Does the Dambusters Raid deserve its growing reputation as operationally daring but strategically futile?

By Wg Cdr M Gilligan

Operation CHASTISE, the breaching of the Möhne and Eder dams in May 1943, represents the most celebrated operation in Royal Air Force history. However, its operational glory has been overshadowed by a growing historical consensus that it failed to achieve the strategic objective of bringing Germany's armaments industry to a standstill. This paper questions the perceived strategic reputation of Operation CHASTISE. Using campaign planning methodology, it establishes alternative strategic objectives and considers whether intended effects were realised. It then establishes the operation's enduring benefits, before concluding that the 'Dambuster Raid' was a strategic success rather than an abject failure.

The Dambusters Raid, by the Lancaster aircraft of 617 Squadron, is arguably the most famous and celebrated single operation conducted in the history of the Royal Air Force (RAF). In the early hours of 17 May 1943, the great western German dams at Möhne and Eder were breached by Barnes Wallis's bouncing bombs during Operation CHASTISE, in what was described by Webster and Frankland as 'the most precise bombing attack ever delivered and a feat of arms which has never been excelled'.[1] However, their further contention that 'the effects of this brilliant achievement upon the German war machine were not, in themselves, of fundamental importance nor even seriously damaging'[2] has been echoed by the majority of commentators since. The overwhelming historical view of the dams raid is that it was operationally skilful and daring, but failed to achieve its strategic intent. One author goes as far as describing the raid as 'a conjuring trick, virtually devoid of military significance'.[3]

This paper questions the validity of such a dismissive conclusion. It is possible that the relative success of the dams raid claimed at the time may well have been skewed by the lack of quantifiable evidence to determine its true effectiveness. Equally, those subsequent claims of its lack of effectiveness could potentially have been distorted by a dispassionately narrow interpretation of the limited evidence of effect, some years after the conclusion of World War II (WWII). In order to determine the degree of success of the mission, it is vital to establish its strategic objectives, and to compare the expected outcome with the results achieved. In general, this paper will examine the planning and results of the Operation through a modern effects-based lens, and to consider its impact beyond the narrow economic effects upon which its level of success has primarily been gauged. As a precursor, the paper will briefly describe the background and operational conduct of the mission. It will then look at the overall strategic context of the time and apply some modern campaign planning principles to establish the potential strategic objectives, before looking in greater depth at how these objectives were furthered in terms of economic, military, diplomatic and psychological lines of activity. It will attempt to use both quantifiable and qualitative historical evidence to determine whether the effects sought by Operation CHASTISE were achieved, whether any unplanned effects were realised and whether the results achieved could have been done so more cost-effectively by alternative means. It will also look at the enduring effect of the raid on the application of air power thereafter, before concluding, contrary to conventional wisdom and literature available on the subject, that the dams raid was extremely successful and had far-reaching strategic effects.

Background

Operation CHASTISE was conceived in order to destroy the great dams of the Ruhr in western Germany, against a strategic backdrop as described later in this paper. Before and during the early years of WWII, the dams had been considered as important, but overly demanding targets, because of their massive construction, the inadequate explosive capacity of available weaponry and the inaccuracies of contemporary airborne armament delivery: the destruction of the dams required a precise and significant explosion below the surface of the water on the upstream face of the dam. Eventually, during 1942, Barnes Wallis, a brilliant engineer at Vickers-Armstrong Aviation, devised an ingenious solution. Having had a previous proposal for a huge bomber aircraft and a 10,000lb 'earthquake' bomb rejected on the basis of impracticality, Wallis formulated the concept of the bouncing bomb; in reality, the munition was a revolving depth charge.[4] Wallis's bomb was designed to be released at low level, skip across the surface of the water, strike the dam wall and slide down the face of the dam until exploding at the optimum depth. Codenamed Upkeep, the cylindrical weapon was to be spun up to 500 rpm on the aircraft and released 425 yards from the dam, at an altitude of approximately 60 feet and a speed of 210 knots: the release conditions were extremely demanding.

