at Verdun lay in air superiority. This enabled aerial reconnaissance which enabled the more accurate placement of artillery fire.<sup>10</sup> At Verdun, effects-based air operations were a reality.<sup>11</sup> The measurement of effect was crude and tragic: the number of casualties inflicted. Elsewhere the bombardment of a new target group, the civilian population, was to have a profound and unintended effect: to bring the whole question of air power *per se* into the political arena. The unreadiness of British air defences for Zeppelin attacks in 1917 led to domestic political turmoil at an already difficult time for the government. This led, in turn, to Prime Minister Lloyd

George's formation of the Smuts committee to examine the state of the air defence of Great Britain, which set the conditions for the creation of the Royal Air Force in 1918, an effect the Germans probably did not intend with their early Zeppelin raids.

In the context of the time, however, retribution as an effect was very much the 'way' in total war and provided political backing for the industrial urge to create four-engined bombers to take the war to Germany as the Germans had brought the war to London. Therefore, it is not surprising that, when the Royal Air Force was formed in 1918 and the four-engined bomber became a military reality, 'main effort' for Trenchard's 'Independent Force' of 1918 was to take the war to the German people. Industrial lobbying of ministers and military



leaders was a trait in the UK 'way' in air warfare as early as 1916.<sup>12</sup> The effect of the raids by the RAF's independent force in terms of casualties and damage to infrastructure in the industrial areas of western Germany was slight, but the long-term effect in terms of shaping UK thinking on air power was profound. At the time, Trenchard saw all this bombing as a distraction from his perceived main effort: to support the British Expeditionary Force on the Western front in France.<sup>13</sup>

Thus, we see even in the 'pre-teen' years of air power, employment strategies and methods of doctrine being shaped as much by political and

hold high command of the Royal Air Force for much of the Second World War.<sup>14</sup> The debate on how effective air control was in keeping the peace became irrelevant. The long-term effect was on 'how' the Royal Air Force went to war.

In the Second World War, the British way in war and strategic effect in terms of air power became hopelessly muddled with the strategic bombing offensive against Germany. This baggage drawn from history and shaped by controversy rages to this day. The rich historiography on the ends, ways and means of the conduct of the strategic bomber offensive has had a lasting effect on the perception of aerial warfare. As Phil Meilinger

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industrial concerns and influences as by tactical considerations. Perhaps this is an enduring trend and one ripe for further study by military students.

At the end of the First World War, the Royal Air Force was the largest air force in the world. But, in an effect that no-one could have predicted, within two years the fledgling Service was embarked upon a fight for its survival. It was this fight that set the conditions for the creation of an unusual operational doctrine in the form of air control. This idea was the air force response to the burdensome cost of policing troublesome mandates and colonies at a time when the British exchequer was on the brink of financial collapse because of the cost of the First World War. From small acorns did large trees of doctrine grow. By 1939, the idea of air control, although manifest in many different ways in different areas of the Empire had an enduring effect: the survival of the Royal Air Force as an independent Service. More importantly for this survey, however, air control shaped the experience and, hence, the personal 'way' in command of all the men who were to

makes clear from the US perspective elsewhere in this Review, the debate on targeting strategy against Germany had all the hallmarks that attract future generations of historians: controversy, friction between allies and generals, emotion, and lots of survivors to interview and loads of data to support one thesis or another. In the Royal Air Force, the debate was no less heated or emotional during the Campaign as it was to become after the war. In Harris's pejorative term, the 'meddlers' from the Air Ministry sent incessant and conflicting directives to the hard-pressed commander-in-chief of Bomber Command. The personal and harrowing accounts of the courageous and undaunted young men who flew to Germany night after night added to the grievous losses of aircrew; everyone had a point of view.<sup>15</sup>

If we examine this rich seam of historiography in a little more detail with an eye to effects-based operations, one thread emerges. From 1939 to 1945, the question of what constitutes a valid target lay at the heart of this intensive Campaign both for the RAF and USAAF. In the RAF, from 1939 to 1942, the conduct of the Campaign was guided and led

by men who had 'earned their spurs' in the First World War. Often they had come quite early to the notice of Trenchard and had 'grown up' as commanders out in the Empire executing the doctrine of air control.<sup>16</sup>

By 1942, following controversy over accuracy which culminated in the Air Ministry's Butt Report, the officers of an earlier age in air warfare were replaced with men who had shot quickly through the middle ranks to become air officers at an age often twenty years younger than the men they replaced. These were the 'new men'. They had credibility with the crews, they were tactically adept and technically trained; airmen such as Bennett (Air Officer Commanding 8 Group) and Cochrane (Air Officer Commanding 5 Group) changed the 'way' Bomber Command engaged in the Strategic Bomber Offensive.

Thereby, the way effects were measured changed with them – the human factor. The stoic, unquestioning defence of bomber crews' ability to find, fix and bomb their targets of the early war years was replaced by a more harsh yardstick: aiming point imagery from the fixed camera within the bomber.<sup>17</sup> Literally, in 8 (Pathfinder) Group, without a validated photograph of the target, the mission did not count towards the total for an operational tour.<sup>18</sup>

These hard-nosed new commanders who had all flown in the current war, understood the strategic requirement: to support Harris as Commander-in-Chief. They entertained few doubts as to the wisdom of the strategy. Instead, they concentrated on how to hit the area targets more efficiently and effectively. As commanders, they were determined to stem the loss of their most valuable resource: aircrew.<sup>19</sup> The result was a concatenation of tactical and technical innovation with operational art and strategy. The choreography was outstanding, the numbers of aircraft continued to increase in number and performance, accuracy steadily improved by day (as Phil Meilinger shows for the USAAF) and by night for Bomber Command with the technical innovations and technical skills of the pathfinders and the specialist squadrons of 5 Group. The effect on the enemy

was cumulative and measured by armies of photographic interpreters poring over aerial photographs backed up by the scientists of the Operational Research Branch.<sup>20</sup> Overy, in 'Why the Allies Won', finally brought closure to the 'so what' debate with his forensic examination of the data to prove the damaging effect of the relentless bombardment on Germany, particularly in 1944/45.<sup>21</sup> At the tactical level, battle damage assessment reach new heights of sophistication basked up by skilled research scientists to measure with careful precision the effect that was being wrought on the enemy.

But, as in many later conflicts, aerial warfare focused upon two-dimensional measurement of damage that could be seen. The effect on what the enemy holds most dear remained the 'holy grail' that only gradually emerged in the years that followed when the German side of the story became available. This limitation in combat assessment should ring bells of warning to those who today talk of near-perfect situational awareness and information dominance.

As a result of the strategic bomber offensive, the Royal Air Force entered the Cold War with a rich heritage of sacrifice and achievement and a 'way' in air war which was highly distinctive and different from the USA with its newly independent and confident USAF, born in 1947. In Britain, in the early post-war years, anything technology could offer to reduce aircrew losses in a future war, would be snapped up by those in command who had fought through the war. The enormous (albeit fragile and transitory) residual capacity in the British aircraft and weapon industry appeared to offer such a choice through jet bombers and the weapons to go with them.

In the Cold War, this suited the strategic mood (and industrial policy).<sup>22</sup> Therefore, we should not now be surprised that serious debate about air power and air warfare became synonymous with nuclear operations. The bomber barons of the Second World War held the high command positions of the Royal Air Force for much of the 1950s and 1960s. In a UK version of Eisenhower's famous descriptor 'the military/industrial



AHB (RAF)

An RAF Hunter on patrol, 1966

*Their performance on exercises and inspections became almost legendary within NATO's tactical air forces evaluation programme. But, their equipment in terms of modernity slipped behind even smaller countries*

complex', in the UK in the mid 1950s, theory, government, science, industry and Service combined to create an air-delivered nuclear deterrent and the means of delivery. Both almost broke the Service's piggy bank which, in turn, accelerated the neglect of the tactical air forces deployed in Germany.

Wynn's definitive study on Royal Air Force nuclear operations shows the depth and intensity of investment, research, development and the support structures (headquarters, bases, training and so on) in order to create and then sustain the V-Force.<sup>23</sup> In strategic terms, deterrence worked and the V-Force was rather gracefully retired after a conventional outing by the Vulcan in the Falklands War and sterling service by the Victor as a tanker aircraft.<sup>24</sup> The effect on the Service, however, of this concentration of resources in search of a strategically dominant role was very deep and long lasting.

Despite the apparent neglect, the tactical prowess of the RAF's tactical air forces based forward in Germany under NATO's doctrine of forward defence was never in doubt. Their performance on exercises and inspections became almost legendary within NATO's tactical air forces

evaluation programme. But, their equipment in terms of modernity slipped behind even smaller countries. For these countries, tactical air support using US provided aircraft such as F-84, F-86, F-104, F-4, F-16 became their *raison d'être*.<sup>25</sup> Within NATO, any debate on air strategy quickly became conflated with force goals, perceptions of national effort and national interest. The Royal Air Force, on the other hand, along with the USAF, the French and Soviet Air Force, had global interests. This led to three, often conflicting, centres of gravity for much of the Cold War: support to UK world-wide interests (bases, strategic air transport, forward presence, exercises etc), the V-force (strategic deterrence and main effort) and the tactical air forces based in Germany (forward defence, NATO's flexible response).

Of course there were operational excursions outside the tectonic plates of the Cold War. The Berlin Airlift represents a classic example of the use of air power for strategic effect. Operations over Suez were less impressive – particularly between components (Fleet Air Arm and Royal Air Force) and allies (UK, France and Israel). Similarly, the retreat from Empire offered several examples of tactical innovation: the use of helicopters in Malaya, show



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RAF Buccaneer

of force operations, outstanding performance from small force elements at the end of immense lines of communications in the Falklands War. All paled against Cold War orthodoxy. The British way in air warfare became rather rigidly taught at the Royal Air Force Staff College with a deep emphasis on staffwork and what Air Vice-Marshal Professor Tony Mason has called the doctrine of equipment replacement, rather than operational planning as at other war colleges.<sup>26</sup>

So what? The prolonged nature of the Cold War, the potential for conflict and the institutionalised nature of the stand-off solidified and strengthened rigidity in and between levels of war between allies and between services as much on the NATO side as on the Warsaw Pact. Of course, much was common and much was harmonious. But, there were differences of opinion between the USAF and

the RAF, which were to play out after the Cold War was over.

NATO air doctrine appeared to be the same across the Allied Command Europe structure. The doctrine differed in application, however, between the British commanded sector in Northern Germany (Second Allied Tactical Air Force) and southern Germany (Fourth Allied Tactical Air Force) commanded and dominated by the US. This thinking did not lead to seminal shifts such as Warden's 'Air Campaign' in 1989 in US thinking, but the emphasis in northern Germany was very much the UK's refinement of the air/land battle in order to lend greater breathing space to outnumbered positional forces.<sup>27</sup> The Royal Air Force with Canberra, Hunter, Buccaneer and later Tornado, working with Allies, became expert in air interdiction and offensive counter air missions with ultra low level

flying as the enabling tactic. The other Allied air forces in the British sector followed suit. This was 'what was taught' at the NATO Tactical Leadership Programme. This way in war required highly trained crews, an element of *auftragstaktik* and decentralised mission command.

In the US sector in southern Germany, however, a divergent way in air war was developed. Following the Vietnam experience and a highly influential RAND study into the doctrine of air/land operations, tactical emphasis switched steadily to medium level to reduce the risk from ground fire and the growing threat from man portable shoulder-launched missiles.<sup>28</sup> This change in emphasis of tactical doctrine is not merely a fall-out between two close air forces, it represents a different 'way' in air war which has remained a source of misunderstanding ever since the Cold War of the North German plains became a hot war in the Persian Gulf.

The development of the US air strategy for the first Gulf War is well-trodden ground. Warden's famous briefing to Horner, the subsequent merger of Warden's ideas into conventional air thinking, is all well known. What is not so well known, however, is that the Royal Air Force 'way' in air warfare had an impact within the Campaign. The British JP 233 airfield denial weapon had been developed as part of the air/land strategy in the Cold War. It was designed to disrupt activity at Warsaw Pact airfields with a mixture of runway denial munitions and aerial-delivered mines. Horner asked for it as part of his strategy. The UK air commanders, Air Vice-Marshal Sandy Wilson and Air Vice-Marshal Bill Wratten both enjoyed access to and, therefore, opportunity to influence US thinking. UK forces were extensively engaged flying over 10% of the Coalition mission total.<sup>29</sup> JP 233 was employed to excellent effect with great skill and bravery by the Royal Air Force in the opening week of the Gulf War. Despite the diver-

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An RAF Tornado deploying JP 233

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gent doctrine, the effect required by the air commander was achieved and measured by UK-provided tactical air reconnaissance. The subsequent disruption to the Iraqi Air Force helped to enable the Coalition to declare air superiority and operate free from interference by the Iraqi Air Force at medium level altitudes.

This USAF 'way' in air war, however, required a large supporting cast of electronic warfare, suppression of enemy air defences, jamming, signals intelligence, tanker, airborne command and control aircraft. This became the 'western' way in air war. Only the US could afford it. Since the Cold War, the main effort in all other European air forces (including the Royal Air Force, Fleet Air Arm and Army Air Corps) has been to work out how to spend enough to stay broadly interoperable with the USA. Post Gulf war analysis in the UK focused upon enhancement to the ability to fight at medium level altitudes and greater emphasis upon precision-guided munitions.

If this was an RAF success for effects-based operations, the first Gulf War exposed many problems with air command and control process for the UK and the US. Much has been made of the way General Horner organised and structured his headquarters to enable Coalition operations and orchestrate the conflicting demands placed upon him as the designated Coalition Force Air Component Commander with his other vital roles as the Theatre Air Defence Commander and the Airspace Control Authority.<sup>30</sup> RAF staff officers provided much-needed expertise in these areas. As for targeting, target lists abounded: some strategic, some operational, some tactical. The effect meant to be achieved upon the enemy was harder to determine in a task-to-strategy audit analysis.

Moreover, the feedback of effects from day-to-day operations into operational planning, despite the best efforts of the reconnaissance aircrews, was not well handled. The fusion of the many and varied means available: signals intelligence, satellite imagery, mission reports, tactical air reconnaissance did not readily find its way into the hands of those that needed it. Therefore, effects-based operations could not be claimed as the central tenet; rather it was the sheer weight of air effort over the thirty-nine days of the air war that was probably the deciding factor.

After the conflict, the answer appeared to be the creation of more staff places inside the air operations centre in order to feed the information monster, including more focus within the RAF on training for battle staffs. The Air Component Headquarters appeared set to grow. Thus, despite the clearly decisive effect air warfare had achieved in the first Gulf War, uneasy questions remained. Integration of air and land forces at the 'interface' of close air support was not as good as it had been in the British sector of NATO during the Cold War. The British and US 'ways' in air war had diverged slightly but importantly and the fusion of command and control with combat assessment to offer a view on the effect achieved had not been as successful as it could have been. Instead of learning and changing, on both sides of the Atlantic, the proponents of air power sallied forth with a rapid sequence of ever more grandiose claims of new dawns and new ages; mankind could be saved by air power alone!<sup>31</sup>

The close season for war in the air was short. A year after the Gulf War, conflict broke out in the Balkans. The international military response was mixed. The debate over the effectiveness of pinprick attacks by NATO aircraft with confused



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RAF Tornados patrolling the skies over Iraq

command and control and 'dual key' arrangements between NATO and the UN is probably the nadir of international decision making in recent years.<sup>32</sup> The claims for air power seemed to be ringing hollow in this new operating environment with confused boundaries, complex command and control arrangements and lack of shared situational awareness.

The West seemed to stumble from one setback to the next. Field Marshal Montgomery might have called it a lack of grip. The grip came in 1995. Not for the first or last time in military history, the personal relationship between the nominated NATO Land Component Commander, Lieutenant General Sir Rupert Smith (UK Army) and the nominated NATO Air Component Commander, Lieutenant

General Mike Ryan (USAF) set the conditions for military success in Operation Deliberate Force. Working together and broadly in cadence with political/diplomatic line of operations, they managed in a short campaign to convince the Serbs that NATO was serious in its request for compliance. Air Power operated with many constraints, but achieved the aim.<sup>33</sup> One reason was that target-validity was very carefully planned and coordinated between the two components.

Despite the success in achieving the aim, however, several of the Gulf War questions lay unanswered. The new processes in the Combined Air Operations Centre – especially when more than ten air force were engaged in the operation – required more and more people. The size of the

Combined Air Operations Centre at Vicenza was almost double that of General Horner's in the Gulf War.

In the mid 1990s, patrol operations went on in the Balkans out of Italy and, in support of United Nations' Security Council Resolution 688, over Iraq. Air operations against Iraq were mounted from Turkey, Kuwait and Saudi Arabia. The new generation of airmen trained since the Cold War (but commanded by Cold War warriors) understood that, although the day-to-day deterrent patrols appeared to achieve an effect, the operational situation could change very quickly, either through enemy action or a mishap. But, despite the grip shown during Deliberate Force, operations in both Theatres continued with a surprising lack of clarity of purpose in terms of effects-based planning. Some spikes in activity were directed top down, such as show of force missions in Bosnia or Operation Desert Fox in 1998, others were prosecuted bottom-up.<sup>34</sup> Other than the inherent right of self-defence (which can hold many interpretations across many air forces), the question of what constitutes a valid target became rather blurred. In the Balkans, the priority was to deny the Yugoslavian Air Force the ability to fly and interfere with the UN/NATO operation. Over Iraq, the stated aim was to deny the Iraqi Air Force freedom of action to intervene in the ground situation; in both cases a strategy of denial but without many of the 'what ifs' in place should the operational situation change.

In 1999, despite the NATO presence, the crisis over Kosovo developed into a full-scale air war. Again, much has been written on the details of the air war and the friction within the command chain as national interests and different shading in the desired outcome tended to blur and almost fracture NATO's unity of purpose. Building on the situational awareness from the patrol and show of force missions, the designated Coalition Force Air Component Commander, Lieutenant General Mike Short, planned a short war at the behest of his superiors. The plan had all the hallmarks of what had become the USAF 'way' in war. First, air needed to establish air superiority. Next, the suppression of enemy air defences to defeat the

Serbian Integrated Air Defence System; followed by carefully selected, screened and approved attacks against 'fixed' interdiction targets and targets which could or should achieve an operational or even strategic effect.

This was where the fun started between the nations and the layers of command. This time the question of what constitutes a valid target could not be properly or easily answered. It depended on who was asking the question and where they sat in the relative chains of command. In theory, for NATO, the North Atlantic Council set the strategic guidelines and delegated the conduct of military operations to the designated Theatre commander, General Wesley Clarke. But as he makes very clear in his book 'Waging Modern War', in practice many of the capitals within the participating nations wanted a say and often a veto over targeting.<sup>35</sup> The Campaign dragged on.

Although the Coalition declared air superiority, Serbian air defences had not collapsed, they hid and took opportunity shots against NATO aircraft requiring the full orchestra of NATO air power to fly night after night. From time to time, authority was given to strike targets inside Serbia, but the main weight of effort was directed within Kosovo. The strategic decision to rule out the employment of ground forces placed more constraints upon NATO airmen as did the masterly use of camouflage, concealment and deception tactics by the Serbian forces, employing the Soviet doctrine of Maskirovka. After seventy-eight days of mounting friction and frustration within the NATO command chain, Milosevic blinked, NATO cohesion remained intact (just) and air power could chalk up another victory. This time, however, the celebrations were more muted, the post war analysis more angst-ridden. Although the internal processes within the Combined Air Operations Centre had been improved, the time taken and number of people necessary to manage air operations remained a drag on rapid and timely decision-making. The NATO Combined Air Operations Centre in Vicenza numbered around 500 for Operation Deliberate Force. During Operation Allied Force, the number reached 1,000. The doubling law held good. That said, there were

*In a 'back to the future' Campaign, air power played a decisive role in support of Afghan proxy forces*



A USAF B-52 preparing for take-off to Afghanistan

improvements in air tasking. The time taken from spotting a target in the Kosovo Engagement Zone to the allocation of an aircraft to attack the target steadily reduced during the Campaign. What became known as 'Time sensitive targeting', was born. Similarly, US-led Combat Search and Rescue Forces again proved their worth in politically-charged complex environments.

In the inevitable post-conflict quest for lessons to identify, the unavoidable impression was that the friction created in order to satisfy the political requirement for multinationality probably exceeded the tangible military benefit offered by that multinationality. A lesson that was not lost on the air power thinkers in Maxwell and Washington as potential air allies lagged further and further behind in interoperability and air technology.

Again the close season to absorb lessons and train a new generation of airmen to exploit new technology and new doctrine was short. Air operations had continued over Iraq since 1992. The Coalition had ebbed and flowed as coalitions do. By the late 1990s, only the US and the UK were flying offensive missions over Iraq. Over time, the no-fly zones became increasingly dangerous places for Coalition aircrew. Even if the Iraqi Air Force flew very little to challenge Coalition air superiority (apart from much publicised raids to shoot down Coalition Unmanned Aerial Vehicles such as Predator), the Iraqi Air Defence forces were shooting at Coalition aircraft nearly every day. Coalition aircraft responded in self-defence.

Iraqi air defences grew bolder and the Coalition responded.

Both the UK and US introduced updated weapon systems and updated procedures. Lessons had been identified from Kosovo. The Combined Air Operations Centre became a warfighting element in its own right.<sup>36</sup> The UK also learned lessons. The Royal Air Force's already impressive tactical reconnaissance capability was enhanced with the introduction of new reconnaissance pods for Jaguar and Tornado. Tactics, techniques, procedures and counter-measures were constantly updated to cater for the enemy's new boldness. The UK 'way' in air war responded to treatment. Effects were being achieved. Then the world changed.

After Sep 11 2001, Operation Enduring Freedom suddenly presented Coalition air forces with a new target set: the Taliban regime in Afghanistan. The state of the infrastructure of Afghanistan after almost a quarter of a century of continuous warfare meant that there was little in the way of fixed arrays of targets to be struck by western air power. Nor was there much in the way of a recognisable air force or an integrated air defence system. Instead, in a 'back to the future' Campaign, air power played a decisive role in support of Afghan proxy forces. Close air support designated by US and other special forces proved to have a devastating effect on the morale and fighting power of the Taliban forces. Kabul fell and the regime collapsed. The pressure brought to bear by air power



*Despite the advances in defence communications networks and the enormous sophistication of intelligence and reconnaissance assets, getting the right information into the right hands at the right time remains a challenge*

continued to mount as the winter made ground campaigning difficult.

This modern form of punishment attack from the air (pioneered by the Royal Air Force in the Middle East in the 1920s), culminated in December 2001/January 2002 in waves of B-52 and B-1B attacks against the 'Tora Bora' Range in eastern Afghanistan. This time UK played an air power supporting role with intelligence, surveillance and reconnaissance, command and control, air to air refuelling, air transport aircraft and, as ever, a lot of helicopters. The effect achieved was out of all proportion to the numbers deployed, drawing private praise from US air commanders.<sup>37</sup> A recognisable UK 'way' in air warfare remained intact.

If air power had offered a decisive enabling effect in the Afghanistan Campaign, the second Gulf war did not appear to follow the traditional route as described above. Instead of the orchestral analogy: commander as conductor, bringing the symphony carefully to life in a deliberately planned sequence of attacks, this time a sudden crescendo from the percussion section started the air war with an attempt to decapitate the Iraqi regime using cruise missiles. In the second Gulf War, the air coalition was much smaller. The participating air forces were all elements of the US, all elements of UK air power (RAF, Fleet Air Arm and the Army Air Corps) and the Royal Australian Air Force.

This gave advantages in the pursuit of an effects-based strategy. Interoperability was easier to achieve and many of the crews were very experienced in the operating environment. Technology was harnessed in support of the Campaign objectives. Building on the success in support of ground forces in Afghanistan, Close Air Support became a critical role in order to sustain momentum and help to prevent the over-stretched ground forces operating with disadvantageous force ratios over long and vulnerable lines of communication, from reaching their culminating point.

Simultaneously air operations continued against a wide variety of interdiction, counter-air and regime targets. Time sensitive targeting was now a powerful reality with command and control fusion and rapid response now a routine. Lessons from this most recent of conflicts will take time to compile. But, the nagging doubts of previous conflicts remain. The interpretation of what constitutes a valid target requires education and understanding between allies, components and within military (and political) headquarters operating across and between the levels of war. Despite the advances in defence communications networks and the enormous sophistication of intelligence and reconnaissance assets, getting the right information into the right hands at the right time remains a challenge.

Whilst the lessons are absorbed, if there is one enduring theme that emerges throughout the case studies from recent operations, it is the difficulty of incorporating a robust method and process of how to measure effect (once the enduring question of what constitutes a valid target has been answered). A generic model is offered below.

#### **How to measure effect**

Throughout military history, generals and those working in support of generals have developed a campaign plan in order to specify how they intend to meet the objectives of their campaign. This process known simply as campaign planning has spawned its own rather Clausewitzian lexicon: centres of gravity, decisive points, lines of operation, branches, sequels, culminating points and so on. It is a flexible process and the interpretation of it to suit the local context in space and time is almost a definition of operational art. There are many shaping factors to influence a campaign plan, which the air planner may need to take into account. For example, weapons of mass destruction.

The mere hint of presence and a lack of accountability or knowledge of potential employment

options – especially in failed states or states of refuge where sub-state terrorism groups or group activists may prevent rational calculation to be made – may become Campaign main effort before conventional component operations can begin. Such shaping factors at the strategic level may affect operational level planning considerations. As a further example, in the era of truly multi-role aircraft, the aircraft required to undertake missions to find, fix and strike weapons of mass destruction may well be the same aircraft that are required, say, for close air support. Nonetheless, these shaping factors must be factored into the assumptions that underpin the campaign plan.

Another area of potential difficulty for the putative effects-based air campaign planner is defining and understanding the enemy. The enemy may have his own plans to disrupt our campaign plan at every stage. Western intelligence staffs, perhaps especially air intelligence staffs, are highly skilled at analysing images or electronic intelligence but may be less adept at identifying enemy intent by thinking like the enemy. Capability can be measured and potential assessed in a reasonably coherent way, but measuring his intent balanced against 'our' capabilities and 'our' potential to take the initiative and disrupt his plans is another example of the operational art required in the intelligence preparation or shaping of the potential battle space. This process, best described as the fusion of operational results with intelligence knowledge, is crucial to making sense out of combat assessment. Again it is a key and recognisable UK way in air warfare.<sup>38</sup>

The key word in understanding the generic model is fusion. Each element may be achieved at unit level, close to the actual air mission in time and space. For example, first phase initial assessment of air tactical reconnaissance may take place in cockpit to form the basis of a mission report in the case of time sensitive targeting or, via datalink, in a control cabin close to the deployed operating base. Other critical elements of the combat assessment process may take place hundreds or thousands of kilometres away in fusion centres or reachback facilities relatively safe from the enemy's reach. Provided the reachback command-

ers understand the in-place commander's intent and has sufficient situational awareness from all sources, thereby mixing high-grade all-source intelligence with tactical results and commander's requests for information, great value can be added to create a fused combat assessment product. This product can turn effects-based planning into operational reality.<sup>39</sup>

Within the overall process of effects-based planning, therefore, the role and place of combat assessment is crucial and often the weak point. In the succession of campaigns illustrated in the case studies, someone in the Combined Air Operations Centre probably had the right 'nugget' of information somewhere, but was unable to place the information in the right hands – the operational or tactical decision-maker – at exactly the right time. This remains a key challenge for the development of processes to make combat assessment the catalyst for the delivery of effects-based operations.

Of course any metric which requires the integration of objective military assessment (mission reports, imagery analysis etc) with subjective assessments of future enemy intent and the effect of information or psychological operations on the enemy's will to fight, is difficult. But, if the process is robust enough to allow military judgement and operational art to be exercised by empowered commanders backed up by the fusion of results, bounded by the rigour of science, then combat assessment could be the next big and yet achievable challenge for air power.

Turning to the 'how' question: one way to overcome the apparent complexity and mythology of campaign planning is to break tasks down into objectives, objectives down into sub-objectives, sub-objectives into target sets, target sets into targets and targets into individual desired points of impact. This linear and hierarchical process enables each task to be linked to the overall strategy and, conversely and usefully, provides an audit trail back from an individual mission or task to the overall strategy of the Campaign (a discipline lacking in many air campaigns). The diagram below offers a picture of this process.

### Effects-Based Targeting



### Effects-Based Targeting



Figure 1: The Strategy to Task Process

As demonstrated, for a measure of effect to be valid, it must fill four objective criteria. Is it quantifiable? For example, are the enemy's surface to air missile radars still transmitting in a particular area over a given time – perhaps measured by signals intelligence. Is the task achievable? Can we reach those radars with either manned or unmanned vehicles at an acceptable level of risk? Can the effect achieved be collected by available means? And last, but often the acid test once operations have begun, is the effect still valid and relevant in the prevailing operational situation? For example, will the removal or disruption of the surface to air missile raiders enable us to achieve the effect we seek? And so on.

Some may see this analysis as simplistic. But, when applied consistently and merged with operational analysis, this model works. Without combat assessment, however, any approach to effects-based operations for air power may well be stillborn.

### 'So What' Analysis

As the foregoing analysis of the evolution of the UK 'way' in effects-based aerial warfare has attempted to show, the creation of an effects-based operations strategy for air power is achievable. The speed of response of contemporary air power makes it an early if not first option of choice for decision-makers. Speed of response can be a powerful indicator of intent. An early deployment of a small but potent force either afloat or ashore on friendly bases can diffuse a situation through deterrent effect or, offer a force on mind to deter further aggression.