From being given the go-ahead on 26 February 1943, the project was completed in a mere 80 days.[5] The weapon was turned from design to reality through a number of iterations, the aircraft were extensively modified, and system integration and safe release trials were conducted. That it succeeded in such short timescales was a remarkable feat of project management; an engineering exploit of similar scale on the software-intensive aircraft of today is incomprehensible. From 15 March, 617 Squadron, under the command of Wing Commander Guy Gibson and constituting experienced crews from within Bomber Command, was formed, before completing six weeks of intensive low-level training.

On the night of 16 May 1943, the first of three waves of 617 Squadron Lancasters took off from RAF Scampton in Lincolnshire and headed for the Möhne, Eder, Sorpe, Ennepe, Lister, and Diemel dams of the Ruhr. The aircraft flew at low level over the North Sea, before descending to below 150 feet whilst over continental Europe; at higher altitude, the bright moonlight (essential to see the dams) would have made the bombers extremely

vulnerable to night-fighters.[6] Gibson led the first nine aircraft to attack the Möhne and Eder dams. The second formation of five aircraft headed for the Sorpe, and a further five aircraft were held in reserve to bomb as directed, subject to the relative success of the preceding waves. Of Gibson's group, two of the first five bombs dropped struck accurately, creating a massive breach through which 116 million cubic metres of water cascaded into the Ruhr valley in just 12 hours. Gibson led the remaining weapon-carrying aircraft to the Eder; the fourth bomb dropped there caused similar devastation, with 154.4 million cubic metres escaping.[7] Of the second formation, only one aircraft reached the Sorpe and, whilst its bomb was successfully dropped, the dam remained intact. Of the third wave, three aircraft were directed to the Sorpe, and the others to subsidiary targets. Of those attacking the Sorpe, one never made it, one released a bomb in thickening mist, and the third could not see the target; again, the dam stood. On the ground, approximately 1,294 people were killed by the floodwater, of whom 493

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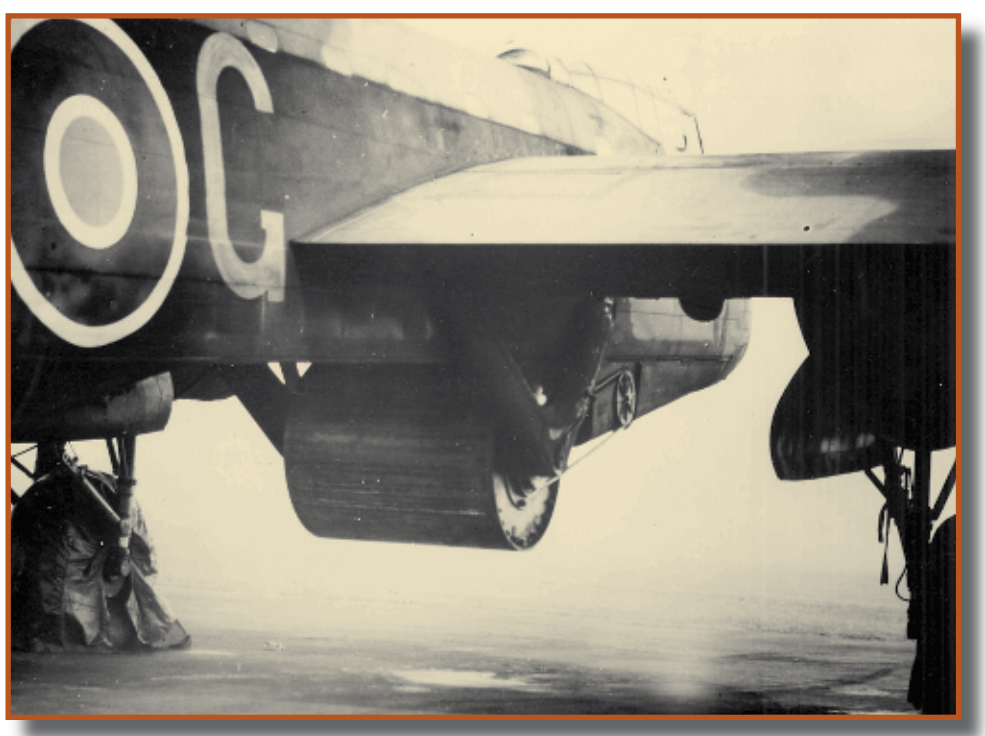