The reach and perspective of modern air power to sustain a presence and offer intrusive reconnaissance and surveillance can also offer a powerful political message whilst containing or defining an acceptable level of operational risk for the political process whilst coalition or diplomatic options are closed off. Thus, the global reach of air power to reach a crisis area with speed is a key strength in any consideration of the adoption of an effects-based strategy.

At the same time, however, expeditionary operations expose a potential flank of vulnerability to the enemy. Host nation support is a vexed question. On the one hand the presence of 'foreign' forces can inflame local sensitivities and make a bad situation worse. On the other hand, the presence of foreign potential intervention forces can reassure reluctant allies. Host nation support restrictions can be mitigated by poisoning the force afloat in an aircraft carrier. Force protection of deployed air assets is another challenge. Local air defences may be able to offer protection during the vulnerable build-up stage, but the vulnerability of large (and therefore obviously foreign) forces 'locked' into remote locations can create a vulnerability in the shape of force protection as more and more forces have to be deployed in the force protection role.

As for opportunities, at the beginning of the twenty first century, there are several enabling technologies that allow air power to exploit the information age through network-enabled capability. Examples include datalinks, interoperable secure



*Ownership of the platform is irrelevant; it is the process of ensuring the product is shared and exploited by those who need it that counts in effects-based warfare*

radios and common command and control/tasking networks. If the fusion of information in warfare is the critical challenge for the method of creating a process to deliver effects-based planning, so the fusion and integration of information warfare in all of its manifestations with warfighting, is the key if not ultimate challenge for future technology. Airmen are already exploiting unmanned aerial vehicle technology to excellent effect. Ownership of the platform is irrelevant; it is the process of ensuring the product is shared and exploited by those who need it that counts in effects-based warfare.

Of course there are threats to all this progress. Interoperability is a tenet of modern operations that must not be taken for granted. The concept is both vertical and horizontal. Air forces may be able to interoperate with each other, but may (in the process) have drifted apart from, say, their national land component. If, as a truism, air/land integration is the most complex and complicated of air power roles and missions, such a drift between the components of a nation must be addressed. Much work is in hand but much remains to be done. Another threat, which requires equal attention but is much more difficult, is how to apply the potential of air power to a non-state, terrorist enemy. Recent operations over Afghanistan and Iraq have, however, demonstrated that airmen can and do respond to new challenges with flexibility in approach and flexibility and discipline in execution of air operations.

Above all, however, the central thesis is that, despite the apparent blurring of many 'ways' in air war into one US 'way' in air warfare, in fact a distinctive and highly capable UK way in air warfare remains intact. Again ownership is not the issue. With the advent of the Joint Harrier Force and the Joint Helicopter Command in the UK, effects launched from the air can be created for joint effect. Within the Royal Air Force, the UK retains highly developed capabilities and operationally experienced personnel which add value to

any effects-based strategy. The commitment to reconnaissance, long range attack, interpretation and all source intelligence, complemented by an understanding of warfare and command and control at the strategic and operational level all point to component force elements ready for the next challenge.

#### Conclusion

I have attempted to demonstrate that the UK has understood effects-based operations in the air environment since the earliest days of air warfare. A distinctive British 'way' in air war developed during and between both World Wars, and continued to retain its edge during the Cold War. Since the Cold War, contrary to much US-inspired writing, the UK has retained its own 'way' and in some elements added lustre to its credibility with a string of successful deployments covering the full range of air power roles and missions. In addition, many of the UK's key strengths: command and control, campaign planning, integrated mission support, tactical reconnaissance, long range attack are particularly useful in support of effects-based operations.

Since the days of air control over Iraq in the 1920s, relatively junior UK air commanders have traditionally been asked to deliver much with little expenditure of national treasure. Air commanders are schooled to think at the operational and strategic level with their colleagues at the UK Joint Services Command and Staff College.

Air Vice-Marshal Professor Tony Mason's warning that Tornado replaces Buccaneer, Buccaneer replaces Canberra, Canberra replaces Mosquito and so on, should be noted as such. Of course such simple Cold War analysis should be behind us in the era of smart procurement. The full and creative fusion across the lines of development of concepts, doctrine, training, people, equipment, sustainability and decision support to joint effect is now the focus, rather than all on equipment.

The risk of reversion to former ways is always there, however; hence the power of the warning.

In the effects-based era, particularly against non-state enemies, the next step is the fusion of force development between allies to ensure conceptual, doctrinal and interoperability in training and exercising (what Lieutenant General Sir Anthony Pigot has called the interoperability of the mind) is required as well as interoperability between equipment. Equipment commonality is often the easy part and the focus of too much staff activity. In addition, other challenges abound. In the UK, too much research and development funding is directed towards cost and risk reduction rather than innovation and technology exploitation in the prevailing procurement culture.<sup>40</sup>

The integration of information operations and the means to measure the effect of psychological operations properly must be an area of renewed effort. Thus far, too many attempts have focused upon simple indicators such as the number of leaflets dropped or hours of broadcast, rather than the impact upon the target population. We also need to reverse the trend of steadily increasing the number of airmen deployed forward to deliver command and control inside the Combined Air Operations Centre. The doubling law should become at least the halving law!

Above all, the UK should retain its distinctive 'way' in air warfare. Despite the risks and challenges, the UK has retained a balanced capability which provides – to any Coalition – a range of options and capabilities proven time and again by hard-won operational experience and robust command and control. But, to paraphrase the NATO Tactical Leadership Programme aphorism slightly, we are only as good as our last war. We need to accept that the price to achieve an effects-based operations strategy is as much about cultural and structural change as the seduction of technology. In effects-based operations as in war, even the most simple task can be difficult.

#### Notes:

<sup>1</sup> The strategic bombardment campaigns of the twentieth century continue to attract authors in search of answers on the effect of bombardment. See Pape, R, *Bombing to win*, Cornell, USA,

1998, Niellands, R, *The Bomber War*, Hutchinson, London, 2000 and Biddle, T, *The Evolution of Strategic Bombing*, Washington, 2002 for recent academic works. In the UK, Lindqvist, S, *A History of Bombing*, Granta, London, 2001 for an unusual reader on the polemics of the subject.

<sup>2</sup> The descriptor RMA to denote a revolution in military affairs crossed the Atlantic almost ten years ago. As is often the case, conceptual aspirations were divorced from technical realities. See Friedman, G & M, *The Future of War*, New York 1998 for a Toffler-inspired vision of future war balanced, more recently, by Colin Gray's, *Strategy*, London 2001 for a more realistic view from the UK side of the Atlantic.

<sup>3</sup> Quoted in AP 3000 3<sup>rd</sup> Edition, Chapter 11, 3.11.1, London, HMSO, 1999.

<sup>4</sup> One trend which is new is the speed by which commanders deliver their memoirs. The early 1990s witnessed a crop of books from the senior commanders of the Gulf War offering their story. Gordon & Trainor, *The Generals' War*, Little Brown, USA, 1995 offered a more balanced assessment. After the Kosovo Campaign of 1999, General Wesley Clark produced his memoir: *Waging Modern War* as early as 2001. Thus, rarely are students or commentators short of material. The problem is that the information flow is very one-sided. Bookshelves are less full of Yugoslavian and Iraqi memoirs.

<sup>5</sup> For example, the lessons learned in air warfare from the First World War took on a very different hue between the victors and the defeated. See Corum, J, *The Luftwaffe Creating the Operational Air War, 1918 to 1940*, Kansas, 1997. Similarly, tactical level memoirs can offer vivid descriptions of 'what it was like', but are less likely to answer the 'why' questions. In particular, there is dearth of perspectives from the enemy's point of view from recent operations, despite the best efforts of the western media. See Weymouth & Henig, *The Kosovo Crisis*, Reuters, 2001 for a reader on the subject.

<sup>6</sup> Napoleon was probably the last general to 'manage' the tactical, operational and strategic levels of war in the shape of one man. See Gates: *The Wars of Napoleon*, Macmillan, London, 2001 and Holmes, R, *Wellington*, Harper Collins, London, 2003 for the profound influence of individual commanders in those wars. The Prussian General Staff organization and structure which grew out of the Napoleonic War remains the basic way by which we go to war in the UK, Western Europe, the USA and Australia. The staff branches for administration, intelligence, operations, logistics, plans, communications, training and finance would all be familiar to Clausewitz. Often it is the human friction and lag inherent in these (often vast) staff structures which inhibit timely decision making and the intellectual assessment of military cause and effect on an enemy.

<sup>7</sup> See Meilinger, *Paths to Heaven*, Maxwell AUP, Alabama, 1998 and Peach, 'It's the Effect that Counts' in Gray (Ed), *British Air Power*, TSO, London 2003 for the influence of the 1920s in shaping the doctrine of the Second World War.

<sup>8</sup> Few volumes on air power concentrate on the Boer War. During the conflict, the British 'way' in colonial war was

severely tested. Many of the enemy's tactics, techniques and procedures were adopted to great effect, but the lessons were not learned for the Great War. See: E. Lee *To The Bitter End* (A Photographic History of the Boer War), Penguin, London 1985. Pp 34-35.

<sup>9</sup> See Pape, op cit for a vignette.

<sup>10</sup> See J. Bailey, *The First World War and the Birth of the Modern Style of Warfare*, Strategic Combat Studies Institute Paper No 22, 1996.

<sup>11</sup> In his classic account of Verdun, Alastair Horne makes much of air superiority as a decisive factor in the battle. 'See A. Horne, *The Price of Glory: Verdun 1916*, Papermac, London, 1990, Pp 160.

<sup>12</sup> See Mason, R.A., *Air Power, A Centennial Appraisal*, Brasseys, London, 1994 for a description of the plethora of types and engines that plagued the Royal Flying Corps and the fledgling Royal Air Force.

<sup>13</sup> See Melvin M, *The Land/Air Interface*, in Gray, P.W. (Ed), *British Air Power*, TSO, London, 2003, P65-68 for an excellent account of how the simplistic mythology of Trenchard as an early exponent of bombing persists. In fact, Trenchard and all the founding fathers of the RAF were wedded to the primacy of air support to the Land Component. Air power evangelism came later.

<sup>14</sup> See Omissi, D, *Air Power and Colonial Control*, MUP, Manchester, 1990 and *Air Policing, 1919 to 1939*, MUP, Manchester, 1991, Cooper, M, *The Birth of Independent Air Power*, Allen, London, 1986 and Towle, P, *Pilots & Rebels*, Brasseys London, 1991, for the full story of air control.

<sup>15</sup> Harris's own account, although ghost written, *Bomber offensive*, appeared as early as 1947. Personal accounts have continued to emerge. Most middle ranking commanders either published autobiographies such as Air Vice-Marshal Don Bennett: *Pathfinder* or have been the subject of biographies. Each year still sees the emergence of new accounts.

<sup>16</sup> The influence of Trenchard upon the selection of commanders shaped both the Second World War and the early years of the Cold War. See Vincent Orange, *Tedder*, Cass, London, 2003 for how the father of the Royal Air Force's influence cast a long shadow over the Service he helped to create. Of note, despite the towering figures in the Royal Air Force and British Army, no single commander was able to exert so much influence for so long, possibly since Nelson upon the Royal Navy after Trafalgar.

<sup>17</sup> See Terraine, *Right of the Line*, Hodder, London, 1985, for highly readable accounts of the profound difficulties encountered by the 'original' crews of Bomber Command in 1939 in attempting to take the war to the enemy.

<sup>18</sup> This may appear tactical detail for a survey on effects-based operations. In fact, in interviews with veterans, all contended it was Bennett's insistence on aim point imagery (which in the Lancaster and Halifax was triggered automatically when the bomb doors were open and weapons released) did more than any diktat from the Air Ministry to exhort the crews to greater

accuracy. By the end of 1943, the practice had been adopted across Bomber Command. See Peach, S, *Pathfinder Station, A History of RAF Wyton*, Cambridge, 1982.

<sup>19</sup> Rivalry between the Groups, Stations and Squadrons of Bomber Command remains an understudied area. For example, the extra pay (through rank and a special badge) of the Pathfinders was resented. Cochrane in 5 Group created his own specialist low level squadrons. 617 Squadron remained an elite unit outside the Pathfinders and enjoyed an intense rivalry with IX(B) Squadron which culminated in both claiming the sinking of the Tirpitz in 1944. An area ripe for further study in the effect it may have had on the pursuit of ever greater effects through accuracy to enhance the Squadron's reputation.

<sup>20</sup> Both became and have remained key skills of the Royal Air Force: photographic interpretation and operational analysis. Encouraged by Churchill, the photographic reconnaissance squadrons of Spitfires and Mosquitos, ranged far and wide over Europe. Flying high and fast, albeit unarmed, their presence was one of the catalysts for the German development of the Me 262 jet fighter. It is a key tactical skill the Royal Air Force has retained. In the Cold War, Hunter and Canberra, now Jaguar and Tornado offer an important contribution to the measurement of effect through combat assessment to this day. Similar arguments apply to OA; a key skill retained at the tactical level with an operational effect.

<sup>21</sup> Overy's *Why the Allies Won*, Pimlico, London, 1995 offered as much of a watershed in historical thinking on the bomber offensive, as had the publication of the official histories in the 1960s.

<sup>22</sup> See Barnett, C, *The Lost Victory*, Hodder, London, 1995 Ch12 for a sobering reflection of the seeds of decline already evident in the British aircraft industry in the 1940s despite government backing and a 'vision' in the shape of the Brabazon Report.

<sup>23</sup> See Wynn, H, *RAF Nuclear Deterrent Forces*, AHB, London, 1991 for details of the extent, depth and expense of the British commitment to nuclear forces throughout the 1950s and 1960s.

<sup>24</sup> The Vulcan flew long range, air to air refuelled medium level conventional bombing raids on sovereign British territory in 1982 having prepared for twenty years to deliver nuclear weapons on the Warsaw Pact from low level. Sir Michael Howard's quote on doctrine refers.

<sup>25</sup> Commencing with NATO's rearmament at the time of the Korean War under the original Lisbon force goals, European air forces especially Belgium, Denmark, Germany, Netherlands, Norway became important, almost guaranteed, export markets for US aircraft and weapons.

<sup>26</sup> Throughout the Cold War, the majority of RAF Staff College papers focused upon better, faster, further type issues rather than strategic questions. The creation of the Director Defence Studies (RAF) post by the Chief of the Air staff in 1977 was, in part, an attempt to widen the debate.

<sup>27</sup> The air/land interface between the Royal Air Force in Germany and the British Army of the Rhine offers an excellent

example of mutual understanding. See Peach, S A Continental Commitment; The RAF in Germany 1945 to 1993, RAF Historical Society, 1999.

<sup>28</sup> The RAND Corporation published the 'Air/land Battle' in 1985. Drawing upon lessons from Vietnam and USAF global engagement in the Pacific and Korea, it represented a rejection of the UK's low level penetration doctrine in favour of a supported medium level air doctrine.

<sup>29</sup> See Hallion, *Storm over Iraq*, Smithsonian, 1992 for details. It was the range of UK capabilities, ability to operate at the operational level and the willingness to engage in offensive operations which marked out a niche in Horner's headquarters.

<sup>30</sup> See Horner, C with Clancy T, *Every Man a Tiger*, Pan, London, 1999, P.316.

<sup>31</sup> Many claims were made for air power: *The Gulf War Air Power Survey*, Hallion's *Storm over Iraq*, conferences at Maxwell and RUSI in the UK, all when re-examined in 2003 have something of an evangelical tone.

<sup>32</sup> See Sims, B, *Unfinest Hour*, Penguin, London, 2001 for a rather depressing polemic on the muddled responses to the unfolding Balkans imbroglio and its effect upon military option planning.

<sup>33</sup> See Holbrooke R, *To End a War*, Little Brown, USA, 1999 for acknowledgement of the need to keep diplomacy and high politics in cadence with military operations.

<sup>34</sup> M. Knights, *Bombing Iraq: Influence and Decision-Making in the Targeting, Planning and Weaponing of Modern Air Campaigns*. Unpublished PhD thesis, Kings College London, 2002, Chapter VII, Pp 199-232.

<sup>35</sup> See Clark, *Waging Modern War*, BBS, New York, 2001, Part III, for a description of the bureaucracy and time taken in the target clearance process.

<sup>36</sup> See, Jumper, J in RAF APR, 2, II, *Air War Kosovo*, for an exposition of the requirement to make the Combined Air Operations Centre part of the warfighting element rather than a headquarters.

<sup>37</sup> The effect of sustained UK investment in ISR systems, AAR and mobility through helicopters continued to offer, what in USAF parlance have become known as high value air assets. During operations in Afghanistan in the summer of 2002, a single squadron of Chinooks flew over 1,700 operational flying hours with only one sortie lost to unserviceability.

<sup>38</sup> The UK Air Warfare Centre was created from the fusion of the Central Trials and Tactics Organisation and the Electronic Warfare Operational Support Element in 1993. The vision of Air Chief Marshal Sir John Thomson, its mission is integrated mission support. The UK Air Warfare Centre teaches effects-based air operations planning, based upon historical experience and campaign planning.

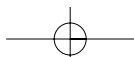
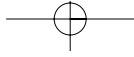
<sup>39</sup> A note of caution and pragmatism: reachback is not a substitute word for command of deployed forces or the need for in-theatre headquarters staff. It is a means of fusing information from many sources into one product to suit the deployed commander. There are two governing dynamics:

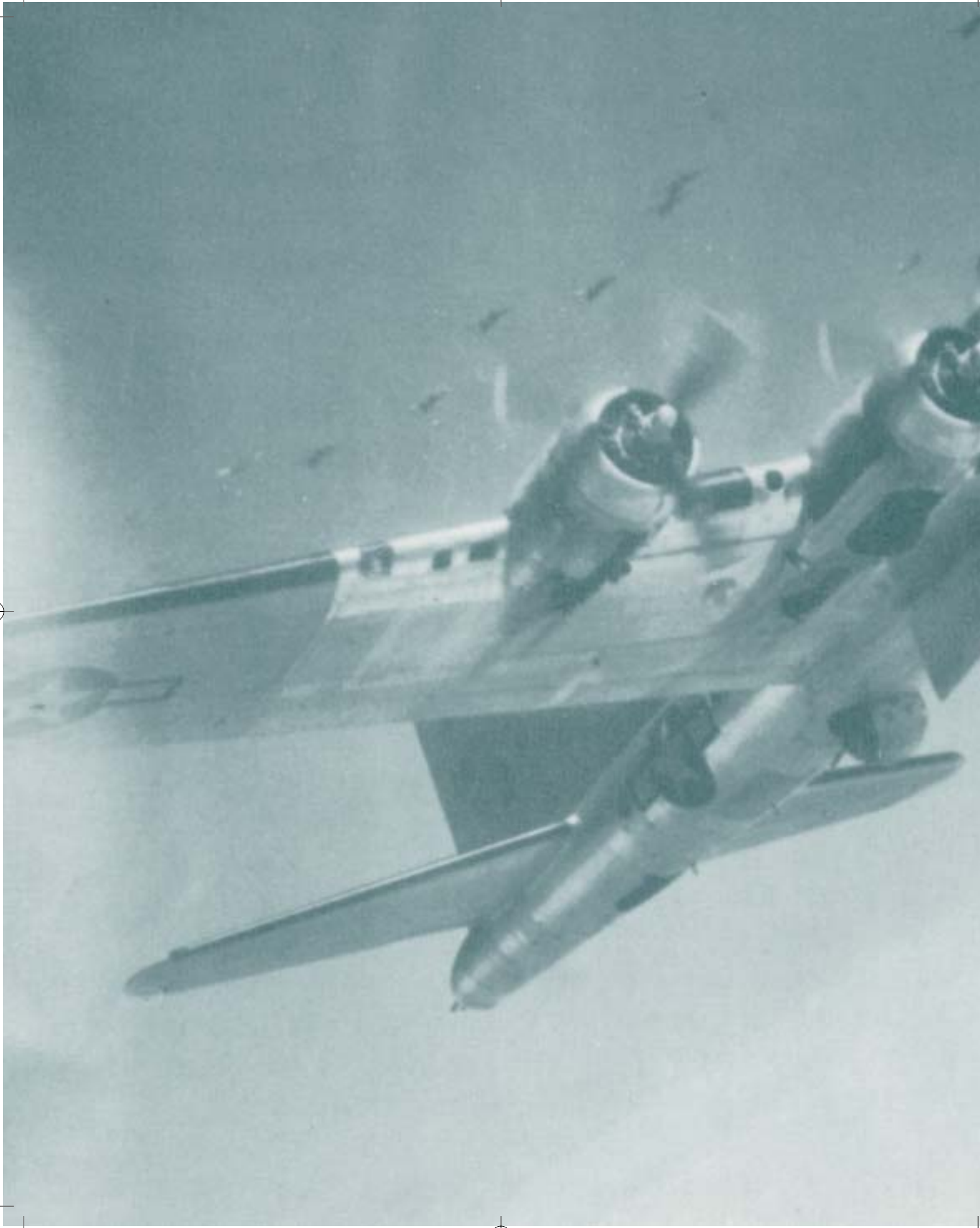


sufficient bandwidth and the support of the Theatre Air Commander.  
<sup>40</sup> Chief Executive QinetiQ speaking at QinetiQ update briefing in 2002.









# *American Bombardment Policy against Germany, 1942-1945*

By Richard G Davis

*The bombing of political centers is prohibited by the laws of warfare. However, since they are the nerve centers of the nation, they are apt to be important targets for bombardment in reprisal for attacks made by the enemy on such centers in our own country, especially since they are apt to contain important factories or stores of war matériel.*  
(US Army Air Service Tactical School, Bombardment Course Text Book, 1926.<sup>1</sup>)

*The U.S. Strategic Air Forces have not at any time had a policy of making area bombing attacks upon German cities. Even our attacks against the Berlin area were always directed against military objectives. Our pathfinder attacks against communications centers have often resulted in an area type of bombing because of inaccuracy in this method of bombing.*  
(Major General Frederick L. Anderson, Deputy for Operations, U.S. Strategic Air Forces in Europe, April 10, 1945)

An air force is a captive of its technology. The capabilities of an air service's support systems, aircraft, and weapons play a pre-dominant role in shaping its doctrines, policies, and methods of operation, and strictly circumscribe its effectiveness. From 1942 through 1945 the U.S. Army Air Forces (AAF) pursued a strategic bombing offensive against Germany. This campaign provides a prime example of the effect of technology on bombardment policy. Bombardment policy, or in current terminology the Rules of Engagement for air-to-ground combat, was a set of guidelines established by the Anglo-American civilian leadership and interpreted by the bomber commanders. It governed the physical release of bombs over enemy territory. This paper examines the bombardment policy of the US Eighth Air Force.

The Eighth began bombardment operations on July 4, 1942. By October 9, it had conducted

*Strict compliance with the directive would have halted American heavy bomber operations. Consequently, the Eighth would appear to have made no changes to bring its day-to-day operations into compliance with the new policy*

B-17s of the US 8th Air Force on a high altitude bombing mission



fourteen heavy bomber raids over Occupied France. These raids highlighted the need to define the American bombardment policy, particularly as it affected the safety of friendly civilians in German occupied territory.<sup>2</sup> Major General Carl A. Spaatz, the Eighth's commander, had the following notification broadcast over the BBC to occupied France:

*American bombing aims only at the Nazis and towards activities in France and occupied countries that contributed to the German war effort. Therefore, all people of France living within two kilometers of recognized German war effort factories are advised to vacate such residences.<sup>3</sup>*

On October 29, either in response to the American initiative, or as part of an effort to clarify its own

policy, the RAF issued new instructions to all its commands. Spaatz adopted it as the official policy of the Eighth as well.<sup>4</sup> The Allies drew a sharp distinction between the bombing of enemy occupied territory and Germany itself. In British, Allied, or neutral territory occupied by the Germans the following rules applied:

1. Bombing confined to 'military objectives' only.
2. Bombing of civilian populations, as such, forbidden.
3. It must be possible to identify the objective.
4. The attack must be made with reasonable care to avoid undue loss of civilian life and if any doubt exists as to accuracy or an error would involve the risk of serious loss to a populated area, make no attack, and
5. Observe the provisions of the Red Cross conventions.



The memorandum supplied a listing of authorized targets in occupied territory, including enemy units and facilities, dockyards, war factories and associated power plants, and fortifications. It specifically excluded lighthouses and the power stations feeding the electrical pumps keeping the Netherlands from flooding. The memo made 'special provisions' for lines of transportation and communications and means of intercommunication 'serving military purposes' in occupied territory. The Allies limited daylight attacks to locomo-

*therefore, apply in our conduct of air warfare against German, Italian, and Japanese territory, except that the provisions of the Red Cross Conventions are to be continued to be observed.*<sup>5</sup>

The multi-tiered system of bombing restrictions tied to the nationality of ground targets this policy established remained in effect throughout the war.

Although the new directive gave the AAF and the RAF the same bombardment policy in theory, it

### *On April 5, 1943 the Eighth struck an aircraft repair plant in Antwerp, drawing a sharp protest from the Belgian government stating that the raid had killed 1,200 civilians*

tives and freight trains, but forbade attacks on passenger trains and attached locomotives. At night all rail traffic was subject to attack. However, the instructions included a blanket clause. Subject to the provisions of avoiding loss of civilian life, it allowed the attack of any objective 'the destruction of which is an immediate military necessity.'

The memo further described a unique problem: British territory occupied by the Germans – the Channel Islands. The memo limited attacks to those 'necessitated by operational considerations of real importance,' and confined those attacks only to the objectives targeted. The Allies added a last restriction, 'Owing to the difficulty of discriminating between troops and civilians, machine-gun attacks on personnel are not to be made.' By inference machine-gun attacks on personnel in occupied and enemy territory was authorized or at least not explicitly forbidden.

The concern for their own and for the people of their subjugated Allies did not extend to the enemy. In two pithy sentences AVM John C. Slessor, Assistant Chief of Staff (Policy), wrote:

*Consequent upon the enemy's adoption of a campaign of unrestricted air warfare, the Cabinet have [sic] authorized a bombing policy which includes the attack of enemy morale. The foregoing rules governing the policy to be observed in enemy occupied countries do not,*

did not have that effect in practice. The Eighth, following its doctrines operated over occupied Europe and with its high altitude precision techniques that could not avoid collateral damage. Strict compliance with the directive would have halted American heavy bomber operations. Consequently, the Eighth would appear to have made no changes to bring its day-to-day operations into compliance with the new policy.

But the broadcasts ordered by Spaatz indicated the Americans did not purposely intend to injure civilians, whatever the limitations of their technique. Throughout the strategic bombing campaign against Europe, American bombing policy would oscillate, sometimes at virtually the same instant, between the very genuine American desire to avoid harming civilians, a feeling shared by all top American air commanders, and the realities of weather and bombing accuracy.

At the Casablanca Conference in January 1943, the CCS placed the Eighth under the overall guidance of the Chief of the RAF Staff, Air Chief Marshal Charles A. Portal. This, in effect, made the Americans' day-to-day bombardment policy dependent on political sensitivities of the British government.

On April 5, 1943 the Eighth struck an aircraft repair plant in Antwerp, drawing a sharp protest

from the Belgian government stating that the raid had killed 1,200 civilians. Whereupon Sir Anthony Eden, the British Foreign Minister, asked the Air Ministry if it were possible that, 'the Americans only bomb targets which are sufficiently far removed from residential districts to allow a safe margin for error.'<sup>6</sup> Portal's assistant, Air Vice Marshal Norman H. Bottomley, wrote to Eighth to

by lower headquarters allow definition of American policy both by inference and by the old bromide 'watch what I do, not what I say.'

Up until the end of September 1943, the Eighth conducted all its bombing by the sole means available to it visually, with the Norden bombsight. In their raids on occupied Western Europe and on

*Remaining records and mission reports submitted by lower headquarters allow definition of American policy both by inference and by the old bromide 'watch what I do, not what I say'*

request, 'that as far as is possible targets in Occupied territory be selected in such a way as to avoid the risk of heavy casualties of the civilian population.'

Lt. General Frank Andrews, the American theatre commander, reported to General Marshall that the War Cabinet wished to limit collateral damage in occupied territory, a policy which if 'interpreted strictly would necessitate abandonment of such bombing since inevitable strays will occur.' However, Andrews added that he had achieved a compromise. The Americans would suggest a list of targets for War Cabinet approval and then the Allies and their civilian populations would be warned. Thereafter, such targets could be bombed as the situation warranted.<sup>7</sup>

The Cabinet accepted 19 targets, but decided, for reasons of operational security, not to inform their Allies of specific targets.<sup>8</sup> The Vice Chief of the Air Staff cautioned the Americans, 'I think it would be advisable to avoid the added risk which might result from employing forces consisting of mainly freshman groups,' and added, 'I am sure that in light of the Prime Minister's instructions you will plan these operations with a view to reducing the risk of casualties to civilians to a minimum.'

American policy towards collateral damage and area bombing lacked the clear and concise definition of British policy and procedure. Nonetheless, remaining records and mission reports submitted

Germany the Americans invariably used the tactics of the high altitude visual attack. Given the incomplete training of some crews, German defenses, the relatively compact nature of some of the targets selected and, the smoke and dust thrown up by previous bombing, the Eighth's efforts were, at best inconsistent. In France, it is said, the saying 'up with the RAF and down with the Americans,' became prevalent. The Eighth apparently did take what precautions it could, such as briefing the crews to identify the proper target, refusing to authorize the selection of alternate targets in occupied countries, and selecting approach angles that directed bombs away from populated areas. The basic inaccuracy of their bombing method betrayed their good intentions.

In any case, the Eighth did not engage in indiscriminate bombing over occupied Europe. By June 27, 1943, the RAF notified the Eighth that all the target areas had received their warnings and specified that, 'You should continue to observe the principle that all possible measures be taken to keep to an absolute minimum the risk of casualties to the civilian population consistent with ensuring the effectiveness of your attacks.'<sup>9</sup> The Eighth's implementing directive somewhat diluted this strict standard, 'In planning operations in enemy occupied countries, care should be taken to spare as many civilian casualties as is practical.'<sup>10</sup> Throughout 1943 Eaker and his bomber commander, Maj General Anderson, and fighter commander, Maj General Kepner, observed a verbal arrange-

*After the invasion of France the demands of the ground forces and their associated tactical air forces necessitated the attack of so many communications, V-1, and combat related targets that the system of tight control of bombing in occupied countries in Northwest Europe disappeared avoid widow*



ment that required both subordinates to clear, before carrying them out, any attacks on occupied territory with their commander.<sup>11</sup>

The British continued to limit Allied attacks throughout 1943 and the first months of 1944. Naturally, the target list changed over time. The discovery of the CROSSBOW/V-1 system added a large number of new targets. On November 26, 1943, the British suspended bombing and strafing attacks on all electrical power installations in France and the Low Countries because they would produce no immediate or large effect on the enemy's war effort and, 'on the other hand create much distress among the civilian population, and may prejudice the success of our future military operations in those countries.'<sup>12</sup>

On the same day the Allies also discontinued fighter attacks on 'the railway transportation system particularly locomotives, trains, and signal boxes in occupied North-West Europe,' but noted that such attacks in conjunction with support of the cross-channel invasion could be planned and

would be authorized when appropriate.<sup>13</sup> By May 20, 1944, the Allies had resumed fighter attacks on all trains, including passenger trains, in occupied territory. After the invasion of France the demands of the ground forces and their associated tactical air forces necessitated the attack of so many communications, V-1, and combat related targets that the system of tight control of bombing in occupied countries in Northwest Europe disappeared.

#### **The bombardment of German territory**

Over Germany the Eighth employed a looser set of rules. The Eighth's 'Bombardment Directive' of June 27, 1943, issued to implement POINTBLANK, stated, 'Any target in Germany is cleared for attack at any time.'<sup>14</sup> The Americans flying in the daylight and using either 'eyeballs' and later radar could seek alternate targets with comparative ease. Consequently, the Americans distinguished target priorities within a raid, while Bomber Command normally did not. The Eighth normally had four target priorities for each mission:

1. **Primary:** visual attack on a specific war plant,

*The Eighth's first ordered city or area raid occurred on September 27 1943 when it dropped, through complete overcast, 506 tons on an objective specified as the 'city of Emden.' This was also the first raid in which the Eighth employed radar-bombing techniques*



rail facility, or military target. Chosen by the AF Headquarters in accordance with current bombing directives.

2. **Secondary:** Usually chosen by AF Headquarters in accordance with current bombing directives, with its location coordinated with the bombers' planned route and fighter protection.

- a. visual: an alternative target similar to the primary, or
- b. non-visual: area attack on city associated with either of the above.

3. **Last resort target:** A tertiary target with the same qualifications as a secondary target.

4. **Target of opportunity:** A target selected by

bomber formation leaders, while in the air, when they are unable to attack any of the above targets. If weather or enemy action scatters a formation all pilots are encouraged to seek targets of opportunity, within specified limits. Forbidden over occupied territory.

The first area raid noted in Eighth Air Force records occurred on August 12, 1943, when 106 bombers attacked the city of Bonn, visually, as a target of opportunity.<sup>15</sup> The Eighth's first ordered city or area raid occurred on September 27 1943 when it dropped, through complete overcast, 506 tons on an objective specified as the 'city of Emden.' This was also the first raid in which the Eighth employed radar-bombing techniques. General Frederick L. Anderson, Commanding General, VIII Bomber Command, who authorized



*The October 2 mission against Emden was the Eighth's first strike to deliver more than 100 tons of fire bombs on a single target. Henceforth, the Eighth would not only conduct intentional area bombing, it would do so using area bombing techniques*

the raid, had been instrumental in the procurement, installation, and use of bombing radar.<sup>16</sup>

The conjunction of radar and city area bombing was not a coincidence. But tactical considerations, not strategic ones, dictated the American adoption of area bombing. In early September 1943, the Eighth obtained four H2S radar devices from the RAF. An American variant of this radar bombing device, H2X, began to equip the Eighth's B-17 and B-24 heavy bombers in December 1943. The initial scarcity of H2S and H2X meant that one or two pathfinder aircraft would lead large formations of bombers, 100 or more. When these large formations dropped through overcast on the pathfinders' markers bombing accuracy declined precipitously. Hence the switch to area bombing.

The primitive radar technology then available allowed the Eighth to locate a city through clouds, but not a specific plant or precision objective.<sup>17</sup> Of course, if weather conditions, such as a break in the clouds, or if the situation allowed it the Americans could fall back on the Norden Bombsight and visual bombing. Within a span of two weeks after the introduction of a mere six sets of radar for the entire force, the Eighth went from a command that had never authorized a city area raid to one that would launch more than one such raid a week, on average, until the end of the war.

On October 10 the Eighth, employing visual sighting struck the city of Munster as a primary target and the German city of Coesfeld and the Dutch city of Enschede as targets of last resort.<sup>18</sup> The day after this raid the Commander of VIII Bomber Command, General Anderson, outlined American target priorities, 'first destruction of the Luftwaffe, its factories and planes; second essential German industries, and third, the cities themselves.'<sup>19</sup>

Anderson also introduced another change in Eighth Air Force policy. It began to take effect at the same time as the introduction of H2S - a large increase in use of incendiary bombs. Anderson

had begun to encourage greater use of firebombs, in July 1943.<sup>20</sup> The September 27 Emden mission was the first of the Eighth's mission to load more than 20% incendiaries, while the October 2 mission against Emden was the Eighth's first strike to deliver more than 100 tons of fire bombs on a single target. Henceforth, the Eighth would not only conduct intentional area bombing, it would do so using area bombing techniques.

After the Second Battle of Schweinfurt bombing policy changed. On the next mission, October 18, the Eighth instructed its bombers to hit as their primary 'Duren, Center of City,' and as their secondary 'Any German city which may be bombed using visual methods without disrupting fighter support.'<sup>21</sup> On October 30 the Eighth amended the bombing instructions for secondary targets to, 'Any German city which may be bombed without disrupting the Fighter Support.'<sup>22</sup> On November 30, 1943 the formulation became 'Any industrial city positively identified in Germany.' The term 'industrial' tended to be a distinction without difference as almost any city in Germany qualified as such. By the end of Lt. General Ira C. Eaker's tenure with the Eighth, the formulation for secondary city targets had reverted to 'Any city positively identified as being in Germany which can be attacked without disrupting fighter support.'<sup>23</sup> The exact wording of the field orders may have changed from mission to mission, but the Eighth's intent to authorize area bombing in a broad range of circumstances remained constant.

Upon their arrival in January 1944, Spaatz, now in overall charge of US Strategic Bombardment operations, and James H. Doolittle, new commander of the Eighth, continued area bombing. On January 29, 1944 the Eighth dispatched 763 effective bomber sorties to Frankfurt-am-Main, with their primary target the city's marshalling yard. As a secondary or last resort target the field order authorized, 'Any city or industrial area positively identified as being in Germany & which can be attacked without disrupting fighter support.'<sup>24</sup> The

next day 701 bombers attacked, Brunswick, weather prevented attack on their primary. Instead they dropped 1,681 tons on their secondary target, 'Brunswick, City.'

Their last resort target instructions reflected the Eighth's drive, in the winter and spring of 1944, to destroy the Luftwaffe, 'Any airdrome in enemy territory or any city or any industrial area positively identified as being German and which can be attacked without disrupting fighter support.'<sup>25</sup> The orders to the Eighth's fighters echoed those to

attacked in occupied territory. When these targets are so obscured that normal bombing accuracy cannot be expected, the bombs will not be released.

Doolittle added, 'Specific admonition that grave consequences will ensue for errors in identification will be repeated and emphasized in the pre-mission briefing of all combat crews.'<sup>27</sup>

On the last day of March, when Doolittle informed Spaatz's Headquarters of his operations plans for

*We will conduct bombing attacks through the overcast where it is impossible to get precision targets. Such attacks will include German marshalling yards whether or not they are located in German cities. This memo had a chilling effect on reported area bombing*

the bombers. On February 9, 1944, Kepner informed his pilots that, 'any target of opportunity within the boundaries of Germany can be attacked.'<sup>26</sup>

On March 7, Doolittle clarified the Eighth's bombing policy by issuing a new set of SOPs. The document bore the singularly unfortunate designation, 'Indiscriminate Bombing.' Doolittle established the following three bombing zones:

**a. Unrestricted Areas.** Any military targets in Germany proper more than 50 miles from occupied territory may be attacked under any conditions provided the mission instructions of the Field Order are followed.

**b. Restricted Areas.** Military targets in Germany proper that are in a zone less than fifty miles from occupied territory may be attacked if they can be positively identified, bombed visually, and attacked without any risk of bombs falling in occupied territory.

**c. Occupied Territory.** Only those targets listed in the Field Order for the particular operation may be

the first half of April, he further stated his policy for use of his force in overcast conditions. His policy explicitly established the link between city area bombing and H2X stating:

When overcast bombing technique must be employed, attacks will be directed against:

- a. Munich
- b. Berlin
- c. Other large German cities.<sup>28</sup>

By July 1944 USSTAF intelligence had compiled a list of cities and towns for H2X attacks. The list consisted of 100 targets (53 cities judged 'suitable' and 47 cities judged as 'poorer targets').<sup>29</sup> In that month the Eighth reached its wartime high for authorized area bombing 10,000 tons.

This did not go unnoticed at USSTAF, HQ. On July 21, a date on which six separate groups of the Eighth's bombers attacked cities visually as targets of opportunity, Anderson issued a new policy memo. He pointed to Spaatz's oft reiterated and continuing intention to direct bombing toward precision targets and categorically denied any

### *The new policy defined a military objective as one which 'materially' aided the enemy*

intention to area-bomb. But having denied the intention, he proceeded to authorize the practice: 'we will conduct bombing attacks through the overcast where it is impossible to get precision targets. Such attacks will include German marshalling yards whether or not they are located in German cities.'<sup>30</sup>

This memo had a chilling effect on reported area bombing. Three-quarters of such raids reported appeared in the Eighth's records before this memo. However, an analysis using the profile of known command city raids; always over 100 aircraft, almost always carrying over 20% incendiaries, and bombing by radar over 80% of the time, and applying it to all Eighth Air Force raids, surfaces 82 more 'area like' raids.<sup>31</sup> Seventy, or 85%, of those raids occurred after Anderson's memo. In August the Eighth's area bombing of Germany dropped to a mere 401 tons. For the first three weeks in September American area bombing followed the same pattern. But by the last week of September the Germans achieved a stalemate on the Western Front. The Eighth returned to area attacks with a total of 4,700 tons on Frankfurt, Cologne, Magdeburg, and Munster.

In October 1944 the Eighth's area bombing increased as bad weather forced attacks on secondary targets. At the end of the month the Eighth Air Force issued a new SOP, 'Attack of Secondary and Last Resort Targets.' It increased the likelihood of area bombing by setting the following criteria:

1. No towns or cities in Germany will be attacked as secondary or last resort targets, targets of opportunity, or otherwise, unless such towns contain or have immediately adjacent to them, one (1) or more military objectives. Military objectives include railway lines; junctions; marshalling yards; railway or road bridges, or other communications networks; any industrial plant; and such obvious military objectives as oil storage tanks, military camps and barracks, troop concentrations, motor transport or AFV parks, ordnance or supply depots, ammunition depots; airfields; etc.

2. Combat crews will be briefed before each mission to insure that no targets other than military objectives in Germany are attacked.

3. It has been determined that towns and cities large enough to produce an identifiable return on the H2X scope generally contain a large proportion of the military objectives listed above. These centers, therefore, may be attacked as secondary or last resort targets through the overcast bombing technique.<sup>32</sup>

Almost every city or town in Germany with a population exceeding 50,000, and a few below that figure, met the foregoing criteria. This policy made it open season for bombing Germany's major cities in any weather. If the AAF had not abandoned its precision techniques for area and terror bombing in this memo, it came perilously close.

At the end of February 1945 USSTAF prepared a comprehensive bombardment policy; THUNDERCLAP, Dresden, and CLARION, all heavily influenced its formulation. The American public's negative reaction to Dresden and the flap it created in AAF headquarters, led to a spate of telegrams back and forth between Washington and London, with Giles and Arnold demanding details of USSTAF's policies and Anderson explaining them. Spaatz was in the Mediterranean for meetings with Eaker.<sup>33</sup> By February 21, in preparation for CLARION, USSTAF issued a policy for the bombing of Czechoslovakia. The Sudetenland, annexed by Germany in 1938 and part of Greater Germany would be treated as German territory. In the provinces of Bohemia, Moravia, and Slovakia air forces would select visual targets 'with due regard to risk to civilian population,' and limit PFF attacks, 'to targets whose military importance clearly outweighs hazards to population.'<sup>34</sup>

On March 1 USSTAF promulgated the new American bombing policy that rescinded any subordinate air force's policies. USSTAF placed Germany, Austria, the Sudetenland, and Hungary, whose territory unoccupied by the Soviets was

controlled by a Fascist regime in a formal state of war with the Allies, into one category and authorized their attack under the following conditions:

**a. By visual sighting method**

- (1) Military objectives will be assigned for attack so as to best fulfill the objectives outlined in current directives as amplified by priority target lists.
- (2) Military objectives may be attacked as targets of opportunity if attack on the assigned targets proves to be impracticable.

**b. By instrument bombing method**

- (1) Military objectives will be assigned for attack so as to best fulfill the objectives outlined in current directives as amplified by priority target lists.
- (2) If attack of the assigned targets is not practicable, military objectives may be attacked as targets of opportunity by instrument bombing technique. These attacks will be made against military objectives outlined under the current bombing directive.

Missions against occupied countries would operate under more restrictive conditions.

**a. By visual bombing method**

- (1) Military objectives will be assigned for attack so as to best fulfill the objectives outlined in current directives as amplified by priority target lists.
- (2) The attack of targets of opportunity is prohibited and crews will be briefed to insure that no such attacks are made.

**b. By instrument bombing method**

- (1) Military objectives will be assigned for attack when their military importance is so great that the risk of causing civilian casualties by bombing with normal accuracy is warranted.
- (2) The attack of targets of opportunity is prohibited and crews will be briefed to insure that no such attacks are made.<sup>35</sup>

This policy, for all its draconian tone, in actuality established less expansive bombing guidelines

than its predecessors. It explicitly recognized the inaccuracy of radar attacks, limiting their application to occupied countries, but not to Greater Germany. The new policy defined a military objective as one which 'materially' aided the enemy: a judgment call, perhaps, but one whose implication was clear – control indiscriminate bombing practices.

The rapidly changing situations of the final months of the war in Europe meant that modifications of the bombardment policy came quickly. The bombings of Switzerland, on March 4, led to a prohibition, on March 6, of attacks on targets of opportunity within 50 miles of a neutral country.<sup>36</sup> On March 29, Eisenhower sharply limited air attacks on Denmark and occupied Holland for humanitarian reasons - only road and rail traffic definitely identified as military should be attacked and only road and rail centers directly connected to the ground battle should be struck. Attacks on V-2 sites near residential areas would require specific SHAEF approval.<sup>37</sup>

On April 2, Spaatz forbade attacks within 25 miles of Berlin.<sup>38</sup> Spaatz went further the next day, ordering that henceforth all targets would be cleared through USSTAF.<sup>39</sup> The actual effect of these moves on bombardment policy and on operations was minimal. In March the Eighth reached its all-time highs for tonnage dropped and sorties flown. It conducted 4 command area bombings in March and two in April. The old ways die hard and the air crews may well have continued past practice until almost the end of the war.

In summation, analysis of the US Eighth Air Force's bombardment policy reveals a set of procedures that strictly differentiated between the nationality of targets and accommodated the operating techniques of the force. In so far as limitations of equipment and considerations of personal safety allowed, American policy encouraged aircrews to do their best to avoid inflicting harm on friendly civilians. As for Greater Germany, the Eighth, offered no quarter. It cannot be overemphasized that this was in keeping with the overwhelming wartime anti-German sentiment of the Allied governments and their civilian



populations. To use the terminology of a later era – the Eighth made the Reich a ‘free-fire’ zone.

#### Notes:

<sup>1</sup>-Air Service Tactical School, Langley Field, Virginia, BOMBARDMENT (Washington, DC: GPO, 1926), pp. 63-64; USAF History Support Office (AFHSO), Bolling AFB, DC, microfilm collection, reel A2686, frames 502-503.

<sup>2</sup>-For example the Eighth's raid of September 5, 1942, on the Rouen-Sotteville marshalling yard purportedly killed 140 and wounded 200 French civilians, while at the same time landing a dud bomb on the city hospital, and the October 9, 1942, raid on Lille killed 40 and wounded 90 civilians. See, Craven and Cate, *Torch to Pointblank*, pp. 218, and 220-221.

<sup>3</sup>-Memo, HQ Eighth Air Force, Col. George C. McDonald, Chief of Intelligence, to AVM Charles Medhurst, Spaatz Papers, Subject File, 1928-1945.

<sup>4</sup>-Memo, CG, Eighth Air Force, to CG, VIII Bomber Command, VIII, Fighter Command, etc., November 6, 1942, subject: 'Bombardment Policy,' Spaatz Papers, Subject File, 1928-1945.

<sup>5</sup>-Air Ministry, C.S.15803/A.S.P.1., Letter to all AOCs, 'Bombardment Policy,' signed AVM J.C. Slessor, A.C.A.S. (Policy), October 29, 1942, enclosure to Ltr M.P./6496/D.B.Ops, Air Commodore Bufton to Spaatz, subj: [USSTAF] Bombardment Policy in Regard to Enemy Occupied Territories,' January 22, 1945: AF/HSO microfilm reel A5616, frs. 16 and 17. Bufton states that the Slessor letter has remained in force up until the date of his letter. There is no reason to suppose it was withdrawn before the end of hostilities.

<sup>6</sup>-Ltr, Eden to Sinclair (Secretary of State for Air), April 25, 1943, PRO AIR 19/218. This letter refers to complaints from the French, Belgians, and Dutch and indicates that at a War Cabinet meeting on April 19 the Cabinet asked Portal to approach the Americans.

<sup>7</sup>-Msg 9013, 23 April 1943, Andrews to Marshall, cited in Msg J.S.M. 909, 28 April 1943, Joint Staff Mission, Washington, to Chiefs of Staff (COS), London, PRO AIR 19/218.

<sup>8</sup>-Msg OZ 1349, Air Ministry to Britman, 12 May 1943, PRO AIR 19/218.

<sup>9</sup>-Msg. AX837, Air Ministry to CG Eighth Air Force and AOCs Bomber and Fighter Commands, June 22, 1943 cleared French targets, Msgs. AX751 (June 15, 1943) and AX 166 (June 25, 1943), Air Ministry to same addressees cleared the Dutch and Belgian targets; AF/HSO microfilm reel A5885, frs. 622, 623, and 632.

<sup>10</sup>-Memorandum, Brigadier General C.C. Chauncey, Chief of Staff Eighth Air Force, to CG, VIII Bomber Command and CG VIII Fighter Command, Subject: Bombardment Directive, June 27, 1943; AF/HSO microfilm reel A5885, fr. 615.

<sup>11</sup>-Memorandum, Col George W. Jones, Jr., Eighth Air Force A-2 Operational intelligence Unit, to Col William N. Cleveland, Eighth Air Force Executive, A-3 Section, Subject: Restrictions on

Bombing in Enemy Occupied Countries in Northwest Europe, January 27, 1944; AF/HSO microfilm reel A5885, fr. 870.

<sup>12</sup>-S.46368/IV/A.C.A.S.(Ops.), AVM W.A. Coryton to CG, USAAFUK, and AOC's Bomber Command and AEF, Subject: Attacks on electrical installations in Occupied Countries in N.W. Europe, November 26, 1943; AF/HSO microfilm reel A5885, fr. 687.

<sup>13</sup>-S.3119/A.C.A.S.(Ops.), AVM W.A. Coryton to AOC Allied Expeditionary Air Force (copies to CG, USAAFUK, and AOC Bomber Command), Subject ADGB and Tactical Air Force Offensive Operations, November 26, 1943.

<sup>14</sup>-Memorandum, Brigadier General C.C. Chauncey, Chief of Staff Eighth Air Force, to CG, VIII Bomber Command and CG VIII Fighter Command, Subject: Bombardment Directive, June 27, 1943; AF/HSO microfilm reel A5885, fr. 615.

<sup>15</sup>-Ltr V.C.A.S., Sir Douglas C.S. Evill, to Maj. General Ira C. Eaker, CG, Eighth Air Force, 10 May 1943, PRO AIR 19/218.

<sup>16</sup>-Charles W. McArthur, *Operations Analysis in the U.S. Army Eighth Air Force, Vol 4: History of Mathematics* (Providence, RI: American Mathematical Society, 1990), p. 69.

<sup>17</sup>-My assessment of the overall accuracy of H2S/H2X aided bombing is based on perusal of many Eighth Air Force's Operations Analysis Section Reports on bomb accuracy and on the many after action reports filed in the Eighth's mission folders. Others have taken a more positive view of the American's radar bombing accuracy, which has led to deny, I believe incorrectly, the extent of actual American city area bombing. For the most cogent and well-reasoned expression of this more optimistic view see, Conrad C. Crane, *Bombs, Cities, & Civilians: American Airpower Strategy in World War II* (Lawrence, KS: University of Kansas Press, 1993.)

<sup>18</sup>-Planner's Data Sheet, Mission 114, AF/HSO reel A5873, fr. 460.

<sup>19</sup>-HQ, Eighth Air Force, Office of the Commanding General, Memo, 1st Lt. E.D. Whitley, to Lt. Col. Agan, Subject: Visit to 3rd Bomb Division Critique of Bremen, Marienburg-Gydnia and Munster Missions, held 11 October 1943,' n.d. [c.a. October 12, 1943], HSO microfilm, reel A5883, fr. 1944.

<sup>20</sup>-McArthur, *Operations Analysis in the Eighth Air Force*, p. 65. For examples of Anderson's interest in incendiaries see his receipt of a special U.S. National Defense Research Committee report on European industrial plants as incendiary targets [Memo, Lt. Col George W. Jones, Jr., VIII B.C., Operational Intelligence, to Brig. Gen. Frederick L. Anderson, CG VIII B.C., July 17, 1943, HSO Microfilm, reel A5500, fr. 1058] and his circular to the Eighth's heavy bomber wing commanders on the usefulness of incendiary attacks [Memo, C.G. VIII B.C. to C.G.'s 1st, 2nd, and 4th Bombardment Wings, subject: Effectiveness of Incendiaries, September 9, 1943, HSO Microfilm, reel B5549, fr. 1492.]

<sup>21</sup>-Planner's Data Sheet, Mission 116, AF/HSO microfilm, reel A5873.

<sup>22</sup>-Planner's Data Sheet, Mission 119 A [Aborted], AF/HSO reel A5873, fr. 457.

23.Planners' Data Sheet, Mission No. 156, AF/HSO microfilm reel A5873, fr. 438.

24.Planners' Data Sheet, Mission 198, AF/HSO microfilm reel A5873, fr. 418.

25.Planners' Data Sheet, Mission 200, AF/HSO microfilm reel A5873, fr. 417.

26.Msg, 8FC F67AE, CG, VIII Fighter Command to CO's 65, 67, and 70 Fighter Wings, February 9, 1944; AF/HSO microfilm reel A5885, fr. 812.

27.Memo 55-2, HQ Eighth Air Force, SOPs, Operations; 'Indiscriminate Bombing,' March 7, 1944, AF/HSO microfilm reel A5616, fr. 119.

28.Memorandum, Doolittle to Spaatz (attn: Anderson), Subject: 'Tentative Operations Plans, Eighth Air Force,' March 31, 1944, HSO microfilm reel A5885, fr. 1063.

29.Memo to General McDonald [USSTAF Director of Intelligence], from Dr. David Griggs, Advisor Special Group [Radar], July 5, 1944, Spaatz Papers, Subject File 1929-1945, Targets.

30.Memo, Anderson to Director of Operations, July 21, 1944, Spaatz Papers, Subject File 1929-1945.

31.This consists of all Eighth Air Force Raids of over 100 heavy bombers, sighting with H2X, and carrying over 20% fire bombs.

32.Memo 55-24, Headquarters Eighth Air Force, Office of the Commanding General, Standard Operating Procedures: Operations, subject: Attack of Secondary and Last Resort Targets, October 29, 1944, Air Force Historical Research Agency, Maxwell AFB, Ala., File no. 519.5991-1.

33.See Davis, Spaatz, pp. 558-562 for a more detailed examination of the trans-Atlantic exchange.

34.Msg UAX 64650, USSTAF to Fifteenth Air Force, February 21, 1945, AF/HSO microfilm reel A5616, fr. 81.

35.HQ, USSTAF, Office of the Deputy Commander, Operations, Bombardment Policy, March 1, 1945; AF/HSO microfilm reel A5616, frs. 95-97.

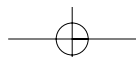
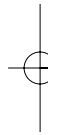
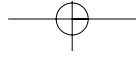
36.Msg UAX 65405 USSTAF to MAAF, March 6 1945, AF/HSO microfilm reel, A5616, fr. 109.

37.Msg A 277, Air Staff SHEAF Forward to USSTAF, March 29, 1945, AF/HSO microfilm reel A5616, fr. 140.

38.Msg, UAX 66845 USSTAF to Eighth Air Force, April 2, 1945; AF/HSO microfilm reel A5616, fr. 144.

39.Msg UA 66900, USSTAF to et. al., April 3, 1945, AF/HSO microfilm reel A5616, fr. 145.











# *The USAF Heavy Bomber Fleet- Flexible Platform, Flexible Future*

By Thomas Withington

**P**rimarily relics from the Cold War, the United States Air Force (USAF) heavy bomber fleet of B-52H 'Stratofortress', B-1B 'Lancer' and B-2A 'Spirit' heavy, long-range bombers have proved indispensable to US military operations since the end of the Cold War. This paper will consider the key attributes of these aircraft and examine why they been so important in recent military operations, then discuss some of the future options being mooted for the USAF heavy bomber fleet as the aircraft reach obsolescence.

#### **The key attributes of the heavy, long-range bomber**

The USAF's present fleet of heavy, long-range bombers such as the massive B-52 Stratofortress were designed primarily to carry large, thermonuclear gravity bombs over an unrefuelled range of 8,800 miles (14,162 km) to targets deep in the Soviet Union. Later configurations of the aircraft such as the B-52G and B-52H retained this capability, but could also carry either nuclear AGM-69 Short-Range Attack Missiles (SRAMs), AGM-28B 'Hound Dog' missiles or AGM-86B air-launched cruise missiles.



*The B-1B has low-observable characteristics, and a radar signature one percent of that of a B-52. This gives it greatly enhanced protection against radar, compared to the much more visible B-52*

**B-1B Lancer**

In addition, the aircraft was able to carry a significant load of conventional 'dumb' weapons. B-52s have since been configured to carry conventional precision weapons such as the Joint Direct Attack Munition (JDAM), the Wind-Corrected Munitions Dispenser (WCMD), the AGM-84 Harpoon Anti-Shipping Missile (AShM), the AGM-142 'Have Nap' glide bomb; the AGM-86C Conventional Air-launched Cruise Missile (CALCM), and the AGM-154A Joint Stand-Off Weapon (JSOW).

The JSOW will be carried by all three USAF heavy bombers. This contains 145 BLU-97A/B submunitions and is primarily designed to hit soft targets such as trucks, armoured personnel carriers,

parked aircraft and surface-to-air missile (SAM) installations. The missile can also carry BLU-108 sensor fused anti-armour submunitions allowing the B-52 to hit tanks and infantry fighting vehicles as well as SAM sites and mobile 'Scud'-style ballistic missiles.

This has allowed an aircraft, designed as a strategic Cold War nuclear bomber, to retain a 'tactical' ability to devastate frontline forces. In 2001, the aircraft was certified to carry the AGM-86D. This weapon, a variant of the AGM-86C, is designed to hit hardened and deeply buried targets; it also retains a standoff range of 600 miles (966 km). The importance of a 'bunker-busting' capability was

B-2 Spirit



*Once in-flight refuelling is factored into the aircrafts' range, their ability to fly from the Continental United States (CONUS) and then to return without requiring a forward base allows them to strike almost anywhere*

illustrated when underground Al-Qaeda complexes were attacked during Operation 'Enduring Freedom' in Afghanistan.

The B-1B Lancer, which entered service in 1986, had an equally large payload, which was able to carry nuclear weapons such as SRAM and Hound Dog as well as B-28, B-43, B-61 and B-83 gravity bombs. Following the end of the Cold War, the B-1B fleet began the Conventional Munitions Upgrade Program (CMUP), with the first part of the programme being completed in 1997. This was designed to re-orientate the aircraft away from its nuclear mission into more conventional roles.

The aircraft was removed from nuclear Single Integrated Operational Plan (SIOP) on 1 October 1997, following the second Strategic Arms Reduction Treaty (START-II) signed between Russia and the United States in January 1993. Following their removal from the SIOP, the B-1B

was first configured to deploy CBU-87/89/97 cluster bombs (CBUs) and their accompanying Wind-Corrected Munitions Dispenser (WCMD). The aircraft can also act as a standoff missile platform, deploying JSOW. It retains low-observable characteristics, and a radar signature one percent of that of a B-52. This gives it greatly enhanced protection against radar, compared to the much more visible B-52.