An Upkeep in position under modified Lancaster ED932 'AJ-G'

Wing Commander Guy Gibson escorting HM King George VI durnig a visit to RAF Scampton on 27 May 1943

The gallantry, skill and danger of the operation were reflected in the award of decorations to 34 members of the Squadron. Most notably, Guy Gibson was awarded a Victoria Cross for his bravery and leadership

were Ukrainian prisoners of war. In modern wars of choice, the prospect of such civilian casualties and the questionable legality of the action would almost certainly preclude the targeting of a dam. However, Operation CHASTISE occurred in a war of survival, where 1,300 was a comparatively humane death toll for a raid in the Battle of the Ruhr.

The gallantry, skill and danger of the operation were reflected in the award of decorations to 34 members of the Squadron. Most notably, Guy Gibson was awarded a Victoria Cross for his bravery and leadership. However, the raid cost 617 Squadron heavily. Of the 19 aircraft that departed only 11 returned. Fifty-three of the 133 airmen involved were killed, with a further three taken prisoner.

Strategic assessment

Throughout history, successful military leaders have applied strategy to the defeat of their enemy. This premise is equally applicable to the conduct of WWII. Political and military planners would have considered the characteristic capability from which Germany derived its freedom of action, physical strength or will to fight: the enemy's strategic centre of gravity.[8] Equally, it would have been as important to consider one's own strengths and weaknesses. Further assessment, albeit in different terms than those used today, would have determined the critical capabilities, critical requirements and, importantly, critical vulnerabilities of both friendly and enemy centres of gravity in order to establish how to gain military advantage. A critical capability is defined as an inherent capability that enables the functioning of a centre of gravity, a critical requirement would be an essential condition, resource or means to enable the centre of gravity or critical capability to be effective, and a critical vulnerability is a weakness through which the centre of gravity can be attacked or neutralised.[9] Specific objectives can then be set to achieve the effects necessary to exploit the weakness. From these objectives, coordinated actions across economic, military, diplomatic and psychological lines of activity, would seek to generate the effects considered necessary to lead to the eventual defeat of the

enemy's strategic centre of gravity. However, the rigour of the modern campaign planning process was not in widespread use at the time; by applying this process in hindsight, it is possible to estimate the strategic imperatives of the day, and from these, to evaluate whether the results of Operation CHASTISE met, exceeded or failed to achieve the effects sought in pursuit of defeating the enemy. In January 1943, during the Casablanca Conference, the Allies publicly demanded the 'unconditional surrender' of Germany, Italy, and Japan.[10] Accordingly, in order to terminate the conflict on favourable terms, Britain's strategic end-state of the campaign within the European theatre of war can retrospectively be considered as the unconditional surrender of Germany. However, the political leadership of the Nazi regime had long since cast their ideological die, and their collective political demise would almost certainly lead to their individual post-war ruin or execution; there was no feasible prospect of their voluntary surrender. Hence, in order to bring about the strategic end-state, it was vital to bring about the complete involuntary downfall of the German political leadership.

From the foregoing, the strategic enemy centre of gravity must be considered to have been the ruling echelons of the Nazi Party. Yet, bringing about their demise would be no mean feat. After all, they controlled all of the internal levers of power. They held sway over a population that had been heavily influenced by years of dogmatic and passionate rhetoric, and they brutally suppressed any opposition to their control. Of vital importance, the Nazi leadership provided the strategic and operational direction to a patriotically committed military who were thoroughly trained, battle-hardened, well-equipped, in unchallenged command over most of the Continent, and with a healthy level of morale borne out of many successes and few defeats. Also, their economy and industrial capacity were buoyant and had significant slack.