The trend towards low-observability and a high payload continued with the B-2A Spirit. Incorporating revolutionary stealth technology, this aircraft was designed to hit mobile Soviet intercontinental ballistic missile launchers such as the RT-2PM/SS-25 (NATO codename 'Sickle') with nuclear weapons such as the B-61 and B-83 bombs; AGM-129 Advanced Cruise Missiles and AGM-131 SRAM-II. The aircraft entered service as the Cold War was coming to an end.

Notwithstanding the speed or stealth characteristics of the B-1B and B-2A, all three heavy bombers in current USAF service share one major characteristic, which is the ability to carry a large payload in a single platform, giving much more 'bang for the buck' compared with several smaller aircraft carrying a similar quantity of ordnance. Moreover, their capacious bomb bays, combined with underwing hardpoints, allows for an impressively varied range of ordnance.

As noted by Air Vice-Marshal Tony Mason, the bomber's range combined with its impressive and varied payload allows the aircraft to perform several varied missions from the outset of a conflict. For example: 'they can neutralise theatre air defences in preparation for the arrival of a follow-up task force. Such tasks will be within the capacity of the B-2, threatening distant political, industrial or military installations or hostile forces close to a frontier. That versatility confers a wide range of responsive options on the government.'<sup>4</sup>

*The US attack on Libya in 1986, ELDORADO CANYON, required over 100 combat and support aircraft. The tasks could have been carried out by six B-2s and six tankers*

For example, the conventional Cold War munitions listed above have since been either combined or replaced with newer weapons such as the JSOW, EGBU-28 glide bomb units and the GBU-30/32 JDAMs. All three aircraft will also carry the AGM-158 Joint Air-to-Surface Standoff Missile (JASSM). This air-launched cruise missile will equip the heavy bomber fleet by mid-2003.<sup>2</sup> An extended range variant will also be available. This will augment the standoff capabilities of the bomber fleet with a range of 575 miles (925 km), further reducing the risks to aircrew from anti-aircraft artillery and missiles by eliminating the need to enter hostile airspace.

All three aircraft in the US arsenal have an impressive range. Unrefuelled, the B-52H can travel 8,800 miles (14,162 km); the B-1B has a range of 3,444 miles (5,542 km) with a normal weapons load; and a 'high intercontinental' range is stipulated for the B-2A. Once in-flight refuelling is factored into the aircrafts' range, their ability to fly from the Continental United States (CONUS) and then to return without requiring a forward base allows them to strike almost anywhere.<sup>3</sup> This was seen with the B-2A strikes in Kosovo and Afghanistan. The range allows the US bomber fleet to strike an enemy suddenly at the outset of a rapidly emerging crisis.

The low level of US casualties in military operations following the end of the Cold War gives a 'value added' attraction to the heavy bomber fleet. Western populations now expect military campaigns involving their armed forces to feature very low casualty figures. Since Vietnam, only two USAF heavy bombers have been lost during hostilities. The first aircraft, a B-52G, crashed on 7<sup>th</sup> February 1991 in the Indian Ocean with the deaths of three aircrew.<sup>5</sup> The second, a B-1B, was also lost in the Indian Ocean on 12 December 2002; however all of the aircrew survived. On both occasions, neither aircraft was lost through hostile action. Crewing levels of five for the B-52H; four for the B-1B and two for the B-2A mean that comparatively fewer US personnel are placed at risk compared to several smaller aircraft carrying a similar payload.

According to Tony Mason, the USAF heavy bomber fleet is a highly economical weapons platform: 'The expansion of the original nuclear weapon deliverer to a multi-role offensive weapons platform over such an extended life cycle makes the (B-52) one of the most cost-effective twentieth century military systems.'<sup>6</sup> Mason argues that this cost-effectiveness extends to the B-2A.





Boeing B-52H

*The US Nuclear Posture Review, which was submitted before Congress on 31 December 2001, stipulated that 97 nuclear-armed bombers should be retained by the USAF*

Although the most expensive combat aircraft yet to enter service, costing on average \$2.1 billion (£1.3 billion) per plane, the use of a stealthy B-2A compared to a large force of non-stealth aircraft requiring fighter escorts, Suppression-of-Enemy-Air-Defence (SEAD) platforms and accompanying Electronic Counter Measures (ECM) planes saves money and aircrew: 'The US attack on Libya in 1986, ELDORADO CANYON, required over 100 combat and support aircraft. The tasks could have been carried out by six B-2s and six tankers.'<sup>7</sup>

However, despite its cost-effectiveness, the B-2A has still not totally replaced the large strike packages more routinely used during air strikes. For example, an attack on a military facility in western Iraq during 2002 saw almost 100 combat aircraft

participating.<sup>8</sup> This was also the case during Operation Desert Storm, when strike missions involving F/A-18 Hornets could sometimes include 30 or more aircraft.

However, during both of these attacks, the USAF already had a significant number of combat aircraft close to the theatre of operations.<sup>9</sup> Secondly, whilst operational specifics are sketchy regarding the deployment of the B-2A in recent operations, rumours have circulated that the B-2A still flies on combat missions with an impressive array of escorting aircraft, notwithstanding tankers. The high cost of the aircraft, coupled with its ultra-secret technology may mean that the USAF is reluctant to put such an aircraft at additional risk by flying it into theatre without an escort.

The nuclear role of the USAF bomber fleet has not been neglected in the post-Cold War world. However, as with conventional munitions, the trend for the heavy-bomber's nuclear ordnance has been to miniaturise weaponry and give it a more focused effect.

For instance, the B-2A has been cleared to deliver the B61-11 nuclear gravity bomb. This is a modification of the B61-7 nuclear bomb, which was originally designed for low-level retarded parachute delivery. For the B61-11 modification, the parachute assembly was removed and replaced with an aerodynamic fin. A reinforced steel nose was also added. The yield of the weapon is unknown.<sup>10</sup>

Plans are afoot to develop a new, bunker-busting nuclear device. It is thought that the B61-II is the only earth-penetrating nuclear weapon in the USAF arsenal. In March 2001, the Defense Authorization Bill earmarked funds for the US Department of Energy to develop a new bunker-busting nuclear weapon in response to concern about Weapons of Mass Destruction (WMD) being stored in deep underground facilities rendering them invulnerable to existing conventional or nuclear munitions.<sup>11</sup> The existing warhead design for the B-61 and B-83 weapons may be under consideration, and that this maybe fitted into a 5,000-lb (2,268-kg) ground-penetrating body.

The study is to be undertaken by the Los Alamos, Sandia and Lawrence Livermore National Laboratories in New Mexico and California. The study phase will produce several prototypes, one of which be chosen for deployment.<sup>12</sup> In terms of numbers deployed. The US Nuclear Posture Review, which was submitted before Congress on 31 December 2001, stipulated that 97 nuclear-armed bombers should be retained by the USAF. This is to include 76 B-52H and 21 B-2 aircraft.<sup>13</sup>

The USAF heavy bomber fleet has brought the attributes of payload, flexibility, range and casualty reduction to recent conflicts involving the US armed forces. The force has demonstrated itself to be an essential platform for the post-Cold-War era. Most importantly, the introduction of hi-tech

precision weapons into the fleet has 'merged precision, stealth, and stand-off with the payload, range and responsiveness of the bomber arsenal.

Bombers are now a critical element of a joint conventional aerospace team with unique capabilities to fulfil Commander-in-Chief requirements across the full spectrum of conflict.<sup>14</sup>

#### Post-Cold War military operations involving the USAF heavy bomber fleet

Operation Desert Storm was initiated on 17<sup>th</sup> January 1991 in response to the Iraqi invasion of Kuwait during August 1990. The air component of the campaign was designed to:

- Attack 'centres of gravity' in Iraq, such as political leadership and military command sites, communications facilities, weapons of mass destruction infrastructure, power stations and industrial facilities
- Suppress enemy air defences
- Prepare the battlefield. Destroy armour, artillery, troop concentrations and ammunition/fuel dumps in the Kuwaiti Theatre of Operations
- Support the ground war to liberate Kuwait

While the B-1B and the B-2A aircraft did not participate in the air campaign, the B-52G played two important roles. Firstly, seven aircraft were charged with launching cruise missiles at military communications and power generation/transmission facilities during 'Operation Secret Squirrel' at the beginning of the conflict on 16 January 1991.

Secondly, once the preparation of the battlefield had got underway, B-52s were tasked with dropping M-117, Mk. 82 and Mk. 84 bombs to devastate Iraqi positions before the Allied ground offensive to liberate Kuwait began. Flying from King Abdul Aziz Airport in Jeddah, Saudi Arabia; Moron, Spain and Fairford, England, they attacked airfields, factories, oil refineries, ammunition dumps and railheads. Throughout the conflict, B-52s dropped 25,700 tons of bombs – 29 percent of the total ordnance delivered during the war.<sup>15</sup>

The effect of the area bombing by the B-52G aircraft not only degraded the Tawakalna, Hammurabi and Al-Madinah Republican Guard

## *The ordnance would arrive without warning; terrorising those who witnessed the attacks*

divisions; it also had a powerful psychological effect. The B-52 attacks badly demoralised Iraqi soldiers who were suffering round-the-clock bombardment prior to the start of the ground war. The attacks were conducted using a three-aircraft formation, which would undertake a co-ordinated strike dropping 153 bombs. The result on the ground would be a 1.5 square mile swathe of destruction. As the bombs were released from high altitude, the Iraqi troops would often not hear or see the bombers as they approached.

The ordnance would arrive without warning; terrorising those who witnessed the attacks. Whilst it is impossible to analyse all of the factors which influenced so many Iraqi troops to surrender prior to the start of the ground war on the 24<sup>th</sup> February, the B-52 attacks undoubtedly had a major effect.<sup>16</sup> The actions of the B-52G aircraft in undertaking both missile and bombing missions illustrated the all-important flexibility of the aircraft. Secondly, as one study commented, the use of the B-52 also demonstrated its considerable cost-effectiveness. Their impressive contribution to the air offensive: 'was reached with little cost in terms of men and aircraft.'<sup>17</sup>

On 24 March 1999, NATO began airstrikes against the Serbian political and military targets following Belgrade's refusal to halt attacks against ethnic Albanians in Kosovo. The B-52 would participate in the conflict as a missile carrier, firing CALCMs against targets in Serbia.<sup>18</sup> It was joined in the conflict by the B-1B and the B-2A. The B-1B had made its combat debut less than four months before, when it participated in Operation Desert Strike against Saddam Hussein's regime for the former's refusal to co-operate with United Nations weapons inspectors.

During the conflict in Kosovo, it assumed a different role, striking Serbian military targets with CBU-87, CBU-89 and CBU-97 cluster munitions to destroy tanks, artillery pieces and ground forces.<sup>19</sup> The B-2A also played an important role during the conflict. On 24 March, the opening night of the air offensive, two B2-As dropped 32 2,000-lb (907-kg) JDAMs against Serbian military sites protected by heavy air defences.<sup>20</sup>

Some experts had claimed that Operation Desert Storm and Operation Allied Force represented the last missions for the USAF's heavy bombers.

David Wragg commented 'One feature that the Gulf War and the Kosovo crisis had in common was what effectively amounted to the final operation of the traditional bomber, with a large aircraft carrying substantial munitions in a bomb bay ... Increasingly, bombing raids became the preserve of the interdicator or strike aircraft, carrying their warload on underwing and under-fuselage strong-point, as with the Panavia Tornados of the RAF, with increasing use as 'bombers' of fighter, strike and ground attack aircraft, including the British Aerospace Harrier GR7, Lockheed F-16 Falcon and Boeing (formerly McDonnell Douglas) F/A-18 Hornet.'<sup>21</sup> However, Wragg could not have foreseen Operation Enduring Freedom over Afghanistan, which, as Operation Allied Force, saw all three USAF heavy bombers being deployed.

Operation Enduring Freedom began on 7<sup>th</sup> October 2001, against Al-Qaeda and Taliban targets in Afghanistan, in retaliation for the former's attacks on the United States on 11<sup>th</sup> September 2001, and the latter's harbouring of the terrorist organisation. Once again, the venerable B-52 illustrated its considerable flexibility. As in Operation Desert Storm, the aircraft dropped unguided gravity bombs against Taliban troop concentrations, enabling the Northern Alliance to break out from their Panjshir Valley redoubt in North Eastern Afghanistan.

Interestingly, the aircraft demonstrated additional flexibility, by operating closely with Special Forces on the ground that fed targeting co-ordinates to the bombers. This enabled the aircraft to act as de facto tactical support platforms, striking targets of opportunities as they emerged.<sup>22</sup> As well as dropping dumb ordnance such as Mk. 82 bombs in saturation attacks on Taliban frontlines, the aircraft also deployed precision-guided JDAMs.<sup>23</sup>

Whilst B-52s acted as proxy tactical air support platforms, B-1B and B-2A heavy bombers also struck targets. Both of these bombers were important in SEAD missions and destroying Taliban

Rockwell B-1B launching a JDAM (Joint Direct Attack Munition) bomb



*The B-1B and its JDAM payload was referred to as the 'weapon of choice' for the air campaign planners during hostilities. Particularly attractive was the aircraft's ability to carry 50 per cent more JDAMs than any other platform*

aircraft on the ground. They also played a vital role in degrading the Taliban's limited command and control structure and assisted the B-52s in destroying targets in the rear.<sup>24</sup>

Whilst the details regarding the participation of the USAF heavy bomber fleet in Operation Enduring Freedom are still sketchy, it is clear that their contribution in terms of payload, flexibility and range were vital to the operation. All three aircraft participated in the action, deploying both smart and dumb munitions. This enabled the aircraft to devastate troop concentrations as tactical platforms, as well as devastating other targets with more pinpoint bomb and missile attacks.<sup>25</sup>

During 'Operation Iraqi Freedom' against the regime of Saddam Hussein, commencing on 20<sup>th</sup> March 2003, all three heavy bombers in the US arsenal were in action. As with the previous campaigns in Afghanistan and Kosovo, the aircraft demonstrated their considerable flexibility. On 8<sup>th</sup> April, a B-1B struck a target in the Mansour area of western Baghdad where Saddam Hussein and his two sons Uday and Qusay were believed to have been meeting.

The aircraft had been loitering over Baghdad and destroyed the target 12 minutes after receiving the order to strike.<sup>26</sup> The B-1B and its JDAM payload was referred to as the 'weapon of choice' for the





*The 'shock and awe' attacks which the USAF executed from 21<sup>st</sup> March 2003, were trumpeted as the first-ever 'precision only' strikes by the force as B-52s armed with around 100 CALCMs attacked several targets in Baghdad*

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Precision attacks on Saddam Hussein's Republican Palace on the Tigris River

air campaign planners during hostilities. Particularly attractive was the aircraft's ability to carry 50 per cent more JDAMs than any other platform.<sup>27</sup> However, reports from Central Command in Qatar confirmed that on one occasion, all three heavy bombers were used in a single strike package to attack leadership and command and control targets in Baghdad.<sup>28</sup>

Much as they did during operations Desert Storm and Enduring Freedom, B-52s again attacked frontline troop concentrations. As well as dropping dumb bombs and JDAMs, the aircraft have deployed CBU-105 WCMDs. Inside each bomb are 10 submunitions. These contain an imaging radar, which homes in on large military vehicles, but also has an inbuilt recognition memory to avoid large civilian vehicles such as buses. They were used to breach the Republican Guard defences around Baghdad.

The munitions were also used against an Iraqi armoured column.<sup>29</sup> Furthermore, B-52s were used to hit rear areas of the Republican Guard divisions guarding the southern approaches to the Iraqi capital.<sup>30</sup> B-52s were also involved in the initial attacks of the campaign. The 'shock and awe' attacks which the USAF executed from 21<sup>st</sup> March 2003, were trumpeted as the first ever 'precision only' strikes by the force as B-52s armed with around 100 CALCMs attacked several targets in Baghdad.<sup>31</sup>

Interestingly, for the first time since it entered service, the B-2A was based beyond CONUS for the campaign. Special climate-controlled facilities are available to the USAF at their bases on Diego Garcia in the Indian Ocean, and RAF Fairford, UK, and two of the planes were thought to have been deployed to the former. The aircraft were primarily used to hit leadership and command and

## *The B-2A is literally worth its weight in gold! Northrop Grumman have estimated that it could cost US\$1 billion (\$636 million) to restart the production line for additional B-2s*

control targets. On 27<sup>th</sup> March, one aircraft dropped two bombs onto a communications tower in central Baghdad. The attack was part of the coalition strategy to: 'degrade the ability of the Saddam Hussein regime to control the actions of Iraq's military forces.'<sup>32</sup>

### **Future options for the USAF heavy, long-range bomber force**

The versatility of America's heavy bomber fleet as underlined by military operations since the end of the Cold War has led to a rethink of the heavy bomber's role in US defence planning. The combination of payload, flexibility, range, casualty limitation and cost-effectiveness has led strategists to consider how these important characteristics could be harnessed in future platforms. In 1999, the USAF released its 'White Paper on Long Range Bombers'. The study stressed the modernisation of the bomber fleet, and introduced new technologies and weaponry.

The paper stipulated that, for the short term, the USAF does not expect to procure any new bombers of either existing or new designs. Instead, the fleet will undergo successive upgrades. The near-term upgrade began in 2000 will conclude in 2010. This is intended to equip the existing fleet with the capability to delivery PGMs. Improvements will also be made to the aircraft's command, control, communications and intelligence (C4I) systems. This will consist of installing systems to enable one aircraft to transmit data to another, in addition to aircraft-to-command-and-control and aircraft-to-sensor connectivity through installation of Link 16 data links. Furthermore, the B-2A will be integrated with Extremely High Frequency (EHF) satellite links, whilst the B-52 will receive an improved ECM suite.<sup>33</sup>

The mid-term upgrade for the fleet will begin in 2006 and will conclude in 2015. This will see the B-1B outfitted with a new cockpit and will further improve the conventional capabilities installed on the aircraft during the CMUP. According to the document: 'This programme increases B-1

survivability by providing critical situational awareness displays needed for conventional operations, keeping pace with current and future guided munitions integration, enhancing situational awareness and improving tactical employment.' Other plans for the mid-term phase including fitting the B-52 with Link 16, and the replacement of the B-2A's analogue engine controllers with a digital equivalent. The B-52 will also receive a new databus in its bomb bay to improve its carriage of JDAM, JSOW and JASSM.<sup>34</sup>

The long-term upgrade project will run from 2015 and beyond. A number of options have been mooted. These include a radar upgrade for the B-1B. The B-2A may also receive new computers, processors and additional improvements designed to further reduce the radar signature of the B2A. The B-52 may receive an Enhanced Bomber Mission Management (EBMM) system, which would enable the aircraft to update and replan its mission whilst in-flight.<sup>35</sup>

One of the major pillars of the paper has been to stress the need to improve the flexibility of the bomber force in terms of munitions, which will increase the flexibility of the missions which the aircraft can undertake. When commenting on the White Paper, Under Secretary for Defence Acquisition Dr. Jacques Gansler commented that: 'These new capabilities will open a wide array of new bomber roles and missions that capitalise on the bomber's unique attributes and permit the bomber force to actively participate in tomorrow's full-spectrum battlespace.'<sup>36</sup>

One idea which has been mooted by the USAF is the 'Global Strike Task Force'. This would see B-2A and F-22 'Raptor' aircraft being integrated into a single force which would be able to provide a stealthy, round the clock precision-bombing capability. Playing to the bomber's key strengths of sudden attack, the Global Strike Task Force would be able to destroy critical targets at the beginning of hostilities and to achieve air superiority in the opening days of a conflict. The force will 'kick the

*when you see something you have to attack, you've got to do it immediately. A 16-hour bombing mission by a B-2 may be too late*

door down for the entry of follow-on forces.<sup>37</sup> One other option which has been mooted for the B-2A includes upgrading the aircraft to engage moving targets.

Paul Marchisotto, Joint Strike Fighter Program Manager at Northrop Grumman, speaking in 2002, commented that: 'We could wind up using the radar to define moving targets – like an armoured column and apply those precision munitions on those vehicles independently. Our current capability against those types of targets is to cut the road. We lay a carpet of weapons out there and we don't actually destroy the vehicles.'<sup>38</sup>

Despite the talk of the Global Strike Task Force, there are few plans to purchase additional B2As. Although the Department of Defense had originally planned to purchase 132 aircraft, the number of planes was capped at 21 in 1992, because of concerns over the aircraft's exorbitant cost. The B-2A is literally worth its weight in gold! Northrop Grumman have estimated that it could cost US\$1 billion (\$636 million) to restart the production line for additional B-2s.<sup>39</sup>

While deliberations continue as to whether additional B-2s will be purchased, the thoughts of the USAF are now turning to both aircraft and technologies, which could complement and replace the existing USAF long-range, heavy bomber fleet. It is expected that by the middle of 2003 a clear picture will emerge from the USAF as to what this will be, provided that the funding, the military requirement and the political will to embark on such a project are present.<sup>40</sup> Three factors are likely to affect what type of system the USAF opts for.

These include the remaining airframe life of the existing fleet; the proliferation of advanced surface-to-air missiles such as the Russian S-400/SA-20, and finally whether the money for what will undoubtedly be an expensive venture is available. It is thought that the USAF will go for one of three options: a new, manned aircraft, an Unmanned Combat Aerial Vehicle (UCAV), or a 'system of

systems' – a mix of UCAVs and conventional aircraft. According to one USAF official: 'We don't want to limit our horizons. It could involve a totally different type of platform or a totally different type of weapon.'<sup>41</sup>

Cost is a major issue regarding a replacement aircraft. Both the B-1B and the B-2A were hugely expensive programmes; add to this the USAF's modernisation of its fighter force with the F-22 Raptor and the F-35 Joint Strike Fighter. Money has also been paid out for the expensive C-17 Globemaster freighter. The air force's current shopping list is both extensive *and* expensive; the question remains as to whether it can accommodate a brand new bomber?

In addition to airframe life and the proliferation of surface-to-air threats and budgetary questions, tactical considerations may also affect what kind of platform is procured. Although the bomber brings unprecedented reach in air-to-ground operations, there is a perception that the present fleet may simply not be fast enough. According to James Roche, Secretary for the Air Force in the US Department of Defense (DoD): 'The attacks of 11 September brought home that we've got to have information, surveillance and reconnaissance systems ... It also told us that when you see something you have to attack, you've got to do it immediately. A 16-hour bombing mission by a B-2 may be too late.'<sup>42</sup>

One option being discussed is the construction of a hypersonic aircraft. The US Air Force Research Laboratory (AFRL) is investigating aircraft capable of travelling at speeds over Mach 5. One earlier incarnation of this was the X-30, although this experimental craft was cancelled in 1995. However, the Bush administration has revived interest in hypersonic travel, which may yield technologies which could be used on a future bomber.<sup>43</sup>

Another option could be to construct a slightly slower platform; one example of this is the 'Quiet

*Another manned bomber concept called 'HyperSoar' would undertake both reconnaissance and strike missions. It is an ambitious project which would see an aircraft of a similar size to the B-52 travelling at speeds of Mach 10 and carrying double the payload. It is thought that HyperSoar would use the earth's surface as a trampoline from which to bounce off in a similar way to a pebble bouncing off the surface of a pond*

Supersonic Platform', which would travel at speeds of Mach 2.4 whilst producing a low sonic boom. The AFRL has reportedly been working on a project with the Defence Advanced Research Projects Agency (DARPA). The AFRL has also been investigating a concept platform called the Supersonic Global Attack Demonstrator Concept. This will demonstrate the concept of developing either a crewed or uninhabited aircraft, which would have a supersonic cruise speed of around Mach 2. Its weapons load would be comparable to the B-2A's 40,000-lb (18,143-kg) warload.<sup>44</sup>

Research being undertaken by Northrop Grumman – the makers of the B-2A – chimes with this emphasis on speed. This is important, as the B-1B is the only USAF heavy bomber with a supersonic capability. A USAF-sponsored study called the 'Future Strike Aircraft' has commissioned Boeing, Lockheed Martin and Northrop Grumman to examine concepts for a new, crewed bomber.

Northrop Grumman is exploring the possibility of constructing an aircraft, which could operate in the supercruise and hypersonic range, with the aim of halving the time it takes for a B-2A to conduct a long-range mission, such as the return trips to Afghanistan during Operation Enduring Freedom. It is thought that Northrop Grumman is considering an aircraft similar to the B-2A, which will use a 'flying wing' design. Dubbed the 'B-3', this aircraft would travel at high subsonic speeds similar to the B2-A, but would have a larger payload.<sup>45</sup>

One option for a replacement aircraft could be to use 'off-the-shelf' components for its construction.

New technologies, such as those being utilised in the F-22 and F-35 designs, could be used to equip a new bomber and would help to reduce costs. This was recommended by the RAND Corporation in 1999. A study undertaken by the organisation stated that the aircraft should have a Mach 2 capability and an un-refuelled range of 4,091 miles (6,588 km). It was stipulated that the aircraft should weigh 290,000-350,000lb (131,543-158,759 kg) and have a maximum payload of 15,000-20,000lb (6,804-9,072 kg).<sup>46</sup>

Another manned bomber concept called 'HyperSoar' has been mooted. This aircraft would undertake both reconnaissance and strike missions. It is an ambitious project which would see an aircraft of a similar size to the B-52 travelling at speeds of Mach 10 and carrying double the payload. It is thought that HyperSoar would use the earth's surface as a trampoline from which to bounce off in a similar way to a pebble bouncing off the surface of a pond. Furthermore, this aircraft would be designed to have a range which would enable it to fly anywhere without refuelling.

HyperSoar was the result of a study by the Physics Directorate and the Laboratory Directed Research and Development Program at the Lawrence Livermore National Laboratory in California and the University of Maryland's Department of Aerospace Engineering. The somewhat optimistic development costs for HyperSoar have been mooted at \$10 billion (£6.3 billion), which is approximately the same as the development costs for the 777 airliner. However, many of the technologies for HyperSoar are yet to be developed. For instance, the necessary 'Scramjet' engine, and heat-



resistant surfaces are still in development. Furthermore, even when developed, these technologies would have to undergo an exhaustive test period.<sup>47</sup>

Rather than using crewed aircraft, UCAVs offer another option. They have the advantage of placing no aircrew at risk. One possible platform is 'StrikeStar'. This is a prototype, unmanned aircraft weighing 24,000lb (10,886 kg) with a 4,000lb (1,814kg) payload and a 105-ft (32-m) wingspan. It is thought that StrikeStar could have a range of 19,787 miles (31,842 km), giving it the impressive range already seen in the USAF's present bomber fleet. Furthermore, the aircraft would be designed to cruise at high altitude to shield it from emerging SAM threats.<sup>48</sup> Yet there are concerns whether the payload levels on StrikeStar would be sufficient for long-range strike missions.

### Conclusions

Ostensibly a leftover from the Cold War, the USAF long-range, heavy bomber fleet has shown itself to be a vital component of military operations in the post-Cold War world. All have impressive, flexible payloads. The advent of precision munitions such as the JDAM have increased the mission flexibility of these aircraft. Furthermore, the stealthy characteristics of the B-1B and B-2 greatly increase their survivability. The ranges of the aircraft allows them to strike almost anywhere on earth.

Moreover, the 'trade off' between crew size and payload allows fewer aircrew to be put in harm's way. These factors make the fleet cost-effective. Operations in the Gulf, Kosovo and Afghanistan have illustrated why these attributes are so useful. All three aircraft in the US heavy bomber fleet have undertaken missions as diverse as air-launched cruise missile attacks, battlefield preparation, suppression of enemy air defences and psychological warfare.

The role of the heavy, long-range bomber has refocused the interest of the USAF towards what will replace the present fleet, as the aircraft leave service. In the short term, the present fleet will receive several important modifications, enabling the aircraft to improve their conventional capabilities,

their reach and flexibility. However, several factors will influence the kind of system which will replace the aircraft.

Considerations regarding the airframe life of the existing force, combined with future military requirements; the proliferation of SAM threats; the political will to procure a new system and finally available funding will determine whether a high speed manned platform is purchased; or whether an uninhabited system, or a combination of both is procured. Whilst the performance and appearance of a future platform may be vastly different from today's heavy bombers, it is almost certain that the core heavy bomber characteristics of impressive payload, mission flexibility, reach, aircrew risk reduction and cost-effectiveness will be at the heart of the design.

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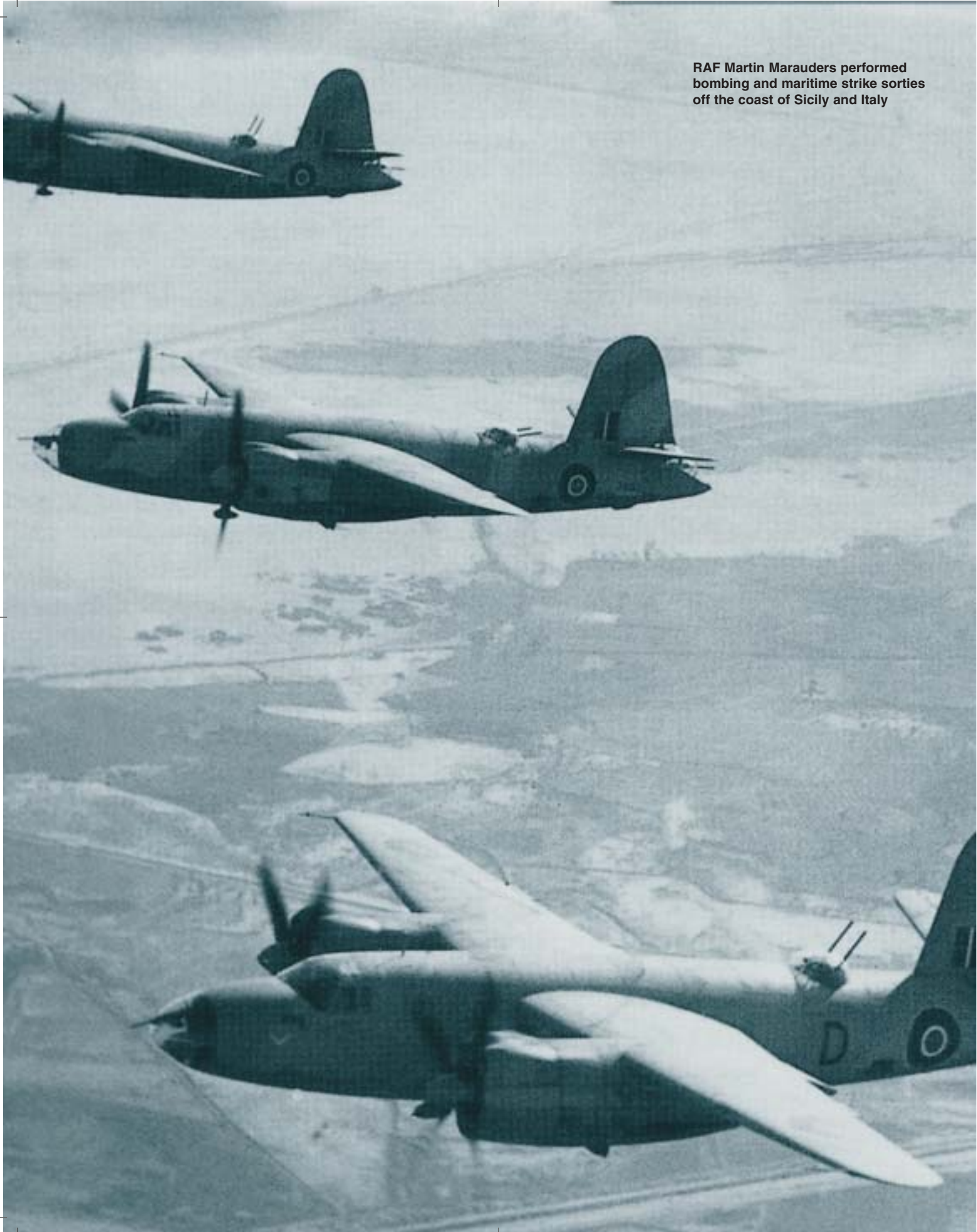
#### Notes

- <sup>1</sup> The 'dumb' weapon load of a B-52 can consist of CBU-52, CBU-58, CBU-71, CBU-87, CBU-89 and CBU-97 cluster munitions, together with Mk. 20, Mk 36, Mk. 41, Mk. 52, Mk. 55, Mk. 56, Mk. 59, Mk. 60, Mk. 62, Mk. 64, Mk. 65, Mk. 82 and Mk. 84 'iron' bombs.
- <sup>2</sup> Sirak, M, 'USAF makes long-range cruise missile choice'.
- <sup>3</sup> Mason, T, 1988, page 120.
- <sup>4</sup> Ibid, page 120.

- <sup>5</sup> Morse, S, (ed), 1991, page 129.
- <sup>6</sup> Mason, T, 1998, page 124.
- <sup>7</sup> Mason, T, 1988, page 149-150.
- <sup>8</sup> 'Iraqi air defence site attacked'.
- <sup>9</sup> Morse, S, (ed) page 87.
- <sup>10</sup> Mason, T, 1998, page 119.
- <sup>11</sup> Forden, G.
- <sup>12</sup> Koch, A.
- <sup>13</sup> Ibid.
- <sup>14</sup> 'Strategic Bombers Overview'.
- <sup>15</sup> Morse, S, page 128.
- <sup>16</sup> Ibid.
- <sup>17</sup> Ibid, page 129.
- <sup>18</sup> Seigle, G.
- <sup>19</sup> Bender, B. 'Tests reveal B-1B's vulnerability in the air'.
- <sup>20</sup> Bender, B, 'Distance limits B-2's combat punch'.
- <sup>21</sup> Wragg, D, 1999, page 261.
- <sup>22</sup> Cook, N, Burger, K, Hill, L, Koch, A, Sirak, M.
- <sup>23</sup> Davies, A.
- <sup>24</sup> Ibid.
- <sup>25</sup> Ibid.
- <sup>26</sup> Koch, A, 'Major Developments for 8 April'.
- <sup>27</sup> Sirak, M, 'USAF: flexibility the key to superiority'.
- <sup>28</sup> Mulholland, D, Lake, D.
- <sup>29</sup> Ripley, T, 'Smart' cluster bombs destroy Iraqi tanks'.
- <sup>30</sup> Ripley, T, 'Republican Guard hit as they move on Baghdad'.
- <sup>31</sup> Sirak, M, 'US military conducts first ever precision-only strike'.
- <sup>32</sup> Hoyle, C.
- <sup>33</sup> Bender, B.
- <sup>34</sup> 'US Air Force White Paper on Long Range Bombers', 1<sup>st</sup> March 1999, pages 7-8.
- <sup>35</sup> Ibid, page 8.
- <sup>36</sup> Bender, B.
- <sup>37</sup> Goure, D.
- <sup>38</sup> Sirak, M, 'USAF enhancing capabilities of B-2'.
- <sup>39</sup> Withington, T.
- <sup>40</sup> Cook, N.
- <sup>41</sup> Ibid.
- <sup>42</sup> Cook, N, Burger, K, Hill, L, Koch, A, Sirak, M.
- <sup>43</sup> Cook, N.
- <sup>44</sup> Ibid.
- <sup>45</sup> Withington, T.
- <sup>46</sup> Ibid.
- <sup>47</sup> Ibid.
- <sup>48</sup> Ibid.







RAF Martin Marauders performed bombing and maritime strike sorties off the coast of Sicily and Italy







## *Allied Airpower comes of Age: its Roles and Contributions to the Italian Campaign*

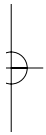
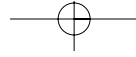
**By Major R Renner USAF**

*'The eventual success of the Allied air force...rested on two major developments. The first was the development of a sound doctrine of how to win and hold air superiority. The second was in developing a satisfactory system of co-operation both between the Allies and between services.'*<sup>1</sup>

*'The Mediterranean theatre has been the primary crucible for the development of tactical air-power and the evolution of joint command between Allies.'*<sup>2</sup> Lt. Gen. Ira C. Eaker, USAAF, commander of the Mediterranean Allied Air Forces (MAAF)

**T**he Italian campaign of World War II remains controversial almost 60 years later regarding its strategic significance, operational effectiveness, and tactical difficulties. Despite this

debate, many of the assumptions used in planning modern joint and combined military operations have their foundations in the Italian campaign, especially the roles and contributions of airpower to joint warfighting. Although the American and British air forces developed airpower doctrine throughout the inter-war years, it was in the inferno of Italy this doctrine evolved into workable realities that significantly contributed to eventual victory. Indeed, the general pattern of airpower application in use today was developed, tested, and refined by the Allies in the life and death struggle for Sicily and the Italian mainland. As the US Air Force historian Richard Hallion elaborated, 'The Italian campaign was characterized by a range of air support operations that were to become commonplace in subsequent fighting elsewhere.'<sup>3</sup>



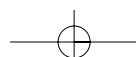
*The Luftwaffe had 147 serviceable aircraft while the MAAF had 12,482 aircraft in theater. Instead of conceding the struggle for air superiority, however, the Axis used robust anti-aircraft artillery (AAA) defenses to counter Allied numerical aircraft superiority*

Airpower played 4 main roles in the Allied Mediterranean strategy, as described by Air Vice Marshal J. H. D'Albiac, the Deputy Commander of the Tactical Air Forces in Italy in 1945. They were: air superiority, interdiction, close air support (CAS), and strategic bombing.<sup>4</sup> This essay will analyze the fight for air superiority during Operation HUSKY (the invasion of Sicily) and the subsequent impact of the ability of Allied airpower to contribute to the land offensives. It will then examine Allied interdiction operations in 1943-1944; specifically, through airpower's efforts to interdict the German evacuation of Sicily, to delay the German counterattacks during Operations

AVALANCHE (the invasion at Salerno) and SHINGLE (the invasion at Anzio), and then to deny German freedom to maneuver during Operations STRANGLE and DIADEM. It will subsequently evaluate the CAS innovations developed by the Allies in Italy, and finally consider the strategic bombing effort launched from the Italian mainland.

**Air superiority**

The Italian campaign illustrated the requirement for armies to have air superiority in order to conduct successful offensive ground operations yet also showed air superiority does not guarantee



success on the ground. Incorporating lessons learned in North Africa, Allied commanders understood the first priority for air forces was gaining air superiority. The 33<sup>rd</sup> USAAF Fighter Group commander acknowledged,

*'The first priority of our air strategy was to gain control of the air. Then we concentrated our efforts on isolating the battlefield and providing close air support. This air strategy provided flexibility to the Allied armies in their ground campaigns and guaranteed a minimum of interference from the German Air Force.'*<sup>5</sup>

Although the Allies achieved air superiority quicker in the Mediterranean than in North-West Europe, the struggle for air superiority over Italy required significant effort. In July 1943, there were 1,850 Axis aircraft in Sicily and Italy, while the Allies had 4,920 (2,900 fighters or bombers). During the battle for Sicily, the Axis lost 740 aircraft in aerial battles and another 1,100 on the ground. By 1 April 1945 the Luftwaffe had 147 serviceable aircraft while the MAAF had 12,482 aircraft in theater (4,393 front-line aircraft).<sup>6</sup> Instead of conceding the struggle for air superiority, however, the Axis used robust anti-aircraft artillery (AAA) defenses to counter Allied numerical aircraft superiority.

During 1944, AAA destroyed 713 Allied aircraft, prompting the truism that air superiority involves 'more than just shiny aeroplanes.'<sup>7</sup> While the struggle for air superiority was a continual process, Allied success during HUSKY wrested 'the initiative in the air [from the Germans, who were] never, except locally in the Aegean for a short pause, to regain it in the Mediterranean.'<sup>8</sup>

The Allied preparations for and invasion of Sicily reveal a determined Allied effort to defeat the Axis air forces. Prior to invading Sicily, the Allies needed to 'reduce' two smaller islands, Pantellaria and Lampedusa. From 18 May to 11 June 1943, concentrated air attacks and naval gunfire on Pantellaria resulted in the island surrendering *before* amphibious forces reached the shore. When the Allies switched the air effort to Lampedusa, it 'surrendered as soon as it could establish contact with [the Allies], and it was known afterwards

that it had been wishing to surrender before the attack commenced.'<sup>9</sup> These successes showed airpower's potential, yet they possibly also contributed to unrealistic expectations of airpower's role later in the Italian campaign. With the air assault on Sicily the Allies prevented any Axis reconnaissance aircraft from discovering the invasion force of 2,800 ships, thus giving the Allies 'complete tactical surprise.'<sup>10</sup> Allied commanders expected to lose around 300 ships to air attacks, but Axis air forces sank only 12 ships due to Allied air superiority.

Because of the primacy of air superiority, when the invasion forces assaulted Sicily on 10 July 1943 the Allies directed the air effort to establishing air supremacy as quickly as possible, leaving no sorties available for CAS for the Seventh Army for the first 48 hours.<sup>11</sup> Axis air forces flew 275-300 sorties per day in the first two days of the invasion but thereafter only flew 150 sorties per day.<sup>12</sup> By contrast, the capture of airfields on Sicily on 10 July allowed the Allied air forces to fly up to 1,200 sorties per day,<sup>13</sup> providing protection and support of the land forces.

The air superiority contest in the skies over Sicily reveals three lessons applicable to airpower today. First, as Generalmajor Hubertus Hitschold, the Luftwaffe's last General der Schlachtfliieger, reflected, 'The prerequisite for successful and lasting operations of ground attack units is air superiority.'<sup>14</sup> With air superiority after Sicily, the Allies were able to use airpower primarily to support land forces. Second, Sicily showed air superiority does not guarantee successful land operations. Despite Allied air superiority, the German Army's characteristic of 'resolution in adversity' allowed it to fight delaying actions, successfully extending the battle for Sicily.<sup>15</sup>

Subsequent operations on the Italian mainland would further prove the ability of a determined army on the defensive to continue fighting regardless of air interdiction, much like the Viet Cong would during Operation ROLLING THUNDER. Conversely, Sicily also provided the first indication of what would be borne out in the rest of the Italian campaign; that modern armies cannot win

## *The escape of the Axis armies meant the Allies would fight these soldiers on mainland Italy, extending the duration and increasing the cost of the Italian campaign*

without air superiority. The Germans would continue to learn this devastating lesson throughout the Italian and North-west Europe campaigns, as would the Iraqi army during the Gulf War of 1991.

### **Interdiction**

*'That was the only hostile aircraft I saw in eighteen months... Our armies simply plough up Italy in nose-to-tail convoys. Had the Germans been able to allocate one-quarter of their air resources to the close cooperation with their army that they had previously, the Italian campaign would have been a great deal tougher even than it was.'*<sup>16</sup> Sir Michael Howard

*'Unremitting Allied fighter-bomber activity makes movement or troop deployment almost impossible ... fighter-bombers maintain constant patrol over all roads ... daytime movement is paralysed'*<sup>17</sup> German 10<sup>th</sup> Army War Diary, May 1944

After gaining air superiority, the Allies were able to dedicate a significant portion of their air assets to interdicting German lines of communication. One author defined the purpose of interdiction as preventing 'men, equipment, and supplies from reaching a place of combat when the enemy needs them and in the quantities he requires.'<sup>18</sup> The mixed results of Allied efforts to interdict the Axis armies during the Italian campaign are seen in the Axis evacuation from Sicily at Messina, the Allied invasions of Salerno and Anzio, and Operations STRANGLE and DIADEM. Producing less than anticipated effects, these operations reveal a lack of effective joint planning as a common theme of these interdiction campaigns.

The successful Axis evacuation of Sicily across the Straits of Messina is sometimes viewed as a failure of interdiction, but it should primarily be viewed as a failure of joint planning and leadership. Allied planning effort focused on securing the beachhead, with a dearth of planning for follow-on operations to conclude the campaign. General Alexander, the Allied commander in the Mediterranean, told his air and naval component commanders on 3 August 1943, 'Indications suggest that the Germans are making preparations for withdrawal to the mainland ... We must be in a position to take immediate advantage of such a sit-

uation by using full weight of the Naval and Air Power. You have no doubt co-ordinated plans to meet this contingency.'<sup>19</sup> In fact, they had *not* made plans to prevent the German evacuation, nor did they after this 'suggestion.'

The Axis armies would successfully evacuate Sicily due to 'the failure of the Allied commanders to view the interdiction of a German retreat from the island as a fundamental strategic requirement that had to be integrated into the plans of all three services.'<sup>20</sup> The difficult terrain around Messina allowed small numbers of soldiers to hold the advance of Allied Armies during the evacuation, and the Navy had legitimate concerns about mines and shore batteries while operating in the Straits of Messina. The resulting reliance upon airpower *alone* to prevent the evacuation did not consider the 150 x 88mm and 333 x 20mm Axis AAA pieces along the straits.<sup>21</sup> On 1 August, Air Vice-Marshal Arthur Coningham (Commander of the Tactical Air Forces) informed Air Chief Marshal Arthur Tedder (MAAF Commander), 'The Messina area 'flak' was now practically prohibitive for all aircraft except the heavy bombers.'<sup>22</sup> Although AAA shot down only 3-5 aircraft, it damaged 28 of 96 (29%) of the bombers on 15 August and 44 of 96 (45%) on 16 August, plus over 30 fighter-bombers.<sup>23</sup>

Coningham's release of the Strategic Air Forces from the commitment to attack the evacuation beaches also shares responsibility for the failure to interdict the evacuation.<sup>24</sup> He released the bombers to hit the backlog of strategic targets and to start preparations for invasion of Italy. When the evacuation was detected, however, it was too late to request the bombers, as they had just attacked Rome. Furthermore, the Strategic Air Forces were busy preparing to receive B-17s from England following the Schweinfurt-Regensburg mission of 17 August.<sup>25</sup>

However, even if Coningham had used the bombers, airpower *alone* could not prevent the German evacuation. The results were a successful evacuation of 38,846 German soldiers, 10,356 vehicles, and 14,949 tons of supplies and an Italian evacuation of 62,000 soldiers, 277 vehicles, and 41



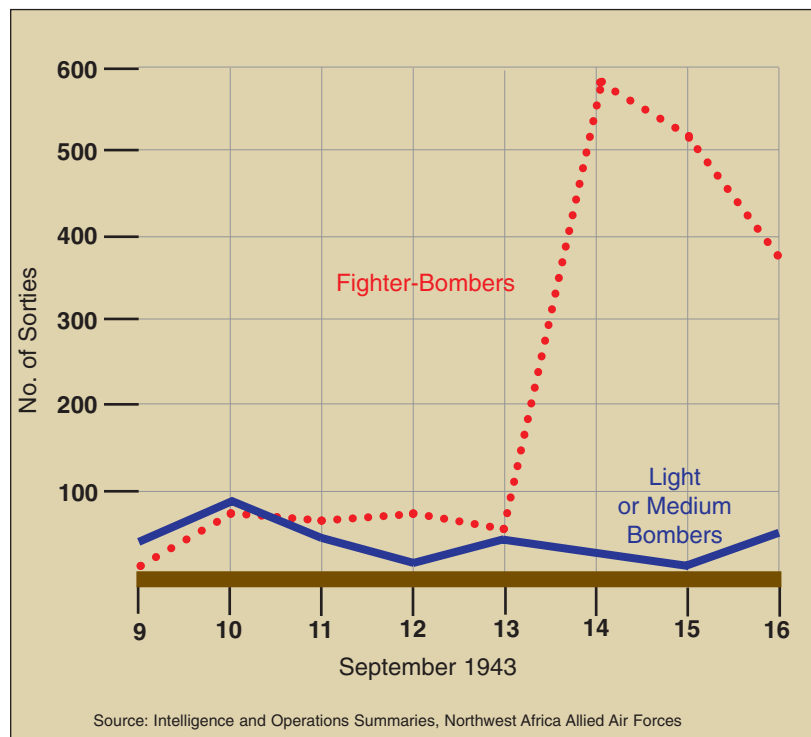


Figure 1. Allied battlefield attacks at Salerno<sup>33</sup>

artillery pieces.<sup>26</sup> The escape of the Axis armies meant the Allies would fight these soldiers on mainland Italy, extending the duration and increasing the cost of the Italian campaign. If the Allies had countered the evacuation through a joint plan, the successful interdiction of the Axis armies might have been the ‘Stalingrad’ of the Italian campaign.

Allied interdiction efforts during Operation AVALANCE, the invasion at Salerno on 9 September 1943, had mixed results. Joint planning problems still plagued the Allies, specifically planning to invade beaches near the maximum range of their fighters. Interdiction’s objective was to prevent the Germans from concentrating their forces faster than the Allies could land theirs.<sup>27</sup> To do this, however, required continual Allied air attacks on German lines of communication.

The distance of the airfields in Sicily presented a ‘grave obstacle,’ since covering the landings with single-engined fighters would be ‘difficult to provide.’<sup>28</sup> Notwithstanding the use of Spitfires and P-38s with long-range fuel tanks and Navy Seafires from carriers, Allied airpower could only provide, on the average, 54 aircraft over the Gulf

of Salerno at any time during the first few days.<sup>29</sup> Even with air-to-air refuelling today, long distances from airfields to the battlespace means more assets are required to support land forces.

When the Allies landed at Salerno, the Germans responded immediately. Allied air interdiction, however, hindered their efforts to swiftly push the invasion forces back into the sea. For instance, the 29<sup>th</sup> Panzer Grenadier Division entered combat near Salerno on 12 September 1943, but they had expected to reach the battlefield on the night of 9-10 September. Attributed by Generalfeldmarschall Albert Kesselring’s (commander of German forces in Italy) headquarters to ‘the interference with road and rail transport...brought about by the Allied air forces,’ fuel shortages immobilized the division.<sup>30</sup> Afterwards, German General von Vietinghoff, 10<sup>th</sup> Army Commander, said the delay of LXXVI Panzer Corps was ‘perhaps decisive’ to the outcome of the battle.<sup>31</sup> When these forces started arriving, the Allied armies called for all available support. As a result,

*Almost the entire strength of the Allied air forces— heavy bombers, medium bombers, fighter-bombers and strafing fighters—carried out a mass bombardment of the communications behind the enemy lines and the German troop concentrations. ... The most critical day on the ground, 14<sup>th</sup> September, was also the day of the greatest air effort. The Luftwaffe was able to put up almost no opposition by then and the German troops had to take, day and night, the full bombing strength which we could bring to bear.*<sup>32</sup>

Figure 1 shows the surge of Allied sorties on 14 September, attributable mainly to the capture of airfields near the beaches that allowed aircraft to be located near the battle. During this aerial flood, the Germans experienced the difficulty of concentrating land forces without air superiority; the Allies, however, seemed to learn airpower alone could protect invasion forces from counter-attack. This belief would prove costly during Operation SHINGLE.

Allied planners for Operation SHINGLE, the invasion of Anzio on 22 January 1944, expected airpower would delay German reinforcements



An RAF Baltimore attacking Axis transport

*While unable to prevent German reserves from reaching the Anzio beachhead, interdiction did logistically constrain the German army*

from reaching the beachhead. In fact, General Alexander's Allied Force Headquarters counted on airpower *alone* to slow the movements of the 29<sup>th</sup> and the 90<sup>th</sup> Panzer Grenadier Divisions, in reserve near Rome, making them unable to effectively oppose the SHINGLE landing.<sup>34</sup> Major General Wolf Hauser, the German 14<sup>th</sup> Army Chief of Staff, believed the Allies 'had not reckoned on meeting resistance from more than advanced German units' because they had 'relied too much on the effectiveness of their air attacks on railways.'<sup>35</sup>

Instead of being a failure of airpower's capabilities, SHINGLE's failure reflected inadequate operational research. Allied intelligence estimated German static divisions needed 4,000 tons of supplies daily, meaning the railroads could meet the 10<sup>th</sup> Army's logistical requirements functioning at only 5% capacity!<sup>36</sup> In addition, during the German build-up at Anzio from 24 January to 4 February, the Germans re-opened marshalling yards in 1-3 days, whereas the average interval between Allied air attacks on marshalling yards was 12.2 days.<sup>37</sup>

While unable to prevent German reserves from reaching the Anzio beachhead, interdiction did logistically constrain the German army. Attacks on bridges and marshalling yards forced German railheads back from the front, straining the inadequate motor transport. Further, strafing fighters roaming behind the battlefield during daylight hours obliged German convoys to travel at night, effectively doubling motor transport requirements.<sup>38</sup> Simultaneous with the Anzio invasion, the Allied offensive at Cassino increased demands on the German supply system.

The result of interdiction combined with this increased demand was 'logistical constriction, the chief manifestation of which was a critical shortage of artillery ammunition.'<sup>39</sup> At Anzio, the Germans estimated they fired one artillery round for 12-15 Allied shells.<sup>40</sup> The reduced artillery support, along with a complete lack of CAS, gave the Allies enough breathing room to survive at Anzio and Cassino.

The Allied air interdiction campaign from 19 March to 10 May 1944, Operation STRANGLE, represented an unrealistic enthusiasm of airpower capabilities based on its prior successes.

Attempting to break the stalemate in Italy *solely* through airpower, STRANGLE's objective was to force a German withdrawal by interdicting supply lines, inflicting shortages, thus leading 'to a contraction of the German war machine.'<sup>41</sup> Although STRANGLE had some success, its biggest failure was in operational research and intelligence.

First, the Allies overestimated airpower's impact on German railroads. The Germans were building locomotives so fast they could throw them away at the end of each trip; neither were they short of rolling stock with an estimated 2,000,000 cars on the continent.<sup>42</sup> In addition, the Allies miscalculated German logistic requirements, estimating they required 4,500 tons of supplies daily (7% of normal railway capacity). Since the Germans were defending static positions, however, they only needed 1,350 tons daily (1-2% of peacetime railway capability).<sup>43</sup> In the first week of the operation, Allied air attacks on railroads successfully reduced daily capacity from 80,000 to 4,000 tons.<sup>44</sup> This reduction of logistic support did not force a

German retreat, but it prevented the re-supply of consumed supplies and the stockpiling of fuel and ammunition to counter the Allied spring offensive, DIADEM.<sup>45</sup>

As a result, STRANGLE 'contributed immeasurably to the defeat of the German armies by denying them the tactical mobility which was essential.'<sup>46</sup> In response to Allied interdiction, the Germans ordered all supply columns after 5 April to move only at night, meaning convoys could no longer make round trips in one day.<sup>47</sup>

Subsequently, Kesselring's headquarters reported in May 1944, 'In the face of Allied air superiority it was impossible to make any computation of the time factor in movements.'<sup>48</sup> A lack of joint planning, however, precluded STRANGLE from conclusively constraining the German forces.

Ironically, in a reversal of normal criticisms, General Eaker complained in a 7 April 1944 letter to General 'Hap' Arnold, USAAF Commander, 'Actually, what we now need more than anything is some Army support ... What we ask the Army to do is to put enough pressure on the enemy to force him to discharge some ammunition and further reduce his reserve.'<sup>49</sup>

Air Marshal Slessor (MAAF Deputy Commander), in a 16 April letter to Air Chief Marshal Portal (Chief of the Air Staff), stated, 'We have now made it impossible for the Hun to act offensively, as he did against the [Anzio] beachhead in February. But we have not yet succeeded in making him pull out, and I don't think we shall by air action alone: what we have done ... is to make it impossible for him to resist successfully a determined and sustained offensive by the ground forces.'<sup>50</sup> Operation DIADEM attempted such a decisive joint air-ground offensive.

From 11 May to 10 June 1944, the Allied joint air-ground offensive called Operation DIADEM aimed at ending the stalemate in Italy and recapturing Rome. DIADEM's key difference from STRANGLE was the synchronization of air and ground offensives.<sup>51</sup> This combination aimed to limit German freedom to maneuver by creating ammunition and fuel shortages. Between 12 and 25 May 1944, 10<sup>th</sup> Army expended 7,499 tons of



AHB (RAF)

*Close air support also came of age in the Italian campaign. Several aspects of CAS taken for granted in modern air forces were developed in the mud and skies of Italy*

ammunition but received only 3,818 tons of re-supply.<sup>52</sup> By 6 June, fuel shortages allowed the German Army to only move short distances before stopping to wait for re-supply.<sup>53</sup>

Despite Allied air supremacy, the German Army was occasionally forced to move in daylight. In one instance at the end of May 1944, the Hermann Goering Division moved toward the Anzio beach-head. General von Greffenberg, the Division Commander, stated that ruthless air attacks during its journey to the front between 23 and 27 May made his division arrive piecemeal and with only 18 of its 60 tanks. Most of the tank losses were likely due to increased wear and tear from making long detours and shortages of spare parts and fuel. Consequently, only 8-10 tanks were serviceable at any one time, and they had negligible effect on the battle.<sup>54</sup> Notwithstanding such limitations, German logistics were not put in crisis because the Allied assault was along a narrow front. This allowed German concentration of motor transport assets to the critical section of the front<sup>55</sup> and prevented whole-scale collapse of their lines, in contrast to that experienced during the broad-front Allied offensives into Germany.

Although interdiction matured during the Italian campaign, it did not make the Germans withdraw but instead denied the German Army essential freedom to maneuver. Operation STRANGLE's failure to force a German withdrawal 'proved the necessity of closely integrating any interdiction attempt with ground operations.'<sup>56</sup> As ground offensives force enemy armies to maneuver and consume fuel, ammunition, and spare parts, interdiction becomes increasingly effective.

As German General von Senger und Etterlin, the commander of XIV Panzer Corps, bitterly observed, 'In a battle of movement a commander who can only make the tactically essential movements by night resembles a chess player who for three moves of his opponent has the right to make only one.'<sup>57</sup> The Allied interdiction campaigns in Italy laid the foundations of the successful joint operations of North-west Europe, but these principles were soon forgotten in interdiction campaigns in Korea and Vietnam.

#### CAS

Like many airpower roles, close air support also came of age in the Italian campaign. Several aspects of CAS taken for granted in modern air





*'Horsefly' FACs of the Italian campaign 'may be considered the predecessors of the Mosquito FACs of Korea, who, in turn, anticipated the FACs of Southeast Asia,' and the OA-10 FACs over Iraq, Kosovo, and Afghanistan*

forces were developed in the mud and skies of Italy. The Allies experienced problems in air-ground coordination, communications, and identification of friendlies, but also implemented several solutions that survive in today's battlespace. One solution was a daily meeting between Army and Air Force staffs to review the day's activities and the Army representatives would nominate the targets they wanted to have attacked the next day.<sup>58</sup> This meeting was the forerunner of today's Joint Coordination Board, at which similar issues are still discussed.

Another solution was 'prearranged CAS' sorties, missions over the next 24 hours initiated at division level (brigade level for the British). These requests made their way to a joint army-air force group that created an air program (now called an Air Tasking Order, or ATO) conforming to the army's overall tactical plan.<sup>59</sup> In addition, some fighter-bomber squadrons were reserved for 'Call Missions' which took into 'account changes in the battle situation that favored attacks against targets of opportunity.'<sup>60</sup> Two further CAS developments forged in Italy were the Rover system and 'Horsefly.'