From a British perspective, the ability to prosecute a successful campaign was dependent upon the continuing cohesion of alliances with the US and the Soviet Union. Without the assistance of their Allies, Britain would have lacked the economic resource and combat power to mount a realistic land-based offensive into Europe. Arguably, without the prospect of powerful intervention, the maintenance of morale amongst the British population and armed forces would have become impossibly demanding over a prolonged period. In hindsight, the friendly strategic centre of gravity can be assessed as the cohesion of the Tripartite Alliance.

Having identified possible strategic centres of gravity, the value of Operation CHASTISE in affecting them should be established in terms of economic, military, diplomatic and psychological lines of activity. This requires further analysis of the desired effects sought by the raid towards achieving those decisive acts considered collectively necessary to bring about the demise of the enemy's leadership and the bolstering of Alliance cohesion. Having estimated those effects sought, it is then important to determine to what degree they were achieved in effects-based operations (EBO) terms, where EBO have been defined as those 'operations conceived and planned in a systems framework that consider the full range of direct, indirect and cascading effects, which may, with differing degrees of probability, be achieved by the application of military, diplomatic, psychological and economic instruments'.[11] During WWII, airmen sought to apply principles equivalent to EBO at the strategic level of war; if a strong military was reliant upon a strong economy, then, by destroying the economy through strategic bombardment, the effect of preventing the enemy's capacity to wage war could be achieved.[12] It was relatively easy to determine the effect sought by military action, but a lack of suitable analytical, cognitive or intelligence tools hampered its effective measurement.[13] Even with the benefit of hindsight, a definitive measure of the effectiveness of operation CHASTISE is impossible.

Economic strategy

A pre-war Allied paper on Broad Strategic Policy recognised that in the first phase of war, the only effective offensive strategy available to the Allies was to apply economic pressure on

Germany. Such pressure was applicable in two forms: the prevention of the external supply of articles essential to the German war effort, and the destruction of economic life within Germany.[14] However, the vast scale of the German economic infrastructure demanded precise nodal analysis to determine those economic targets of most significant strategic importance; it was the role, within the UK, of the Ministry of Economic Warfare (MEW) to conduct that analysis. Their role was hindered by a lack of reliable information, resulting in a significant amount of intelligent guesswork and application of analogies.[15] Soon after the outbreak of war, the MEW had identified 'grave financial weakness' among the chief defects of the German economy,[16] but Germany had not mobilized its economy for war to anywhere near the degree assumed.[17] Unfortunately, expectations of a German economic collapse failed to materialise. Ironically, Germany received much of its supply of scarce materials from the Soviets[18] and from the Far East by means of the trans-Siberian railway.[19] By June 1941 it was apparent that, with Germany controlling most of the European continent, economic war alone would not defeat Germany. Nonetheless, continued blockade and the increasing strategic bombardment of the economic infrastructure would continue to focus on denying those resources in short supply. The latter task was to be the concern of Bomber Command.[20]

In the context of spring 1943, the German ruling elite maintained its considerable grip on power almost exclusively through the strength of its military; the defeat of the military would strip away the Nazi's protection and lead to their capitulation. The German military as a force were highly effective but entirely dependent upon the German industrial base for the re-supply of armament and equipment. The armament industry was equally dependent upon adequate power supplies, which in turn were wholly reliant upon natural energy sources and a plentiful supply of water. Economically, the German industrial base was a critical capability that required power, and that power supply was critically vulnerable to a loss of water.

From as early as 1937, the MEW and Air Staff had generated military plans for use in the event of general war against Nazi Germany; of these, Western Air Plan 5 (WA5) identified 45 industrial plants in the Ruhr as vital to the German war machine. The destruction of the Möhne and Sorpe dams was thought to be capable of demolishing these plants,[21] but weapon accuracy and payload limitations of the time precluded their effective targeting. Nonetheless, the Air Ministry maintained effort in seeking the means to attack the dams successfully. Besides denying vital water supplies to industry, the dams'destruction had the potential to cause enormous flood damage to the hydroelectricity generating stations, railways, bridges, pumping stations and industrial chemical plants of the low-lying Ruhr valley.[22] The advent of a suitable weapon in early 1943 made an attack against the dams feasible.