The Rover system significantly improved CAS effectiveness and army-air force cooperation. Named Rover David and Rover Paddy (after 2 fighter pilots and originators of the idea) for the RAF and Rover Joe (as in G.I. Joe) for the USAAF,<sup>61</sup> it was the pioneer of today's FACs (Forward Air Controllers). The Rover system paired air controllers and army liaison officers to 'rove' the bat-

tlefield calling fighter-bombers to attack targets of opportunity.<sup>62</sup> To respond to these CAS requests, fighters were 'Cabranked,' whereby flights of aircraft arrived at 30-minute intervals. Prior to take-off, the fighter-bomber pilots planned for alternate targets they would attack if they received no call after 20 minutes on-station. If, however, the Rover had a suitable target, he would talk the flight onto the target through grid coordinates, terrain description, and artillery-fired colored smoke.<sup>63</sup>

The only noticeable change in today's CAS missions in Afghanistan is the use of technology (specifically, Global Positioning Satellite (GPS) and laser-designation) to mark targets. Operational Analysis of fighter-bomber support for British V Corps operations in Italy between October and December 1944 showed 100 fighter-bomber attacks (equal to about 500 sorties) equated to 60-90 fewer troops killed and 200-300 fewer wounded by German artillery shellfire. The cost to the RAF was 2.6 pilots killed or missing, 0.3 pilots injured, and 4.5 aircraft lost.<sup>64</sup> Sufficient CAS, then, can help win battles and save friendly soldiers' lives. This level of CAS support, however, is only possible with air superiority, as previously discussed.

Another innovation in Italy that improved Allied CAS effectiveness was 'Horsefly,' a precursor of today's Airborne FACs. An artillery spotter pilot flying a Piper 'Grasshopper' suggested the concept for 'Horsefly' when he realized a 'Grasshopper' could also 'direct fighter-bombers onto a target when artillery was unavailable to mark the target with smoke shells.'<sup>65</sup> Accordingly,

*The air superiority struggle requires a continual effort, a significant allocation of resources, and consideration beyond 'shiny airplanes' in order to be successful*

fighter-bomber pilots on assignment with the Corps flew modified 'Grasshoppers' as Airborne FACs. Each 'Grasshopper' also carried an infantry observer to help distinguish friendly from enemy forces, and if operating with armored forces, would carry an observer expert in identifying friendly and enemy armor.<sup>66</sup>

Ranging as far as 15-20 miles behind enemy lines, 'Horsefly' FACs marked their targets by dropping small smoke bombs. Indeed, the 'Horsefly' FACs of the Italian campaign 'may be considered the predecessors of the Mosquito FACs of Korea, who, in turn, anticipated the FACs of Southeast Asia,<sup>67</sup> and the OA-10 FACs over Iraq, Kosovo, and Afghanistan.

While the Italian campaign produced many CAS innovations that still apply in today's complex battlespace, it also confirmed ideas fundamental for maximizing joint synergies. The sophisticated Allied CAS systems and procedures greatly enhanced air-ground cooperation, but they could not substitute for hard fighting on the ground. Conversely, a modern army cannot single-handedly defeat an enemy army, especially a well-organized, disciplined army fighting in difficult terrain. Undeniably then, air and ground forces needed to cooperate during the Italian campaign, and they need each other's capabilities even more to effectively fight today's wars.

**Strategic bombing**

The ground campaign in Italy resulted in the capture of airfields crucial to the Allied strategic bombing efforts. Airfields near Foggia allowed Allied heavy bombers to attack targets previously too distant to hit. With these airfields, 'in November, 1943, the big two-way bombing of Germany's war production started. ... [T]he damage inflicted on such targets as the Ploesti oilfields, the aircraft factories at Augsburg and Klagenfurt, the ball-bearing and other factories in northern Italy and southern France, and many marshalling yards in Germany and her satellites have been a

very real and important contribution towards victory and shortening the length of the War.'<sup>68</sup>

Although the army viewed the heavy bombers as a logistical strain,<sup>69</sup> strategic bombing against Axis oil production caused a severe shortage of fuel for the Germans in 1945. Further, the Italian campaign showed the need for shrewd apportionment of heavy bomber sorties when confronted with army requests for heavy bombers for CAS. Despite the failure of the ground offensives at Cassino, bombers could be effective in CAS if the army rapidly followed up the air strike with a ground attack.<sup>70</sup> However, this coordination proved difficult in World War II due to technological limitations in communications and accuracy.

With today's technology of GPS-guided bombs, this coordination is still subject to the 'fog of war' and human error, as seen in tragic fratricides in Iraq and Afghanistan. Air Chief Marshal Sir Arthur Tedder, commander of the MAAF and later Deputy Supreme Allied Commander Europe, compared the British Army's continual requests for heavy bomber support to 'having been drugged with bombs, [and] it is going to be a difficult process to cure the drug addicts.'<sup>71</sup>

**Conclusion**

The Allied experiences in Italy were fertile proving grounds for the maturation of airpower. Airpower's roles in today's joint campaigns (air superiority, interdiction, CAS, and strategic bombing) were refined during this struggle, and many of the procedures and systems cultivated in Italy still exist in doctrine manuals and tactics pamphlets used in Air Forces throughout the world. First, the invasion of Sicily, as well as the rest of the Italian campaign, underlined the essential requirement for air superiority. As the NATO air forces relearned in the skies over Serbia during 1999's Operation ALLIED FORCE, the air superiority struggle requires a continual effort, a significant allocation of resources, and consideration beyond 'shiny airplanes' in order to be successful. Gaining air superiority also requires joint synergy, as the Allied air forces in the Italian campaign required the capture of airfields in order to

provide more sorties to support the land offensives. In fact, John Terraine called the entire African campaign and the invasion of Sicily a 'war for aerodromes'.<sup>72</sup> Interdiction operations in Italy established the need for appropriate intelligence efforts to identify enemy vulnerabilities and also confirmed that only joint campaigns can succeed. Also, the CAS systems and procedures formulated in Italy still flourish in the form of today's FACs.

The strategic bombing efforts from Italy, combined with the aerial armadas launched from England, revealed strategic bombing is a long-term effort but can yield long-term effects on the enemy. However, the Italian campaign effectively demonstrates the dangers of over-reliance on airpower capabilities rather than conducting joint campaigns, especially when confronting a determined enemy willing to fight on in the face of overwhelming odds.

#### Notes:

- 1 Overy (1980), p. 67
- 2 Hallion (1989), p. 186
- 3 *Ibid.*, p. 181
- 4 D'Albiac (1945), p. 324
- 5 Momyer (1978), p. 1
- 6 Brookes (1996), p. 56, 60
- 7 *Ibid.*, p. 61
- 8 D'Albiac, op. cit., p. 327
- 9 *Ibid.*, p. 325
- 10 *Ibid.*, p. 327
- 11 Hallion, op. cit., p. 178
- 12 Terraine (1997), p. 574
- 13 Mark (1994), p. 61
- 14 Hallion, op. cit., p. 180
- 15 Terraine, op. cit., p. 576
- 16 Brookes, op. cit., p. 60. While a soldier at Salerno, he saw 1 German aircraft.
- 17 Hallion, op. cit., p. 186
- 18 Mark, op. cit., p. 1
- 19 *Ibid.*, p. 66-7
- 20 *Ibid.*, p. 51
- 21 *Ibid.*, p. 66
- 22 Terraine, op. cit., p. 579
- 23 Mark, op. cit., p. 74
- 24 *Ibid.*, p. 72
- 25 *Id.*
- 26 *Ibid.*, p. 76
- 27 *Ibid.*, p. 81
- 28 D'Albiac, op. cit., p. 330
- 29 Mark, op. cit., p. 86
- 30 *Ibid.*, p. 97
- 31 *Ibid.*, p. 98
- 32 D'Albiac, op. cit., p. 331
- 33 Mark, op. cit., p. 106
- 34 *Ibid.*, p. 114
- 35 *Ibid.*, p. 129
- 36 *Ibid.*, p. 119
- 37 *Ibid.*, p. 133
- 38 *Ibid.*, p. 131
- 39 *Ibid.*, p. 109
- 40 *Ibid.*, p. 137
- 41 Hallion, op. cit., p. 185
- 42 Mark, op. cit., p. 149
- 43 *Ibid.*, p. 165 & Gooderson (1998), p. 210
- 44 Brookes, op. cit., p. 61
- 45 Mark, op. cit., p. 161
- 46 RAND analyst F. M. Sallager, in Hallion, op. cit., p. 185
- 47 Mark, op. cit., p. 168
- 48 Gooderson (1998), p. 212
- 49 Mark, op. cit., p. 182
- 50 Terraine, op. cit., p. 594
- 51 Hallion, op. cit., p. 186
- 52 Mark, op. cit., p. 203-4
- 53 *Ibid.*, p. 206-7
- 54 Gooderson (1998), p. 215
- 55 Mark, op. cit., p. 179
- 56 Gooderson (1998), p. 210
- 57 Mark, op. cit., p. 207
- 58 Wilt (1990), p. 206
- 59 *Id.*
- 60 *Ibid.*, p. 207
- 61 *Ibid.*, p. 208
- 62 Brookes, op. cit., p. 59
- 63 Wilt, op. cit., p. 209
- 64 Gooderson (1998), p. 192
- 65 Hallion, op. cit., p. 182
- 66 *Id.*
- 67 *Id.*
- 68 D'Albiac, op. cit., p. 332
- 69 Richards and Saunders, in Terraine, op. cit., p. 586
- 70 Gooderson (1992), p. 369
- 71 *Ibid.*, p. 368
- 72 Terraine, op. cit., p. 569-570





Manhattan Island is engulfed in smoke and dust after the collapse of World Trade Center's Twin Towers



# The UK Approach to future Command & Inform (C4ISR)

## Key to abbreviations & acronyms

C&I	Command and Inform	JOA	Joint Operational Area
CEA	Campaign Effectiveness Analysis	MN	Multinational
CoI	Communities of Interest	NEC	Network Enabled Capability
COP	Common Operational Picture	NGO	Non-Governmental Organisation
EBO	Effects Based Operations	NRT	Near Real Time
HLOC	High Level Operational Concept	OGD	Other Government Departments
I&W	Indicators & Warnings	SSA	Shared Situational Awareness
ISR	Intelligence Surveillance and Reconnaissance		

By Lieutenant Colonel I D R Pickard

*'The command system...will remain a key force multiplier and advantage... opponents will seek to contest this through electronic warfare, computer network attack and asymmetric techniques'*<sup>1</sup>

Recent work at the UK Joint Doctrine and Concepts Centre has concentrated on developing a future High Level Operational Concept for UK Armed Forces to articulate how the components of the Defence Capability Framework<sup>2</sup> (Command, Inform, Operate, Prepare, Project, Protect and Sustain) will be realised and harmonised out to 2020. We first set the scene by looking at the strategic environment and the nature of future operations. We then looked in

detail at the nature of future Command and Inform (C&I) to give a framework for the other components and, more particularly, to give a conceptual basis for the significant investment now being made in Network Enabled Capability.

### Future environment

Although the risks of armed conflict on a Cold War scale may have reduced there is increasing turbulence world wide with persistent mid- to low-intensity threats, a trend that is likely to continue. Threats will increasingly include terrorists, rogue states and other, non-state, actors who may not be easy to identify or locate. None of these are likely to observe international law and moral conventions

## *We will face adversaries whose structures lack traditional nodes and whose Centres of Gravity will be hard to define and attack*

to the extent that we do. We can expect them to continue asymmetric attacks on our Strategic and Operational Centres of Gravity but across a much wider battlespace.<sup>3</sup>

At the same time Globalisation, the interconnection of world-wide resources, economics and information, will create conditions where intentional effects can lead very rapidly to unintended consequences. Potential adversaries will rapidly adapt to this complex environment, where cause and effect will be hard to predict. We will face adversaries whose structures lack traditional nodes and whose Centres of Gravity will be hard to define and attack.<sup>4</sup> They may choose to operate where our strengths are mitigated and theirs are maximised, such as the complex terrain of urban areas. It is judged that there will increasingly be a move away from a geometric, Jominian<sup>5</sup>, model of the battlespace toward a model that is non-linear and non-contiguous in both space and time.

Arguably, the structure, processes and equipment of the UK Armed Forces remain best suited to operations against symmetric adversaries in a geometric, industrial-age, battlespace.

ing as a shaper of public opinion, we are likely to be called upon for rapid intervention in order to avert crises and to respond to humanitarian disasters.

Operations in 2020 are as likely to be in *ad hoc* coalitions of the willing, as they are to be with established allies. The technological capabilities of potential coalition partners will range from those who stay abreast of US Transformation, to those who retain some form of interoperability to those who do not. It is also likely that many non-military organisations with whom we need to operate in the battlespace will lack compatible C&I capabilities. Therefore, whilst technological interoperability is a major issue, culture, organisational structure, procedures and training will influence significantly the effectiveness of all organisations involved in joint or combined operations.<sup>7</sup>

It is likely that tolerance within our society to friendly, adversary and civilian casualties, collateral damage and damage to the environment will diminish, whilst legal imperatives will increasingly constrain our freedom to operate and train. For sound legal and operational reasons in our pluralistic society we will require an audit trail of opera-

## *Our compelling need is to adapt to the new Strategic environment*

There is, therefore, a compelling need to adapt to the new environment and move away from forces that are physically and conceptually heavy, relatively inflexible and strategically immobile, toward lighter, more agile and mobile forces. Although UK Armed Forces should remain optimised for warfighting, trends derived from recent operational experience indicate that we will still need to undertake a wide range of other operations from peacekeeping and counter-terrorism to power projection and deliberate intervention. The full range of operations may take place simultaneously in the same battlespace, the so-called 'Three Block War'<sup>6</sup>. With 24-hour international media increasingly act-

tional decisions and consequences. Adversaries, on the other hand, will rarely operate under such constraints, giving them the asymmetric advantage.

Against this background emergent nanotechnology, information technology (communications, data processing and fusion, information collection, distribution and dissemination), power sources, satellites and advanced sensors offer the potential to revolutionise our ability to C&I. There is a growing realisation, however, that although technology is rapidly delivering more information the processes needed to manage this information have not kept pace:

*To achieve the desired effect in some circumstances it may still be necessary for British soldiers to 'take the bayonet to the Queen's enemies' as the only way of affecting an adversary's capability and will*

*'The Information Management challenge is about to overwhelm us'*<sup>8</sup>.

If we are to maximise the leverage offered by technology, it will be necessary to prevent commanders and their staffs being swamped by information and thus more efficient Knowledge and Information Management (KIM) techniques are required, which must encompass technology, procedures, training and structures.

#### **Network Enabled Capability**

UK Armed Forces intend to exploit emerging technology through the adoption of a Network Enabled Capability (NEC)<sup>9</sup>. It allows us to exploit the potential of 'network' technologies and enables integration with emerging US concepts. NEC promises to deliver Shared Situational Awareness (SSA)<sup>10</sup>, a condition where force elements achieve a common or, at least, consistent understanding of both the Strategic and Operational level contexts and the prevailing tactical situation. Despite advances in technology, however, information will never be complete. The electro-magnetic spectrum will continue to be constrained by power, propagation, bandwidth and enemy action and it is highly unlikely, therefore, that we could ever realise a complete picture of our own forces' dispositions and intentions, let alone those of an adversary.

Military operations will continue to be characterised by a degree of uncertainty: the so-called 'fog of war'. This uncertainty will be exacerbated by the political imperative for speedy decisions. These two factors together mean that, as today, many critical decisions will continue to be made on the basis of incomplete information. Furthermore, although blue forces will gain advantage by degrading an adversary's C&I capability, reliance on advanced C&I capabilities represents an increasing vulnerability. This vulnerability can be considered in three specific areas; systems attack (to which COTS technology is likely to be particularly vulnerable), intrusion and misinfor-

mation (whose effect will be magnified by networks) and, finally, the danger that the uninformed may have unrealistic expectations of a 'high tech' military's ability to achieve success at minimal or no cost.

#### **Future operations**

UK Joint Vision seeks to realise the full potential of the Manoeuvrist Approach<sup>11</sup> and articulates Effects Based Operations (EBO) as the best way to achieve this. EBO are focused on actions and their influence on behaviour, rather than simply on targets and attrition. The concept is not new; good commanders have in the past intuitively understood and applied a wide range of effects, but it is intended to develop a system that will deliver the right effect more consistently. It is envisaged that a lexicon of effects will give specifics, such as reassure, persuade, deter, coerce or destroy. The overriding aim, however, will be to influence will.

Effects fall into two broad categories: physical (often called kinetic), that can be targeted against capability and cognitive, that can be targeted against will. They can be primary and subsequent (second, third, fourth order etc), intended and unintended. Effects can be applied to friendly, adversary and neutral parties, across the seven dimensions of the Strategic environment<sup>12</sup> by using each of the Instruments of Power<sup>13</sup>. To unlock the full potential of EBO, future commanders will need to exploit a much richer information environment than hitherto. It is important to emphasise, however, that to achieve the desired effect in some circumstances it may still be necessary for British soldiers to 'take the bayonet to the Queen's enemies' as the only way of affecting an adversary's capability and will.

#### **Future ethos**

Over-reliance on past lessons can lead to the phenomenon of 'preparing for the last war', which is a high-risk strategy at a time of rapid geo-political and technological change. We propose a more

## *Agility will allow us to counter the unexpected with more confidence*

balanced approach that recognises the value of historical analysis but demands a forward-looking posture underpinned by an ethos of *agility, optimum tempo and persistence*.

*Agility* is a core ethos of mind, function, equipment and procedure. It will be fundamental to future operations and has four attributes, which can be measured: responsiveness, robustness, flexibility and adaptability. *Responsiveness* is the speed with which force elements recognise the need for action or change relative to an adversary and is, therefore, a measure of how quickly we can seize the initiative. We must assume that in future, when faced by an asymmetric threat, we may start from a position of disadvantage. In this case speed will be critical if we are to regain the initiative. *Robustness* is not just the degree to which forces remain effective following degradation, but also the ability to conduct different missions with the same capability. We can no longer afford 'single note' instruments (i.e. dedicated organic capabilities). *Flexibility* is the ability to operate along multiple paths and present an adversary with complex and unpredictable futures. It also seeks to avoid the trap of foreclosing options at too early a stage in planning. In addition it will allow us to overcome system failure or enemy action by ensuring we are not dependent upon a single course of action or only one way of operating. Most importantly of all, *adaptability* is the aptitude of force elements to learn rapidly about their operating environment, particularly when faced with the unexpected, to recognise the need for change<sup>14</sup> and then reconfigure to succeed. Whilst agility

*Decision Superiority*<sup>15</sup> at all levels in order to gain and retain the initiative. Better SSA will be a major contribution to Decision Superiority but also requires more responsive and adaptive command processes, to improve the decision-action cycle and deliver decisive operational advantage in the form of enhanced *tempo*.

Tempo is the rate or rhythm of activity relative to an opponent; higher tempo allows a commander to get inside the adversary's decision-action cycle by exploiting information and acting on it before the adversary has time to react. Tempo must, however, always be viewed as 'speed within context'; in certain operating environments we may wish to pick the correct time to act and timing can be more important than time *per se*. We will require commanders who have an intuitive 'feel' for the precise moment when they have sufficient information to take or seize the initiative, without waiting too long and losing it.

Finally, tempo allows the sudden massing of effects to achieve surprise. In a highly networked force, where the tactical level of command is fully empowered, a high degree of synchronisation may manifest itself as 'swarming'. These natural opportunities for simultaneity, whereby an adversary is overwhelmed by threats so that he is unable to concentrate on any one, or even establish priorities, are key to achieving operational momentum and to shattering an adversary's cohesion. The overall effect of tempo is reinforced by *persistence*, an ability to maintain effects over time, should this prove necessary.

## *Optimum tempo will shatter an enemy's cohesion in warfighting and ensure effects are delivered in the best sequence in other operations*

describes notions of speed of reaction, or even pro-action, it need not substitute speed for mass. Indeed, agility can be exploited to achieve mass from a dispersed force, if that is deemed desirable to, for example, mask blue force intentions. Commanders will seek to achieve and maintain

### **Command**

*The authority for the direction, coordination and control of joint and integrated forces*<sup>16</sup>

SSA, together with widely shared Command Intent<sup>17</sup> should allow forces to grasp and generate



fleeting opportunities and to cross traditional environmental (land, sea, air) and functional boundaries (intelligence, operations, logistics etc), confident that it will not lead to unintended effects such as fratricide and collateral damage. The result should be an ability to create effects at optimum tempo. There is tension, however, with on the one hand the responsiveness, creativity and freedom of action that the concept of agility seeks

conditions for both information flow and individual action. *Collaborative planning* will allow Command Intent to be engineered concurrently, allowing all force elements to understand the Strategic context but to be focused on the Operational or Tactical commander's intent. SSA should allow *optimum synchronisation*<sup>19</sup> between force elements but, if it slips, higher level commanders must be ready to reassert control.

### *Collaborative planning will be a key element of Shared Situational Awareness*

to enable and, on the other hand the degree of control required to ensure tactical actions are harmonised with the required effects at the Operational and Strategic levels. We should strike the balance between the two by empowering all levels of command, but allowing higher commanders to 'reach forward' and exert control when appropriate – in other words an 'adaptive' C2 system.

There is a danger, however, that the continual oversight that networks provide can allow senior commanders, politicians and even their advisors to exercise detailed control on an almost minute-by-minute basis. This can emasculate subordinate commanders, lead to a reluctance to take risks or to innovate and encourage a tendency to 'interfere-forward'. It will require high quality leadership to ensure that this does not happen and that subordinates feel free to exercise freedom of action. If we get it right it will, however, be an expression of *Mission Command*<sup>18</sup> for the Information Age.

It follows that in all operations commanders will need to strike an appropriate balance between centralised and decentralised operations, also to ensure that they maintain clear lines of responsibility.

The key to resolving the tension between the two will be a shared information environment that uses a richer, more broadly distributed and better understood *Command Intent*. This will set the con-

The ideal will be minimal corrections on the 'command tiller' to re-establish synchronisation, followed by re-delegation to the lowest possible level. Although difficult to achieve (doubly so in coalition operations, where cultures and command philosophies vary), the prize is higher tempo and improved agility. Future training must examine the tension between centralised and decentralised modes. For the bulk of force elements, particularly at the tactical level, the decentralised mode is the most challenging. At higher levels, training should emphasise the identification of those occasions where reversion to the centralised mode is appropriate.

#### **The role of understanding**

An operational environment that emphasises agility and tempo will require commanders who have the confidence and flexibility to exploit fleeting opportunities and who allow subordinates the freedom of action to use their initiative. Above all, commanders will need what Frederick the Great termed 'coup d'oeil' - the inner light of understanding derived from experience and intuition that will allow them to make sense of a chaotic, non-linear, battlespace. They will not only need to understand this environment, they will need to be comfortable in it.

#### **Collaborative planning and execution**

A shared information environment will allow commanders and staffs at all levels and functions to interact immediately a plan is initiated, in other

## *Force Elements will be mission and not environmentally organised. C2 structures will be more responsive*

words to plan collaboratively. This is very different from the traditional approach, where multidisciplinary teams at each level of command develop plans sequentially and then cascade orders downward. Firstly, because everyone is continuously aware of the Strategic and Operational level context, collaborative planning will be an important element of SSA. Secondly, it should allow much earlier identification of critical paths such as logistics. Thirdly, since force elements are privy to the same information as higher HQs they should be more likely to respond correctly to fleeting opportunities.

Finally, it should reduce the time required to synchronise operations. Force elements may even be able to prepare for operations before being ordered to do so and plan on the move, as already demonstrated in US Experimentation. Subordinate HQs at every level should be able to initiate their part in the operation with SSA allowing continual adjustment and coordination across virtual flanks<sup>20</sup>.

Networked information will allow force elements to remain dispersed for as long as possible, which will enhance Force Protection and minimise logistic footprints. As mission planning evolves, force elements would assemble virtually, across component and echelon, to form *agile mission groups*, coming together physically only at critical junctures, to maximise concentration of force whilst achieving economy of effort. The composition of

commanders will be critical, as will their own speed and freedom of manoeuvre. On the downside, the inability to interact in person and for commanders to exercise their physical presence may erode mutual trust and cohesion and it will be essential to maintain formed teams at certain levels of command. Unit integrity and mutual trust are critical to making Mission Command work at the tactical level and must not be sacrificed in a headlong rush for agility.

Staff organisation will also require to become more agile. The availability of information on a network should erode the tendency to stovepipe information within traditional staff branches. Smaller HQs would help cross fertilisation and it may be that the traditional J1-J9 staff branches are no longer appropriate. Future HQ structures could, for example, extend the current PJHQ philosophy of adopting task-oriented planning and execution groups, who take ownership of operations from inception to completion.

### **Coalition C2**

Coalition warfare will require us to work with a wide range of capabilities and cultures. Cross-component and coalition C2 should be viewed as a requirement to initiate and coordinate tasks<sup>21</sup>. Technological capability, along with these human and organisational attributes can be used to describe the need to firstly, *integrate*<sup>22</sup> for combat operations with key allies that are able to exploit

## *It is the organisational, doctrinal and cultural aspects that are the real barriers to interoperability*

mission groups would vary according to the specific capabilities required and the scale and duration of the task.

This virtual assembling could also mask intent, by providing unpredictable patterns of operation and increasing the likelihood of surprise. This concept would, however, have major implications for logistic support compared with traditional operations. The understanding of Command Intent by logistic

the future information environment, but perhaps only *inter-operate*<sup>23</sup> with other MN forces. In the extreme case of allies with no digitised capability or strong cultural barriers we will *de-conflict* entirely, although we will still seek unity of purpose.

Integrated forces will exchange near real time information over secure links using shared procedures, a common command ethos and deep understanding of cultural differences. Inter-operable

## *The control of forces consumes time. The objective of control is to contribute, not to interfere*

forces are likely to use reversionary techniques and processes such as liaison officers and standing procedures. De-conflicted forces will share a 'unity of purpose' within the coalition but separate their activities in space and time in order to prevent them becoming an unacceptable drag on coalition tempo.

In most cases it is the organizational, doctrinal and cultural aspects, not just the technological issues, which are the real barriers to interoperability. Of all these security is probably pre-eminent.

It, more than anything else, inhibits the flow of information within the military, between Government departments and within a coalition. Differences between coalition partners will continue to cause friction. In particular, the British way of command may sit uneasily with the preference amongst others for more detailed control. The key will be to retain unity of coalition effort, if not the traditional view of unity of command. It is likely that some allies, even if they have the technology, will have cultural differences that inhibit the desired tempo. It follows that UK Armed Forces will require commanders and staffs who have the patience, tact, flexibility and cultural empathy needed to minimise these difficulties. These qualities will also be required to manage relations with non co-operative agencies, such as NGOs, who can create both positive and negative effects.

### **Control**

Control is about guiding an operation: ideally commanders will exercise a degree of control consistent with the objectives at their level. Command should, however, be de-coupled from control wherever possible because control of forces consumes time and may hinder rather than help tempo. Put another way, the objective of control is to contribute, not to interfere. Therefore the exploitation of technology to 'reach forward' is valuable only if it contributes to success. The imperfect interpretation of Command Intent,<sup>24</sup> combined with chaos in the physical domain, may lead to operations becoming desynchronised and, therefore, the need for a measure of control to realign tactical actions with Strategic and operational level goals.

There is a strong link between the complexity of the operating environment, what constitutes optimum tempo for that environment and how much control might be exerted to achieve it, as demonstrated by the way Army C2 has developed in Northern Ireland over the years<sup>25</sup>. Finally, Campaign Effectiveness Analysis is a crucial element of control. It is what allows commanders to detect discontinuities, adverse outcomes or simply the wrong effects occurring in the battlespace. With that immediate feedback, control can be exerted to shape the correct outcome.

### **Inform**

*The acquisition, collation, processing, management and distribution of information*<sup>26</sup>

The majority of our current information systems are compartmentalised by component, sub component, echelon and weapon system. Although recognised maritime and Air pictures exist and can currently be merged into a nascent Common Operational Picture (COP)<sup>27</sup>, a Recognised land Picture is some way off. Therefore, a truly Joint operational Picture is a distant aspiration and, as a result, UK Armed Forces do not yet enjoy SSA.

In addition to SSA, 'Inform' is required to enable EBO by enhancing the information currently available (such as infrastructure nodal analysis, military capability and environmental data), but also to give more detailed knowledge covering culture, Value Sets<sup>28</sup>, leadership structure, and the information needed for CEA, for red, white and blue components in the battlespace.

### **A new information paradigm**<sup>29</sup>

Theoretically SSA would give every platform and individual access to all information. The laws of physics and finance suggest, however, that this is not achievable whilst the Information Management challenge presented by our current level of digitisation suggests that it may not even be desirable. Instead, we need a structured environment where sufficient information for comprehensive SSA is made available to those who need it. Above all, the current information 'push' paradigm, where producers determine what users need, needs to be replaced by an information 'post

## *The Information domain should consist of predetermined and reconfigurable Communities of Interest*

and pull' paradigm, where users state the requirement or extract what they need from 'bulletin boards'. This has enormous cultural implications, particularly for communities who have traditionally 'released' information as they saw fit.

### **Communities of interest**

The detail of SSA required will vary at each level of command and a single picture will not satisfy all. It follows that the battlespace should be configured for efficient information sharing by identifying *Communities of Interest (CoI)*, within which information flows can be matched to reflect the differing perspectives of commanders and staffs, as well as their capacity to handle information. It should also permit access to wider communities on demand, with information communities reconfiguring as required. Although 'pull' will be domi-

space sensitive and should not be considered permanent or enduring. It follows that we will need to focus our information gathering resources at the time and place of our choosing and that we will need an Intelligence Surveillance and Reconnaissance (ISR) management process to ensure that this happens and that high value assets are used effectively, even with conflicting priorities.

The UK is unlikely to afford a collection system capable of permanent watch on a global scale 'We cannot be all-seeing all the time – we simply do not have the resources'<sup>31</sup>.

It is, however, within our means to exploit a wide range of sources (military, diplomatic, allied, media) to provide Indicators & Warnings (I&W) which can cue a narrower focus to give a more

## *All information has potential relevance at all levels of command. The notion of organic ISR will apply less in future*

nant we should also have a culture that encourages all entities in the battlespace to 'push' information intelligently where they perceive a need elsewhere.

Of primary importance is that information communities are dynamic and not constrained by echelon, component or functional boundaries. Whilst this may seem a prescription for anarchy, experimentation shows that communities rapidly coalesce and adapt as operations develop<sup>30</sup>, even if full freedom is given at the outset. In order to inform EBO, CoI must reach into the Instruments of Power and the information domains of coalition partners, OGDs and, when appropriate, NGOs. Examples of CoI could include: Military Strategic level planners, task groups formed to undertake a particular line of operation and high data rate, pre-configured sensor-shooter groups.

### **Organising ISR**

To achieve Decision Superiority commanders will need to secure information ahead of adversaries. An information position, however, is time and

concentrated regional view<sup>32</sup>. This approach *could* result in the UK entering a crisis in a position of information weakness. In this case an initial disadvantage could be offset by the creation of pre-populated Knowledge Bases for likely crisis areas and exploiting Knowledge Bases held by other sympathetic parties<sup>33</sup>.

### **Information support to EBO**

Compared with the coarse-grained I&W system,<sup>34</sup> EBO will require much wider, richer information<sup>34</sup>. In particular it will cover all dimensions of the Strategic environment with an ability to analyse adversary Value Sets, strengths, vulnerabilities<sup>35</sup> and the physical environment<sup>36</sup> for a Joint Operational Area (JOA). Finally, EBO requires us to understand and track measures of effectiveness for CEA. The effects based philosophy seeks to achieve cognitive effects, which are difficult to measure. We need, therefore, a better understanding of how events impact upon an adversary's mind, which will depend upon correctly identifying reliable secondary and tertiary indicators of behaviour.



### Analysing information

Analysis is the task of converting data into useful information. The detailed information needed for EBO implies an increased amount of processing, due to the far higher number of information sources. It is imperative that it is analysed using common processes across the Joint Force, otherwise differing interpretations could lead to the delivery of divergent effects. Some raw data will have immediate utility, but some will require assessment by specialists to enrich it and to avoid being deceived by an adversary. This concurrent process will require careful management for the following reasons:

- Processing can destroy information. The producers of information cannot know all the uses to which it might be put or the significance of some details for particular organisations. This reinforces the 'post before processing' paradigm so that information is not lost through processing<sup>37</sup>.
- It will be important to get information into wider CoIs early and it will no longer always be appropriate for specialists to release the product of their analysis as completed packages. Agility demands earlier and wider exposure of potentially useful information, for which we will need better visualisation techniques if we are to make sense of it.
- The formatting and indexing of this less structured information must be carefully managed if correlation is to be made between key items of information within a CoI. New KIM techniques may become critical enablers for the integration of information streams, although the most complex correlation will continue to be undertaken by experienced commanders.

### Exploiting information

The initial composition of a CoI would be determined as a result of the EBO process; it would then be primed by an intelligent 'push' of information. This initial burst must contain Command Intent and other critical information needed to set the context for subsequent information flow and exploitation. The information required by a pre-determined CoI (e.g. a dedicated sensor-shooter team), is likely to be well structured. For more

flexible CoIs that have been created for a specific task the priming package is, however, less likely to be complete and will generate a greater need to 'pull' information. This, in turn, could lead to adjustment of CoI composition.

A CoI should also push any new information deemed useful for others back into the wider domain. This inward and outward flow of information will encourage better synchronisation of elements; an essential requirement for increased tempo. A further benefit of synchronisation should be fewer information gaps; this will lead to fewer requests for information and allow bandwidth to be preserved for swift responses to the unexpected.

### Disseminating information

The future information architecture must be joint, reliable, robust, secure, interoperable with other MN forces and integrated with digitised forces. It is likely to be federated, linking established and emergent CoI in a common domain. If it is to benefit from rapid advances in technology and avoid early obsolescence it needs to be based on commercially available protocols and standards<sup>38</sup>. Ideally, it would enable a real and NRT capability at formed unit level. The only restrictions on access to information should be on the basis of classification, sensitivity or granularity. Managing access will, however, be made more complex by the need to support EBO.

Content-based information security processes and technology will enable a single structured information domain<sup>39</sup>; essential to a 'pull' based information handling approach. This could permit 'virtual' collaborative planning, thus permitting dispersal within or beyond the theatre of operations. Moreover, the availability of Reachback to major databases and functions in the UK should help reduce deployed footprints. Databases will require careful management. Information formats will also need to make best use of available bandwidth, particularly at tactical levels where the bandwidth is narrowest and the rate of messaging highest. Paradoxically this could require a return to the discipline of formal staff processes, which have been eroded by the advent of e-mail<sup>40</sup>.

### Maintaining information

Given the role of information in the EBO process, Information Assurance will be imperative to ensure its availability, integrity, authentication, confidentiality<sup>41</sup> and timeliness. The information domain will need careful protection; of both its physical elements and the information it contains within it. This is a critical vulnerability that will be discussed in the 'Protect' element of the HLOC. Apart from the need in a democracy to audit decision making, there will be an increasing need to provide information that is precise, timely and evidential in order to prove the legality of military action, particularly where pre-emptive self-defence is concerned.

As the legitimacy of our decision making is determined by reference to information that is reasonably available to us, timely collation and dissemination has an additional impetus. There will also be the need rapidly to produce evidence in order to rebut adverse or incorrect media assertions. As a result, we must maintain an audit trail of all information flows that lead to decisions.

### Summary

- The future battlespace will be complex and uncertain. Globalisation has created conditions where effects are very closely coupled with multiple, possibly unintended, consequences. Proliferation of information and weapon technologies is expected to continue but tolerance to casualties and collateral damage will diminish. Legal imperatives will constrain our freedom to operate and this will give our adversaries an asymmetric advantage.

- EBO could realise the full potential of the manoeuvrist approach. Effects are physical and cognitive, primary and subsequent, intended and unintended. They can be applied to friendly, adversary and neutral parties, across the seven dimensions of the Strategic environment using each of the Instruments of Power. EBO seeks to exploit the full lexicon of effects; therefore its full potential lies across a wide spectrum of operations.

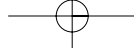
- Future operations are as likely to be in *ad hoc* coalitions of the willing, as they are to be with

established allies. The technological capabilities of potential coalition partners will range from those that attempt to stay abreast of US Transformation to those that cannot. In most cases it is the organizational, doctrinal and cultural aspects, not just the technological issues, which are the barriers to interoperability. Therefore we will need to *integrate* fully for warfighting with certain allies but perhaps only *inter-operate* with others. In the extreme case we may need to *de-conflict* entirely in space and time from those allies that do not share communication structures, processes or culture. The key will then be to retain 'unity of purpose' within the coalition.

- UK operations will be underpinned by an ethos of agility. This core ethos is characterised by responsiveness, robustness, flexibility and, most critically, adaptability. It is an attitude of mind and a benchmark for future capabilities, structures and procedures that will better enable UK Armed Forces to deal with the unexpected.

- The immense power of new information tools may go to waste until we understand which relationships between command and control are most relevant to the information age. We should decouple command from control in order to exploit the new information tools. Control should only be exercised if it *contributes*.

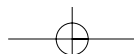
- The Command and Inform (C&I) goal is to enable Effects Based Operations (EBO) to guide highly responsive, mission-oriented force elements that exert synchronised freedom of action throughout the battlespace. It is underpinned by Shared Situational Awareness, a condition where force elements achieve a common understanding of both the operational context and the tactical situation. The net result will be a significant operational advantage through a step change in agility and tempo. The Command core concept is an enduring vision of Mission Command relevant to the Information Age. It promotes high tempo through the creativity and initiative of well-informed subordinate commanders. It relies on a network-wide expression of Command Intent and a high degree of SSA. An adaptive C2 process will seek to reduce the inevitable tension between desired freedom of action and the synchronisation of effects



needed to align strategic and Operational level goals with tactical actions. The result will be an agile joint force fully empowered to exploit with resilience the most fleeting of opportunities in the battlespace. Linked to the idea is the delivery of Decision Superiority, generated by SSA within and between task-orientated Communities of Interest. It will exploit a federated information architecture in order to enable collaborative processes within a single information domain.

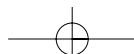
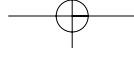
#### Notes

- 1 JDCC, Strategic Analysis Programme, Summary of Implications, Pilot Iteration.
- 2 The UK Joint Vision, JDCC, 15 June 2001.
- 3 Defined as the three environments of Land, Sea and Air, plus time, the Electro-Magnetic Spectrum (EMS) and the computer generated dimension.
- 4 A current description of AI Q'aida as birds, which generally travel alone but come together to form a flock in response to 'swarming' stimuli, may indicate the shape of adversaries to come.
- 5 In his seminal work, 'Summary of the Art of War' Jomini described the geometric battlefield with boundaries and positive control lines that has characterised land warfare in the Industrial Age from the time of Napoleon through to the present day. In particular, he articulated the requirement for a base, an objective, lines of operation and lines of supply. It was never a very successful way of describing the Maritime and Air environments and is ill suited to warfare in the Information Age.
- 6 'In one moment of time, our service members will be feeding and clothing displaced refugees - providing humanitarian assistance. In the next moment, they will be holding two warring tribes apart - peacekeeping. Finally, they will be fighting a highly lethal mid-intensity battle. All in the same day, all within three city blocks'. Gen C C Krulak, Comdt USMC.
- 7 Thea Clark and Dr Terry Moon, Interoperability for Joint and coalition Operations, ADF Journal No 151 Nov/Dec 01.
- 8 V Adm M Stanhope, DCINC FLEET, at the Fleet Study Period, Maritime Warfare Centre, 26 Nov 02.
- 9 'Linking sensors, decision makers and weapons systems so that information can be translated into synchronised and over whelmingly rapid effects'. D/CM(IS)2/1(106/02) dated 29 May 02.
- 10 Situational Awareness (SA) is defined as 'the understanding of the operational environment in the context of a commander's (or staff officer's) mission (or task)' - JWP 0-01.1.
- 11 An approach to operations in which shattering the enemies overall cohesion and will to fight is paramount. It calls for an attitude of mind in which doing the unexpected, using initiative and seeking originality is combined with a ruthless determination to succeed. British Defence Doctrine, JWP 0-01, 2nd Edition.
- 12 Economic, political, military, legal, ethical and moral, cultural, physical - JDCC Strategic Analysis, Pilot Iteration.
- 13 Diplomatic, Military and Economic.
- 14 In other words, to avoid 'groupthink', a recognised situation in close knit groups whereby challenging the 'truth' can be perceived as disloyal or disruptive.
- 15 'The application of knowledge by commanders to make quality decisions directing assigned forces and harnessing additional support at the right time, such that they preserve operational flexibility and maintain the initiative in the battle space'. DG Info (CBM) working definition May 02.
- 16 Definitions are taken from the Defence Capability Framework D/JDCC/7/1, 13 Sep 02.
- 17 Command Intent is a statement that focuses on the decisive elements of how a mission should be accomplished. It must be rich enough to convey intent but simple enough to be unambiguous. The key is to leave sufficient room for initiative and interpretation by individual commanders. Adapted from Network Centric Warfare - Developing and Leveraging Information Superiority 2nd Edition Aug 99 p34. David S Alberts et al, DoD C4ISR Co-operative Research Programme.
- 18 A style of command that seeks to convey understanding to subordinates about the intentions of the higher commander and their place within his plan, enabling them to carry out missions with the maximum freedom of action and appropriate resources. Adapted from British Defence Doctrine, JWP 0-01, 2nd Edition.
- 19 Optimum synchronisation not only includes time and space but is achieved when primary and secondary effects are being generated in harmony with Command Intent, in particular the Strategic and operational goals.
- 20 The disruption caused by the fuel tanker strike in the UK during winter 2000 is an example of so-called 'self synchronisation'. Lacking any national leadership or formal organisation, but armed with a common intent to move the government on the fuel tax issue, and informed by mass media telecom and the Internet, disparate groups acted in concert to create havoc. This concept is not as revolutionary as some would claim. A 1930's German Army pamphlet stated: 'the emptiness of the battlefield requires fighters who think and act on their own and can analyse any situation and exploit it decisively and boldly'. The German Army system demanded that, when necessary, the various Arms should co-ordinate and act together without direction from above. In J Storr, A Command Philosophy for the Information Age. Ed D Potts, The Big Issue, SCSi No 45, Mar 02.
- 21 As described in the US DoD 'Levels of Information Systems Interoperability' (LISI). This sees seven support layers for C2: C2 Frameworks, which constrain and support processes, which can be organisational, legal, philosophical, financial or conceptual in nature; C2 Processes that identify key activities, individuals and groups and illustrate how the C2 organisation works; Information Management that captures stores and retrieves information; and finally, Information Technology; and Communications Links. The emphasis on the higher level of support (C2 Frameworks and Processes) is toward people. It highlights again the importance of the human element of command. Further Human Sciences research may be needed to optimise the development of future C2 structures, processes and training, whereas 'pure' technology has more emphasis at the lower levels (IT and Communications Links). A development of the LISI model ( by Thea Clark and Dr Terry



- Moon, in 'Interoperability for Joint and Coalition Operations', ADF Journal No 151 Nov/Dec 01) derives levels of interoperability from four enabling attributes: *Preparedness* considers what doctrine, experience and training enable organisations to work together; *Understanding* asks what level of information and knowledge sharing exists and how it is used; *Command Style* addresses how roles and responsibilities are delegated or shared; and *Ethos* determines the levels of trust, culture, values and goals that are shared.
- 22 'Combine or be combined with to form a whole'. Concise Oxford Dictionary, 10th Edition.
- 23 'Able to operate in conjunction'. Concise Oxford Dictionary, 10th edition.
- 24 There is a human factors issue when conveying an experienced commander's thoughts to less experienced subordinates through the information domain; where the 'lense of human perception' can complicate the process. Whilst doctrine and training make the process more predictable, intent is often misinterpreted.
- 25 A good example of an 'adaptive C2' system that works well is UK Army operations N Ireland, a very politically sensitive operating environment. Land forces in N Ireland have had an 'all informed' voice radio system for twenty years, whereby the GOC (if he chooses) or any other commander can listen to any tactical radio net. This has proved very powerful for Media Ops staff, for example, who can listen to an incident as it unfolds and issue a very rapid and credible account, before other organisations who may wish to give a different version of events. Although the GOC and Brigade commanders could in theory 'interfere forward' on the tactical net, in the authors experience this happens very rarely. Long experience has taught that this creates uncertainty and confusion at a time when tactical commanders have to think and act very fast indeed. In other words, it does not *contribute* to the success of the operation. Any corrective action tends to take place 'off line' between commanders and staffs, so that the integrity of the chain of command is maintained and not undermined
- 26 Definitions are taken from the DCF.
- 27 The COP is a subset of the JOP that shows the current, Near-Real-Time picture. The JOP is a much broader information tool. See 'Inform: Exploit' below for a full description of the COP and JOP.
- 28 Those 'values' held by an individual, group, organisation, regime or nation, which form the basis of their Strategic Centre of Gravity. This involves understanding a potential adversary's psychology, plus the formative factors (cultural, religious, ideological, historical, economical and political) that drive his intentions, objectives and modus operandi.
- 29 'A technical example, pattern or model'. Concise Oxford Dictionary, 10th Edition.
- 30 US experimental experience indicates that CoI self configure very rapidly once information starts circulating around a net work. Personal communication from Vice Admiral Cebrowski, Head of the US DoD Office of Transformation.
- 31 CDS Speech to RUSI, 10 Dec 01.
- 32 The 'cue-scan-focus' approach. Maj Gen R Fulton, UK MoD Capability Manager (Information Superiority) in a speech to the RUSI C4ISR Conference 10 Sep 02.
- 33 It is likely that soon most major NGO's, for example, will have accessible databases for areas where they operate. It is likely, also, that these Knowledge Bases will have been built up over many years and will represent a body of knowledge that the military could not hope to replicate in normal operational time frames.
- 34 The elements of information 'width' or reach are: Sharing by Functional area; Sharing by Alliance/Coalition; Sharing by component/echelon; Sharing latency; Sharing by security level; Sharing by number of nodes; Continuity over time; and Geographic range. The elements of information richness are: Completeness; Correctness; Currency; Accuracy or precision; Consistency; Assurance; Timeliness; and Relevance. P 95 - 100, Information Age Warfare, David S Alberts, John J Gartska, Richard E Hayes and David A Signori, DoD C4ISR Co-operative Research Programme, 2001.
- 35 The JDCC-led Potential Generic Adversary project has a well-advanced study examining the motivational and capabilities aspects of future adversaries.
- 36 Geophysical, hydrographic and meteorological data for forces' manoeuvre generally, propagation information for surveillance sensor tasking and weapon performance limitations.
- 37 Information Age Transformation, David S Alberts, DoD C4ISR Co-operative Research Programme, 2002.
- 38 It is industry's view that in future military orders will be such a small part of their overall business that, as they are reliant on large volume/small margin production, investment in 'bespoke' military standards will not be cost effective. RUSI C4ISTAR Conference 24 - 25 Sep 2002.
- 39 JFCOM presentation to NATO CDE Conference Oct 02.
- 40 It is useful to reflect that Army operational 'Staff Duties' originated in order to facilitate message transmission using Morse Code on telegraph and, later, HF radio - in other words to make full use of restricted bandwidth.
- 41 JWP 3-80 dated Jun 02.







# *Pre-Emptive Strike*

By Dr Alfred Price FRHistS

Shortly before dawn on 22 June 1941, without the courtesy of a formal declaration of war, German forces launched a massive attack on the Soviet Union, Operation Barbarossa. On that first day one of the primary Luftwaffe aims was the destruction of the opposing air force. Its attack achieved complete surprise and found the Soviet Air Force completely unprepared. As a result, that service suffered the heaviest defeat ever inflicted by one air arm on another.

Although Germany and the Soviet Union had signed a non-aggression pact in August 1939, there was little trust between the two nations. Under

the terms of the treaty the Soviet government was free to extend its sphere of influence in Eastern Europe. In short order its army occupied Latvia, Estonia and Lithuania and seized parts of Rumania and Finland.<sup>1</sup>

To Adolf Hitler the non-aggression pact with the Soviet Union had been merely a diplomatic tactic to prevent Soviet interference, while he pursued his aim to invade Poland and recover territory lost in 1918.<sup>2</sup> Once that nation had been defeated, under the terms of a secret agreement Germany and the Soviet Union divided its territory between them.<sup>3</sup>

*For the opening of the campaign the Luftwaffe amassed 2,699 combat aircraft in the east. It was a strong force, but considering it was about to launch on a campaign fought over a frontage of more than 1,000 miles, it was by no means lavish*

As a long-term policy aim, Adolf Hitler sought to establish an empire for Germany by seizing large swathes of the territory of the Soviet Union. As early as July 1940, when the Battle of Britain was in its initial stages, he had the Operations Staff of the Army General Staff begin initial planning for an invasion of the Soviet Union. The planning staffs were kept as small as possible, and only those officers who had been sworn to secrecy and had a 'need to know' were involved in the discussions.<sup>4</sup> Hitler thought a campaign of three or four weeks would be sufficient to smash the Soviet Army, or at least seize sufficient Soviet territory to establish a German state in the Ukraine, organise a league of Baltic States and enlarge Finland.

By the spring of 1941, while the night blitz on Great Britain was in full swing, the planning for the attack on the Soviet Union was almost complete. At the end of April, with a minimum of fanfare, the first Luftwaffe combat units earmarked for the operation transferred to bases in Germany to reform. Others moved to bases in Poland for 'retraining'. The operation had been minutely planned to keep its true intent secret for as long as possible.

#### **Secrecy precaution**

Leutnant Dieter Lukesch, a Junkers 88 pilot with IIIrd Gruppe of Kampfgeschwader 76 based at Cormeilles-en-Vexin near Paris, described the elaborate subterfuge that attended the move of his unit to the east. The first indication he had that something was afoot came early in June 1941, when his unit was ordered to remove the temporary black distemper applied to the aircraft for night operations against Great Britain. Instead, the upper surfaces of the bombers were to be repainted in light brown camouflage. That suggested daylight operations in a desert area, but where? Before the work was completed, the order was countermanded. The planes were to be restored to their original colour scheme with the topsides camouflaged in two shades of green. Once that work was complete, most of the unit's technical personnel were suddenly ordered to leave for an undisclosed destination. Only a few men were left behind to look after the aircraft. In the days to follow the mystery deepened, as Lukesch explained:

*The aircrew were summoned to a meeting in the middle of the airfield, well clear of everyone else. There the Gruppe commander, Major Lindmayr, solemnly opened an envelope that contained our sealed orders. What followed only served to heighten our curiosity. Our planes were fuelled up. We were told to load our personal kit on the aircraft, then take off and form up by Staffeln behind Lindmayr who was to lead us to our still-secret destination. We took off from Cormeilles and flew over Holland and Germany before landing at Anklam [a Luftwaffe airfield on the Baltic coast]. After we taxied in and shut down the planes, we were driven to a barrack block where we were kept in isolation. Everything there had been prepared for us, our beds were made, the tables had been laid and a meal was ready.<sup>6</sup>*

The next day was a near repeat of the previous one. Again there was the briefing on the airfield, again the brown envelope was solemnly opened and again the crews were told to take off and follow Lindmayr to the undisclosed destination. Lukesch continued:

*This time, after a flight of two hours, we landed at Schippanbei just south of Königsburg. When we arrived we found that our technical people were already there, they marshalled us into prepared camouflaged dispersal points around the airfield. The aircraft were then carefully concealed under camouflage netting and branches cut from trees. Then the planes were refuelled and bombed up, but still we did not know where we were going.<sup>7</sup>*

The IIInd Gruppe of Kampfgeschwader 3, also with Junkers 88s, experienced a similar pattern of events. It flew in stages from Oldenburg in Germany to Podlotowka near Brest-Litovsk in Poland. Rumour followed counter-rumour on the reason for the move as one of the unit's pilots, Feldwebel Horst Schulz, recalled:

*When we arrived at Podlotowka we saw a lot of army units there, infantry, artillery and tanks. Rumours were rife and the most popular was that the Russians were going to let a German force of two or three divisions with air support through their territory to attack the British oil fields and pipelines in Iran.<sup>8</sup>*



As part of the measures designed to conceal these moves, those units that had been operating against Great Britain left behind some of their radio operators to send spoof W/T transmissions, to give the impression that their unit was still in place. The final part of the transfer of Luftwaffe combat units to the east was accomplished within a space of about three weeks.

#### German order of battle

For the opening of the campaign the Luftwaffe amassed 2,699 combat aircraft in the east, as listed in the table. It was a strong force, but considering it was about to launch on a campaign fought over a frontage of more than 1,000 miles, it was by no means lavish.

#### Luftwaffe order of battle assembled for attack on the Soviet Union, 21 June 1941<sup>10</sup>

The line up of Luftwaffe units in the east was as follows:

Luftflotte 1 under Colonel General Keller with 474 combat aircraft was to support Army Group North (26 divisions) during its advance along the Baltic Coast through Lithuania, Latvia and Estonia.

Luftflotte 2 under General Field Marshal Kesselring, with 1,208 combat aircraft comprised the main part of the Luftwaffe striking power; it was to support Army Group Centre (51 divisions) during its advance on Smolensk and then on to Moscow. Luftflotte 4 under Colonel General Loehr, with 935 combat planes, was to support

	Luftfl. 1	Luftfl. 2	Luftfl. 4	Luftfl.5	Total
Single engined fighter	98	358	337	10	803
Twin engined fighter	-	78	-	-	78
Ground attack aircraft	-	51	-	-	51
Twin engined bomber	210	372	334	10	926
Dive bomber (Ju 87)	-	115	-	42	157
Long range recce	70	63	113	10	256
Short range recce	69	171	151	10	401
Coastal	27	-	-	-	27
<b>Totals</b>	<b>474</b>	<b>1,208</b>	<b>935</b>	<b>82</b>	<b>2,699</b>

Table shows the total numbers of combat aircraft on the strength of front-line units. Serviceability was about 60 per cent. The Luftflotten fully committed to the attack on the Soviet Union were Luftflotten 1, 2 and 4. Luftflotte 5 operated from airfields in Norway and was committed mainly to operations against Great Britain. In its case the table gives the approximate numbers of aircraft it contributed initially to the campaign in the east.

It can be seen that the Luftwaffe provided a powerful reconnaissance effort to support the land and air operations in the east, with 657 long range and short-range reconnaissance/army co-operation aircraft. These comprised almost a quarter of the Luftwaffe strength committed to the new campaign. Note the small number of Junkers 87 Stuka dive-bombers committed to the operation, 157 aircraft or about 6 per cent of the force. In the months to follow these units would punch well above their weight.

*German intelligence had discovered that Soviet forces were massing along the border for a treacherous onslaught against Germany. It went on to say that the Fuehrer had now been forced to order the counter-stroke, to save European civilisation and culture. There was, of course, no Soviet strike in the offing.*

Army Group South (40 divisions) advancing along the northern shore of the Black Sea. Luftflotte 5 under Colonel General Stumpff, operating from bases in Norway, was only partially involved in the new offensive and it contributed 82 combat planes.<sup>11</sup>

#### **Soviet air strengths, and weaknesses**

According to Luftwaffe intelligence sources, in June 1941 the Soviet Army Air Forces had 7,300 aircraft deployed in European Russia, about 3,000 in the interior and 2,000 in the deployed in the Far East. In fact that massive total, 12,300, was an underestimate by nearly one-fifth and the actual figure was just short of 15,000 aircraft. Along its western border the Soviet Army Air Force 7,850 aircraft deployed, supplemented by 1,500 Home Defence fighters and 1,445 aircraft deployed with the Navy's western fleets. A further 4,140 aircraft were deployed in the Far East.<sup>12</sup>

Certainly the Soviets possessed huge numbers of aircraft, but the vast majority of these planes were obsolescent or obsolete types. The new mono-plane fighters just starting to come off the production lines in useful numbers, the LAGG 1, the LAGG 3, the MiG 3 and the YAK 1 were a great improvement over their predecessors, though only the last one was really a match for the latest Messerschmitt 109F which equipped many Luftwaffe fighter units.<sup>13</sup>

Compounding the weaknesses in equipment were the weaknesses in personnel, particularly at the higher levels. Joseph Stalin's purges of the officer corps had hit the Army Air Force hard. That force was now on its fourth commander in less than four years, the previous incumbent having been arrested in April 1941 (he, together with the erstwhile head of Long Range Aviation, would be shot in October). His successor, Lieutenant General Pavel Zhigarev, was inexperienced in the post as were most of his senior subordinate commanders.<sup>14</sup>

As if those problems were not serious enough, there was the added weakness of Stalin's propensity to leadership by whim. He discounted the reports coming in from various sources of a possible German attack as 'western propaganda', intended to sour the relationship between the two countries. He impressed on his military and air commanders the need to do nothing that the Germans might consider provocative. To that end, air force units were specifically forbidden to disperse or camouflage their aircraft. At many airfields they were set out on the ground in neat rows, as if for inspection.<sup>15</sup>

Stalin finally realised an attack was imminent at around midnight on 21 June. An order went out to all military units in the west to come to immediate readiness, and air units were ordered to disperse their aircraft and camouflage them. The Soviet communications system left much to be desired, however, and in many cases the new order failed to reach front line units before the initial blow fell.<sup>16</sup>

#### **The offensive opens**

During the evening of 21 June the units earmarked for the operation finally learned whom they were to attack, and when. The men were assembled and each commander read out an order of the day from Adolf Hitler. The order stated that, despite the treaty of friendship between the two nations, German intelligence had discovered that Soviet forces were massing along the border for a treacherous onslaught against Germany. It went on to say that the Fuehrer had now been forced to order the counter-stroke, to save European civilisation and culture.<sup>17</sup>

There was, of course, no Soviet strike in the offing. However, many German officers and men who heard the order would continue to believe the canard for many years after the war.<sup>18</sup>



*The Ju 88s cruised at 10,000 feet, each carrying the standard load of four 250 kg and ten 50 kg general-purpose bombs*

Shortly after 0300 hours Central European Time on 22 June, the German army opened its offensive on the Eastern Front. First there was a massive artillery bombardment then, in true *Blitzkrieg* style, armoured spearheads began thrusting forwards. Between the Baltic and the Black Sea 117 German divisions, of which 48 were armoured, plus 14 Rumanian divisions and a Hungarian army corps, swung into action. Facing them in the immediate battle area were 132 Soviet Army divisions of which 34 were armoured. Thus 7\_ million men were committed in the most ferocious armed clash in history.<sup>19</sup>

German Army commanders had decreed that the onslaught would commence before dawn, so their initial attacks could achieve maximum surprise. The Luftwaffe had to fit in with that timing as best it could. It therefore sent small numbers of Heinkel 111s, Dornier 17s and Junkers 88s flown by picked crews to attack the more important Soviet airfields shortly after zero hour. Their aim was to disrupt activity at the Soviet airfields, and delay the dispersal of aircraft until the larger German attack forces reached them when it was light.<sup>20</sup>

With the arrival of dawn, however, the majority of Soviet air units had not received the warning order and as a result they were taken by surprise. Even when they heard the thunderous German artillery bombardment commence to the west, many Soviet airfield commanders were too afraid of incurring Stalin's wrath to initiate moves to safeguard their aircraft. As a result, hundreds of Soviet fighters, bombers and reconnaissance planes were still sitting on the ground in neat rows close together.