Military historians have largely considered the results of the dams raid in economic terms. Moreover, they have compared the results with the most optimistic pre-war expectations of effect that the destruction of the dams, and the Möhne in particular, would bring: in essence, the belief that the entire industrial capacity of the Ruhr would be completely paralysed, and that a consequential knockout blow would be delivered to the German war machine.[23] By March 1943, however, the economic benefits of attacking the dams had come under critical examination and were broadly considered to be overstated. Scientific Advisers to the Minister of Production concluded that the breaching of the Möhne would be sufficient to cause a 'disaster of the first magnitude', a 'substantial loss of electricity' and have 'serious repercussions on morale'.[24] They further concluded that a successful attack on the Eder would have insignificant economic importance. The MEW largely supported an attack on the Möhne as justifiable in physical and morale terms, even if the industrial effects were unlikely to be significant. However, they stressed that the simultaneous destruction of the Sorpe dam would be worth much more than twice the destruction of one [of the dams].[25] Importantly, in April 1943, the Chief of the Air Staff, Air Chief Marshal Sir Charles Portal, became aware that the potential effects of an attack on the Möhne dam had been overestimated, but he determined that the operation remained meaningful.[26]

Notwithstanding an awareness of the importance of maximising effect through a simultaneous attack on both the Sorpe and Möhne dams, the differing types of construction limited the prospects of achieving such an objective. The Möhne was a gravity dam of masonry construction with a vertical wall on the water side, whilst the Sorpe was an earth dam with sloping earth walls on either side of a central concrete core. It was known that Wallis's weapon was optimised for the former, and unlikely to breach the latter. Despite a specific change in attack strategy for delivery of the weapon against the Sorpe, expectations were tempered by the belief that the weapon was likely to be non-effective against the Sorpe, and that the totality of effect predicted by the MEW was unlikely to be realised. Thus, the economic effects sought by Operation CHASTISE were to disrupt industrial water supplies and to destroy some of the means of production; the former was expected to be more serious than the latter.[27] At the time of the Raid, the planners harboured no false expectations of bringing the German war machine to its knees. The Operation Order for the mission reflected a suitable degree of realism: 'Destruction of target X [Möhne] alone would bring about a serious shortage of water for drinking purposes and industrial supplies. This shortage might not be immediately apparent but would certainly take effect in the course of a few months. The additional destruction of one or more of the five major dams in the Ruhr area would greatly increase the effect and hasten the resulting shortage. Target Z [Sorpe] is next in importance. A substantial amount of damage would be done, and considerable local flooding would be caused immediately consequent on the breach of Target X. In fact it might well cause havoc in the Ruhr valley. There would be a large loss of electrical capacity in the Ruhr partly caused by destruction of hydro-electric plants, but also due to loss of cooling water for the large thermal plants.'[28]

It has become the established academic view that the dams raid failed to achieve its economic objectives, as the water production for the Ruhr's industry was recovered to its pre-raid levels by 27 June 1943.[29] Whilst the expected shortages of water for industrial purposes did not materialise to the degree expected, the effect was achieved in part. Cooper contends that 'The Möhne attack caused flooding of pumping stations, which in turn caused a shortage of water. Post-war German records show that production in the Dortmund area was reduced by between 10 and 15% and was not fully recovered for 6 months'.[30] Also, the Index for German Armament Production shows a reduction of about 8% in the rate of growth during June 1943;[31] whilst this must be attributed to the totality of the bomber offensive, Operation CHASTISE was at least partially responsible. The unexpected speed with which the Germans garnered resources and set about reconstructing the dams is also partially responsible for the restriction of the duration of the effect; rapid and unmolested repairs to the dams were completed shortly before the arrival of the autumn and winter rains, meaning that the shortages would not continue into the following year as had been hoped. This was due to the requisitioning by Albert Speer, Germany's Head of War Production, of replacement machinery from around the Reich: the reduced effect in the Ruhr must have had a negative, although indeterminable, effect elsewhere. Speer was surprised that the British did not press home their advantage during the rebuilding phase when the work was most vulnerable.[32] There are three possible reasons for this. Firstly, the Germans had increased their defences around the dams considerably and would have been more alert to further attacks. Further attacks would probably have met with greater attrition than the already excessive losses of the first operation: as Air Chief Marshal Sir Arthur Harris, Commander-in-Chief of RAF Bomber Command, remarked, 'Any action deserving of a Victoria Cross is, by its nature, unfit to be repeated as an operation of war'.[33] Secondly, it is possible that the strategic effect sought had been achieved outwith the economic line of activity, rendering a further attack as nugatory. Finally, British expectations were that the dams could not be repaired in time for the autumn and winter rains, and that the expected economic impact would take effect in the longer term.

Whilst ensuing industrial water shortages did not meet expectations, the devastation caused by the

torrents certainly did. The industrial destruction caused by the breaching of the dams was significant, affecting some one hundred and twenty-five factories. Of these, eleven were destroyed, a further forty-one severely damaged and seventy-three others suffering varying degrees of lesser damage.[34] Post-war translations of German documents detail that six power plants, a steel works, two weirs and nine water-works were destroyed or severely damaged; these 18 assets were considered by the Germans to be works of great economic importance.[35] Based on these latter achievements alone, the dams raid achieved the equivalent of 40% of the requirements of WA5. In addition, the raid accounted for the destruction of two armaments factories and damage to a further ten.[36]

WA5 had envisaged the destruction of the 45 specified plants by utilising 3,000 conventional bombing sorties over a two-week period, with an anticipated loss of 176 bombers (equating to 5.9% per sortie);[37] these figures were based on pre-war predictions of weapon accuracy and aircraft attrition rates. As a cumulative total up to June 1943, 10,466 aircraft were lost during 308,919 sorties of the wider strategic offensive,[38] equating to an average aircraft loss rate of approximately 3.4%. Also, night-bombing weapon error was initially assumed to be about 1,000 yards,[39] but the 1941 Butt Report suggested that, in the Ruhr, only one-tenth of aircraft came within five miles of its aiming point.[40] Also, during 1943, the relative density of bombs dropping within a square mile around the aiming point stood at 33.4 tons per thousand tons of explosives dropped.[41] In other words, only 3.3% of weapons released landed within a half a mile of the target; of these, only a tiny proportion would have struck the point targets that WA5 had prescribed. The US Department of Defense have reported that, with American B-17 bombers, to achieve a high probability of destruction of a point target would have required 1,500 aircraft and 9,000 bombs.[42] The Lancaster ultimately had a weapon-carrying capacity of 18,000lb, approximately three times the load of the B-17.[43] By extrapolation and assuming similar accuracy, for a Lancaster to strike a point target of factory proportions would have required some 500 sorties; that equates to 9,000 sorties to

Dr Joseph Goebbels

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achieve parity with the effects of the dams raid. At an attrition rate of 3.4%, approximately 305 aircraft and 2,100 airmen would have been lost as compared to the 8 aircraft and 53 airmen lost on Operation CHASTISE. Therefore, in cost-benefit terms, the raid provided an exceptional return on investment in destroying 18 high-value industrial assets.

Operation CHASTISE's economic success is magnified further when considered from an effects-based perspective. Post-war data suggests that when conventional bombs struck their targets, they did not necessarily achieve the destruction sought; detonating on the factory roofs, they appeared externally to have caused significant damage, but only 5% disabled the machinery within.[44] The damage caused to the factories in the path of the flooding is undeniable. Even those not destroyed suffered the debilitating mechanical and electrical effects of flooding and silting. Therefore, although 9,000 conventional bombing sorties may have struck as many economically significant targets as the dams raid, they would have had a twentieth of the effect of Operation CHASTISE by comparison.