The initial target for Dieter Lukesch's Gruppe was the airfield at Krudziai south of Riga in Lithuania. Although he had flown several combat missions previously against Great Britain, this one was quite unlike any other:

*The skies were beautifully clear, with visibility almost unlimited. Soon after we took off we could see the front line quite clearly, marked by fires and the smoke from bursting shells. Once we had passed the front, however, there was no flak. We did not have, not did we expect to need, an escort for the first attack. As we passed other airfields we saw Russian fighters taking off, but they climbed somewhat slower than our cruising speed so we soon left them behind.<sup>21</sup>*

The Ju 88s cruised at 10,000 feet, each carrying the standard load of four 250 kg and ten 50 kg general-purpose bombs. At the target the bombers moved into line astern and released their bombs in shallow dives. Although this was some hours after the start of the artillery bombardment, there were more than a score of the Tupolev SB-2 bombers drawn up in line along one side of the airfield. Lukesch continued:

*There was no flak, and even though the war had been in progress for about three hours it seems that we had achieved surprise. As we approached for the first attack we could see ground crewman standing on the wings refuelling the aircraft, looking up in curiosity as we ran in. As the bombs started to explode they made hasty retreats into the nearby forest.<sup>21</sup>*

The Ju 88s attacked in line astern, but there was some jockeying for position. As Lukesch was about to release his bombs he saw another aircraft converging on him from the right as it released its bombs.

*I had to break away, make a circuit and attack at the end of the force. I ran in as the last aircraft in the Gruppe to attack. By then several aircraft on the ground were burning and there was quite a lot of smoke, but the line of trees behind the aircraft helped me to line up on some planes that had not been hit before. During the attack my observer fired at the enemy planes with his machine gun. As we pulled away after the attack some Russian fighters appeared on the scene, Ratas and Gulls [Polikarpov I-16s and I-15s]. Although they got close they did not fire at us, perhaps they did not have any ammunition. With my greater speed I soon left them behind.<sup>22</sup>*

The Luftwaffe compendium report on the day's action gave details of attacks on individual airfields, excerpts from which are given below.<sup>23</sup>

*0320-0355 hours. Attack on Kowno I by 11 bombers with 48 SC 250 [general-purpose 250 kg] and 60 SD 50 [semi-armour piercing 50 kg] bombs, from altitudes between 2000 and 2500 m [about 6,500 and 8,000 feet]. Along the west side were parked aircraft, some of which were destroyed with direct hits. Numerous parked aircraft as well as one hangar on the north side observed to*

*be on fire. [Defensive Reaction] inaccurate medium Flak, ineffective. Attack by three I-16 [fighters] without result. [Post strike reconnaissance] 25 destroyed aircraft, mostly single-engined types. 20 single-engined aircraft not destroyed.*

*0348-0400 hours. Attack on Poniewesch by ten bombers from an altitude of 25 m [about 80 feet] with 3,600 SD 2s [small bombs, see below]. The bombs fell amongst a large number of aircraft. Six aircraft were observed for certain on fire. [Defensive reaction] Weak light Flak. [Post strike reconnaissance] 50 aircraft destroyed, 5 multi-engined aircraft seriously damaged, 25 single-engined aircraft not destroyed.*

*0305-0340 hours, 0558 hours and 0950 hours. Attack on Libau II by 34 bombers from an altitude of 500 to 4,100 m [about 1,600 to 13,000 feet] with 952 SD 50 bombs. Crews observed bomb hits amongst aircraft parked and taking off, predominantly I-15s [fighters] . . . Several aircraft set on fire in the western parking area. [Defensive reaction, second attack] Large amounts of medium Flak, accurate. Five single engined fighters seen but they did not attack. [Third attack] Between 15 and 20 fighters launched a weak attack, after opening fire each one immediately broke away.*

#### **The devil's eggs**

That morning some Luftwaffe units employed a new weapon for the first time: the SD-2 fragmentation bomb (weight 2 kg, sometimes called the 'Butterfly bomb'). These small weapons were carried in large numbers in special magazines fixed to attacking planes. After release, the bomb's casing opened up to form a pair of 'wings' and the weapon spun to the ground like a sycamore seed. The 7-oz explosive charge detonated on impact, hurling high velocity fragments with sufficient force to damage to aircraft up to forty feet away. Dropped from aircraft flying low over Soviet airfields, the SD-2 proved highly effective against aircraft and other soft targets.<sup>24</sup>

The IInd Gruppe of Jagdgeschwader 27 was one of the units using the new weapon that day. Each of its Messerschmitt 109E fighters carried 96 SD-2s in a magazine mounted under the fuselage. The unit sent thirty-one fighters to deliver a low altitude bombing and strafing attack on the airfield at



*On the first day of the campaign KG 51 lost fifteen bombers, most of them due to accidents with the SD-2s. That amounted to nearly half the total Luftwaffe loss on that day. The SD-2s immediately gained the grim nickname 'Devil's eggs'*

Wilna. Mounted in conjunction with one by fifteen Junkers 87 dive-bombers, the attack destroyed 31 Soviet aircraft on the ground. The two raiding forces then attacked Lomza-South airfield and claimed the destruction of another forty planes. All the raiders returned safely.<sup>25</sup>

Kampfgeschwader 51 had a much less happy initial experience with the SD-2. That morning the Geschwader despatched all 91 serviceable Junkers 88s to attack six Soviet airfields on the southern part of the front. Each plane carried 360 SD-2s in magazines fitted in the bomb bay. The bombing and strafing attack on Stryj airfield, by eighteen Ju 88s, caused the destruction of about twenty Soviet bombers; the raiders then continued to Lemberg airfield where they destroyed about fifteen fighters.<sup>26</sup>

On their return to their airfield, however, the bomber crews learned that the new fragmentation weapon could be dangerous to friend as well as foe. During the attacks a small proportion of the bombs failed to leave their magazines, and the plane's crew was unaware of the hang-up. Moreover, due to a fault in design, if there was a hang-up the bomb's fuse sometimes became 'live' in flight. Thereafter, the slightest shock might detonate the weapon. Alternatively, on landing, a jammed SD-2 might jolt free and explode. On the first day of the campaign KG 51 lost fifteen bombers, most of them due to accidents with the SD-2s. That amounted to nearly half the total Luftwaffe loss on that day. The SD-2s immediately gained the grim nickname 'Devil's eggs'.<sup>27</sup> Within a few days the weapon was withdrawn from service. It re-appeared several months later adapted for release in containers, as a cluster munition.

#### Other targets

In addition barracks, military headquarters, artillery parks, munitions dumps and an oil storage depot also came under attack during the day. Bombers also flew armed reconnaissance missions along roads leading into the battle area. The compendium report<sup>28</sup> listed the results of some of these missions:

*0855-0913 hours. Attack on an enemy column on the road Tauggen to Schaulen by four bombers with 8 SC 250 bombs, 8 SD 250, 20 SC 50 and 20 SD 50 from an altitude of 1,400 to 2,000 m [about 4,500 to 6,500 feet].*

*1145-1205 hours. Lorry columns on the northern and southern exits of Schaulen, vehicles on roads to the southwest of Schaulen, and a column on the road to Blianske, attacked by one aircraft from an altitude of 400-500 m [about 1,300 to 1,650 feet] using 2 SC 250, 2 SD 250, 4 SC 50 and 4 SD 50 as well as machine gun fire.*

*2030 to 2100 hours. Column of armoured vehicles on the roads Uzventis to Schaulen and Kursenai to Schaulen, attacked by 16 bombers dropping 25 tons of bombs. About 40 armoured vehicles were destroyed.*

While the bombers went about their work of destruction, packs of German fighters swept over the battle area hunting for any Soviet planes that had got airborne. Again, it was a one-sided battle. The Luftwaffe units involved had considerable fighting experience, while most of their opponents had none at all. Moreover the superior German tactics, training and level of aggressiveness gave the attackers a considerable edge.<sup>29</sup>

The Luftwaffe pilots also enjoyed a high degree of technical superiority. Close to the ground the

*Savagery would be a feature of the war on the Eastern Front, in which neither side gave quarter nor expected it from the enemy*

Polikarpov I-16 Type 24, the main Soviet fighter type, was almost as fast as the Messerschmitt 109F. But the I-16's radial engine was optimised for low altitude operations, and as height increased its performance fell markedly. At 20,000 feet the I-16 was about 100 mph slower than the German fighter.<sup>30</sup> The Soviet fighters were the more manoeuvrable, but in air combat the faster fighter always held the initiative. The Luftwaffe pilots used the same tactics against the Soviet fighters that had proved effective during the Spanish Civil War four years earlier: patrol at higher altitudes, attack from above in the dive, then zoom climb to regain altitude before setting up the next attack. Pilots were advised that on no account should they slow down and attempt to engage the Soviet fighters in manoeuvring combat.<sup>31</sup>

That day Luftwaffe fighter losses were minimal. One notable loss was the commander of Jagdgeschwader 27, Major Wolfgang Schellmann. He pressed to short range his attack on a Soviet I-16 fighter, and following an accurate burst his victim exploded. Debris struck Schellmann's fighter, inflicting serious damage. He baled out and was taken prisoner, but it appears that his captors shot him soon afterwards.<sup>32</sup> Such savagery would be a feature of the war on the Eastern Front, in which neither side gave quarter nor expected it from the enemy.

From mid-day small forces of Soviet bombers attempted to deliver retaliatory attacks on Luftwaffe airfields, but with little success. About a dozen Tupolev SB-2s, without fighter escort, carried out a high level bombing attack on the airfield at Biala-Podlaska just inside German-held Poland. The airfield was base for the Junkers 87 dive-bombers of 1st Gruppe of Sturzkampfgeschwader 77, which were being refuelled and re-armed after their initial mission. In contrast to those of their opponent, however, the German planes were well dispersed and

camouflaged. A flak battery positioned nearby engaged the raiders and, although some bombs burst across the airfield, no Stuka was damaged. The bursting flak shells summoned several German fighters to the scene, and in the action that followed the Soviet bomber formation lost about three-quarters of its aircraft.<sup>33</sup>

#### Results of the attacks

That morning, up to 1000 hours, Luftwaffe twin-engined and dive-bombers flew 637 sorties and struck at 31 airfields.<sup>34</sup> The effect of those attacks is described in the official Soviet post-war publication *History of the Great Patriotic War of the Soviet Union* - not a source likely to exaggerate German successes:

*During the first days of the war enemy bomber formations launched massive attacks on sixty-six airfields in the frontier region, and in particular those where the new Soviet fighter types were based. The result of these raids and the violent air-to-air battles was a loss to us, as at noon on 22nd June, of some 1,200 aircraft, including more than 800 destroyed on the ground.<sup>35</sup>*

By sunset on the first day of the campaign against the Soviet Union, the Luftwaffe had flown 1,766 sorties by single-engined and twin-engined bombers, and 506 by fighters. The operations cost the Luftwaffe thirty-five aircraft. Official German sources claimed the destruction of 1,489 Soviet planes destroyed on the ground and a further 322 shot down in air-to-air combat or by AAA fire during the entire day.<sup>36</sup> Normally such a claim would be treated with considerable reserve. However, given the Soviet admission that up to noon they lost 'some 1,200 aircraft, including more than 88 destroyed on the ground', the German claim has a ring of truth.

In the course of the eighteen-hour period, between 0300 hours and sunset on 22 June 1941, the Soviet Air Force suffered the greatest defeat ever inflicted

*The Soviet Air Force suffered the greatest defeat ever inflicted by one air force on another. Most of those aircraft had been caught on the ground*



by one air force on another. Most of those aircraft had been caught on the ground. Yet it is also worth pointing out that the German claim of 322 Soviet aircraft destroyed in the air, by fighters or AA fire, was also the largest number of planes an air force had shot down in a single day.

During the weeks that followed the German armoured units thrust rapidly into the Soviet Union, over-running every one of the airfields the Luftwaffe had attacked on the first day. This compounded the effect of the earlier losses, for aircraft not airworthy due to battle damage or unserviceabilities had either to be destroyed or were left to be captured. The capture of the enemy's airfields by ground forces is the most effective way there is to reduce the effectiveness of his air force. Yet, despite the enormous material losses suffered

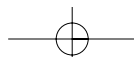
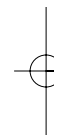
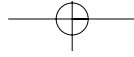
by the Soviet Air Force during the early days of the war, their effect would not be crippling in the long term. By June 1941 the programme to re-equip the Soviet front-line units with modern aircraft had just begun to take effect. The great majority of the aircraft lost were obsolescent types, scheduled for replacement. Moreover, relatively few Soviet aircrew were lost during the attacks on the airfields, so when the modern planes became available there was no shortage of crews to fly them. Despite the ferocity of their initial onslaught, the German forces were unable to secure victory in the eastern front within the expected five months. When the ferocious Russian winter arrived, with it came an offensive by much-improved Soviet ground forces. This was not going to be a short war.

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The German cruisers Goeben and Breslau

# *The Hunt for Goeben and Breslau*

From Tee Emm, January 1942

In January, 1918, the whole of the forces in the Eastern Mediterranean were stirred into special activity by the sortie from the Dardanelles of the two German cruisers, Goeben and Breslau. A message that these cruisers had come out was intercepted at Mudros on the morning of January 20th, and all aircraft were immediately ordered to concentrate at Mudros and Imbros. The two cruisers had passed out of the Dardanelles about 5 a.m. with the object of attacking the two British monitors in Kusu Bay, Imbros, and of bombarding Mudros. Off Mavro Island the Goeben struck a mine, but the cruisers went ahead and they opened fire on the monitors and on general shipping in Kusu Bay about 8 a.m. Six or seven salvos were fired, and these destroyed the two monitors.

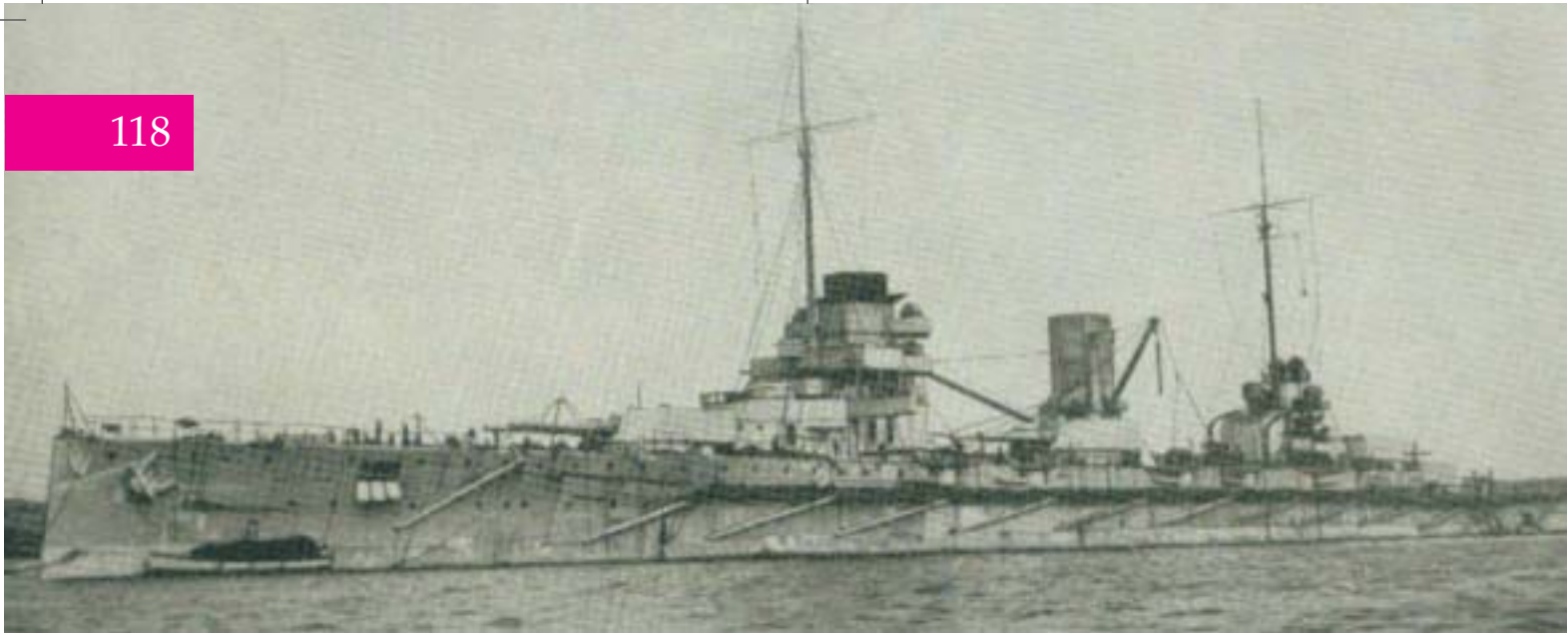
The cruisers then turned off towards Mudros, but aircraft from Imbros were now on the scene and they began to attack with bombs. Before any hits were made, the bombing, indirectly, brought about the destruction of the Breslau. The anti-aircraft shells fired by the guns from the Goeben were seen to be falling close to the Breslau and the latter ship was thereupon ordered by her consort to take

station ahead. As she moved to obey orders the Breslau was so harassed by the attacking aircraft that she zig-zagged into a mine-field near Rabbit Island and had her stern shattered by a mine. Almost at the same moment she received a direct hit from a bomb. The Goeben turned to take the Breslau in tow, but soon gave up the attempt and left the damaged cruiser to her fate. The Breslau struck more mines and finally sank.

The Goeben, meanwhile, continued her journey towards Mudros, but struck a mine on the way. Her commander thereupon decided to go back, but failed to find the gap he had made in the mine-field off the Dardanelles and struck another mine going in. As the Goeben entered the Straits two bomb-carrying Blackburn 'Baby' seaplanes, escorted by a Greek pilot in a 'Camel,' appeared over her, but they were promptly engaged by a formation of ten enemy seaplanes.

In a sharp fight, three of the enemy seaplanes were driven down by the 'Camel' pilot, and one of the Blackburn 'Baby' seaplanes fell in flames. By this time the hostile formation had been broken and





The cruiser Goeben

the second Blackburn 'Baby' pilot persisted in his bombing attack and aimed his 65-lb bombs at the Goeben, but without the luck of a hit. He was then forced, by engine trouble, to land in the Straits. Soon after this attack two D.H.4 aeroplanes found the Goeben, apparently in trouble, and they saw her run aground south of Nagara. Before returning to report her plight the D.H.4s dropped their bombs and scored a hit on a vessel making to assist the German cruiser.

When the position of the Goeben became known, aircraft were sent up to take photographs, and the concentration of bombers and fighters at Imbros and Mudros was pressed forward. In the afternoon there were low clouds and some patches of mist, but four 112-lb bombs were dropped, without direct results, by D.H.4 aeroplanes. At the same time a widespread air patrol of the waters off Mudros was made by all available aircraft to test the truth of statements, made by rescued members of the crew of the Breslau, that mine-fields had been laid outside the harbour by U-boats. No mines were discovered, and it is a point of interest that the prisoners' statements, whether they were made in good faith or with the intention to deceive, had the effect of diverting temporarily the activities of aircraft from the possible bombing of the Goeben.

The attack on the battle cruiser was resumed at dawn next morning, January 21st, but clouds at 500 feet and mist hampered the bombing operations. Three separate attacks were made during the day, but only one bomb, of 112-lb weight, hit the Goeben. After dark, nine aeroplanes were sent to

the Straits, but they got a poor view of their target and no hits were claimed.

On the 22nd and 23rd day and night attacks were kept up; one direct hit was claimed on the morning of the 22nd, with a 112-lb bomb dropped from a D.H.4. All the bombing formations were escorted by fighters, but there was no opposition other than heavy anti-aircraft gun-fire, by which a Greek pilot was shot down on the 23rd. On January 24th the carrier Empress arrived and her pilots were used to relieve the over-worked officers at Mudros and Imbros. Next day, also, the Manxman reached Mudros with badly needed supplies of bombs. Strong winds and low clouds continued to make bombing difficult up to the morning of the 27th. On the evening of the 24th a monitor, with aircraft observation, attempted to fire at the Goeben, but just when her shells were being signalled near the target a haze spread over the Straits, and no further spotting was possible. On the morning of the 27th a 'Camel' pilot, in difficult conditions of weather, reached the Straits to find no trace of the German cruiser, but a little later another 'Camel' pilot thought he could distinguish her in the mist. She had, in fact, got off on the 26th, and by the morning of the 27th had reached Constantinople under her own steam, but it was not until the morning of the 28th that the weather was clear enough for air observers to say definitely that she had gone. During the few days in which she had been grounded in the Straits fifteen tons of bombs had been dropped. Pilots had been tireless in their efforts to disable their enemy, but they had no luck, nor could they be expected to achieve much with the only bombs immediately available which





were of 65-lb or 112-lb weight, too light to inflict serious damage on a ship of the Goeben's construction.

No reliable torpedo-carrying aircraft were in the Eastern Mediterranean when the Goeben ran aground. An attempt was made to fit a 14-inch torpedo to one of the old Shorts in the Ark Royal, but the seaplane, so loaded, would not move off the water. When the Manxman arrived in Mudros harbour from Brindisi at 7 a.m. on January 25th, she brought with her two seaplanes fitted with 18-inch torpedoes, but there was an unaccountable delay in sending up her seaplanes, and, on the 26th, the day of the Goeben's departure, the wind freshened and the sea was judged too choppy for the torpedo-loaded seaplanes to get away.

Meanwhile the officers of the Ark Royal had succeeded in fitting one of the Short seaplanes to take depth-charges of 300 lb or 18-inch warheads. On the night of the 27th, when it was still doubtful whether the Goeben had gone, a pilot set out in a Henri Farman aeroplane, loaded with a warhead, to search for her. The visibility over the Dardanelles was poor, and although the pilot could not locate the Goeben, he decided to drop the warhead, from 1,600 feet over Nagara Point, in the hope that the ship, although not visible through the mist, might still be aground. The resultant explosion was so heavy as to shock the anti-aircraft gunners into immediate silence.

Other naval seaplanes were over the Straits that night to keep the attention of the Dardanelles garrison off the entrance in order to make easier

the passage of a British submarine, the E.14, which had been sent out in the afternoon to attack the German cruiser. The E.14 got through to Nagara, but found that her quarry had gone and that her gallant attempt had been made in vain. Nor did she otherwise have the luck she deserved: on her homeward journey she was sunk by gun-fire off Kum Kale.

Many subsequent reconnaissance flights, by D.H.4 aeroplanes fitted with extra fuel tanks to give an endurance of seven hours, were made to Constantinople to keep watch on the Goeben in Stenia Bay. But she never came out again.

Note the moral: In spite of the persistent air attacks and the losses incurred, the Goeben was not sunk—but she never came out again. So, too, have our aircraft played their part in this war. They have persisted in attack after attack over the harbour of Brest; their losses have not been light; nor have they yet sunk either the Scharnhorst or the Gneisenau. But for nine months now those two would-be commerce raiders, later joined by the scurrying Prinz Eugen, have been kept off the seas, bottled up firmly in harbour. Their anti-aircraft defences are something more terrible than the last war ever knew, the targets are skilfully camouflaged and smoke-screened and naturally a heavy toll is taken of our visiting aircraft. But the courage and self-sacrifice of our raiding pilots have kept those ships there where they are not much more useful than if they were at the bottom of the sea. And perhaps that moment won't be so far off either.

# Book Reviews

## The Dam Busters

By Jonathan Falconer

Published by Sutton Publishing  
ISBN 0-7509-2974-X  
Hardback 242 pages  
Black & white and colour photographs  
Price £25



Reviewed by G R Pitchfork

Few RAF operations during the Second World War have attracted such interest, or epitomised so graphically the courage of RAF aircrew, as the raid mounted by 617 Squadron on the night of 16-17 May 1943 against the Ruhr dams. To commemorate the 60th Anniversary of this epic action, the highly regarded author of other books on Bomber Command, Jonathan Falconer, has produced a superbly researched and lavishly illustrated book that offers a wider perspective on the operation. The raid has previously attracted the attention of various authors and a film maker, so some may question the need for another account. Once they have seen this book, I am sure that any such doubts will immediately disappear.

This book could perhaps best be described as the encyclopaedia of the Dams Raid. Having set the backdrop to the bomber offensive, the author relates the development of the idea and value of attacking the Ruhr dams, Barnes Wallis's concept for the Upkeep 'bouncing bomb', and the trials that took place to prove his brilliant technological concept. The author then concentrates on the formation of 617 Squadron under its charismatic leader, Guy Gibson, before describing the raid in great detail. With the aid of many photographs and excellent colour maps, the reader is able to follow the progress of the raid very clearly. The author's coverage of the aftermath from the German perspective is particularly interesting, and is illustrated with many rare photographs.

The author pays due tribute to the aircrew who flew on this operation, and he has devoted sections that describe their actions, their later operations, and the decorations that they earned. He concludes the book with a fascinating insight into the making of the classic film starring Richard Todd, who has written the Foreword to the book.

The casual observer may, on first glance, think that this is an illustrated narrative of the raid, such is the extensive use of photographs, including some unique German material, and the quality of the technical drawings and maps, both of which are clear and very informative. The use of rare colour photographs of many of the aircrew adds a very evocative aspect to the book, as does the inclusion of two excellent paintings by the well-known aviation artist, Nicolas Trudgian. However, there is much more to this book than a wide selection of excellent illustrations. Jonathan Falconer has, as usual, carried out his research in a meticulous fashion, and the great merit of this book is that it encapsulates all aspects of the epic Dams raid in one superbly produced volume.

At a time when it seems to be the fashion for modern journalists and historians to sit in their comfortable chairs to find fault with operations that helped produce the peace that they enjoy, it is appropriate that Jonathan Falconer reminds us of the gallantry and sacrifice of so many young men of the Dam Busters. Although my private library contains all the other books describing this operation, I suspect that this volume will be the one I refer to most frequently. It is strongly recommended.

# Book Reviews

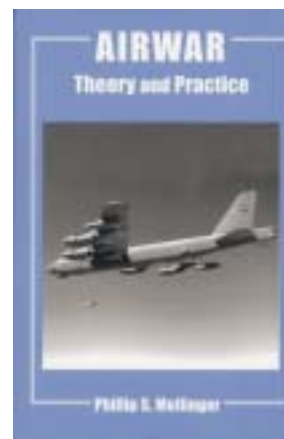
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## Airwar – Theory and Practice

By Phillip S Meilinger

Publisher: Frank Cass Publishers  
ISBN: 0 7146 5310 1 Hardback £45  
ISBN: 0 7146 8266 7 Paperback £18.50

Reviewed by Gp Capt C J Finn



This book, which is the latest in the CAS Studies in Air Power series, is the first to tackle the more theoretical and doctrinal aspects of air power. A collection of essays written between 1991 and 2001, the book predates 9/11 and the second Gulf War, and the author's views have to be seen in that context. The chapters in the book break down into 3 main groupings, although there is obviously some overlap. The first 8 deal with the history of air power thought, from Douhet through to the strategic bombing offensive against Japan in World War II. The next 5 take a more theoretical view, looking at modern air power theory, in particular the development of the concept of effects-based warfare and the debate between the proponents of coercive and denial theories about the offensive use of air power. The last chapter stands alone as a view of the problems facing the United States as the primary aerospace nation.

Throughout the book 2 consistent threads emerge, the first being historical. A lot of the examples in the book – Chapters 2, 3, 4, 6 and 7 – deal specifically with RAF history; for example the development of doctrine in the inter-war years, and the analysis that proponents of strategic bombing did not in fact have complete primacy. There are also some very pertinent observations re jointery, in particular its value, the negative effect of inter-service resource battles and the impact of personalities at the higher levels of command. The other thread is that of the philosophy of the use of air

power. In this the arguments about the merits of counter value and counter force targeting strategies emerge, as does the lesson of the need for control of the air, not for its own sake but to enable all other operations. Phil Meilinger also exposes ethical issues that have emerged, concerning the employment both of atomic and precision weapons, and concerning the political concept of gradual escalation.

Although in a couple of chapters Meilinger bangs a personal drum about the morality and value of sanctions against Iraq, this should not detract from the book as a whole. As one has come to expect, the historical aspects of the book are extremely well researched and argued, and are very readable. The book contains many useful lessons for RAF officers and aircrew in terms of the numbers of widely held preconceptions that it debunks. In its treatment of the development of air power theory the book is a useful summary of the key debates that one can trace through the last 100 years, in particular those concerning strategic bombing versus strategic effect and the theories as to how best to achieve the latter.



# Notices/ Reunions

## 17(F) SQN REUNION DINNER

17(F) Squadron reunion dinner on Saturday 11th October 2003 at RAF Cottesmore. All former members of the squadron and their partners are most welcome. The reunion will coincide with the reactivation of the squadron equipped with the Typhoon. Tel: Greg Smith on 07740 724362 or Andy Hine on 0207 2186565 for full details of the event and to register an interest.

## ST. CLEMENT DANES, STRAND, LONDON CENTRAL CHURCH OF THE ROYAL AIR FORCE

This beautiful Wren Church, which is also the Royal Air Force Central Church, has a world-wide following and is open daily from 09.00 am – 4.00 pm. There is Choral Eucharist or Matins every Sunday at 11.00 am, sung by the famous choir. Civilians and all members of the Armed Forces are welcome to visit the church and attend the services.

## ROYAL AIR FORCE HISTORICAL SOCIETY

Formed in July 1986 to study the history of air power, the RAF Historical Society examines such topics as the Strategic Bomber Offensive of World War II, the V-Force, various air campaigns, and further aspects of modern air power. The Society holds lectures, seminars and discussions, bringing together those involved in RAF activities past and present, at a membership fee of £15 a year.

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