From a German perspective, Dr Joseph Goebbels, Hitler's Propaganda Minister, recorded in his diary that 'The attacks of British bombers on the dams in our valleys were very successful. Damage to production was more than normal'.[45] Speer concurred, 'A mere 19 bombers of the RAF tried to strike at our whole armaments industry by destroying the hydroelectric dams of the Ruhr. Industry was brought to a standstill and the water supply of the population imperilled'.[46] He further recorded that, 'The British came close to a success which would have been greater than anything they have achieved hitherto with a commitment of thousands of bombers'.[47] Speer was referring to the bomb damage at the Sorpe, which was: 'slightly higher than the water level. Just a few inches lower – and a small brook would have been transformed into a raging river which would have swept away the stone and earthen dam. But they made a single mistake which puzzles me to this day: they divided their forces and that same night destroyed the Eder Valley dam, although it had nothing whatsoever to do with the supply of water to the Ruhr.'[48]

Speer's comments confirmed the MEW conclusion of the impact of breaching both the Sorpe and the Möhne simultaneously. The division of forces that Speer referred to was achieved more by catastrophe than by design; of the eight aircraft of the second and third waves directed to the Sorpe, only three survived as far as the dam, and only two managed to drop their payload. Whilst the weapon had not been expected to damage a construction such as the Sorpe, the first dropped bomb had landed on the crown of the dam and cratered it. The raid came surprisingly close to causing more significant economic damage than was realistically anticipated. Hastings shares Speer's sentiment that the attack on the Eder demonstrated 'profoundly flawed reasoning' and that the 'target was attacked because it was destructible, not because it was vital'.[49] In effects-based terms, this stance may be valid from an economic perspective alone, but if the overriding strategic objective was diplomatically, militarily or psychologically driven, then physical damage was what was sought. If so, then the Eder offered a more realistic pre-mission prospect of achieving the effect, because the weapon was optimised for such a construction.

Military strategy

Notwithstanding the respective capacities of the protagonists in Western Europe to re-arm, the critical capability from a German military perspective that supported the enemy's strategic centre of gravity was their possession of European territory. From an Allied viewpoint, gaining a foothold in France or elsewhere, even with a numerically stronger invasion force, had the potential to be very costly in terms of life and resource, such that the resulting military balance could feasibly swing back towards Germany. Therefore, a critical requirement of the campaign was the combat effectiveness and the combat strength of Germany's fielded forces in France. It was therefore essential to create an environment of retrenchment by drawing Germany's military resources back to defend their home nation and also to reduce their fighting capacity by

disrupting their logistics chain. The enemy's critical vulnerability in both respects was its homeland, and in particular its industrial targets. A concentration of the combined strategic air power of RAF Bomber Command and the United States' 8th Army Air Force (AAF) could deliver the effect such that sufficient diminution of the enemy's extended defensive posture could be achieved. Strategic bombing offered the only means of projecting power into Germany at that point in the war.

However, the Allies needed a well-defined common purpose for a combined air offensive, that could also meet the disparate doctrines of the two bomber forces;[50] for good reasons the Americans favoured daylight precision-bombing attacks, whilst the RAF preferred area bombing at night. The Casablanca Directive of January 1943 gave an agreed general aim that satisfied both camps: 'Your primary object will be 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.'[51] Therefore, through the subsequent destruction of the economic industrial infrastructure, the military strategic objectives of shaping the battle space for an impending invasion would be achieved in part. Within the spirit of the Casablanca Directive, the effects sought by Operation CHASTISE were to impede industrial activity through denial of essential industrial water supplies, and to flood as much industrial infrastructure as possible.

In Churchill's speech to Congress on 19 May 1943, he specified that, 'our air offensive is forcing Germany to withdraw an ever larger proportion of its war-making capacity from the fighting fronts in order to provide protection against air attacks'.[52] This statement provides explicit evidence that retrenchment of the enemy was a specific strategic goal of the bomber offensive, of which CHASTISE was a part. Speer noted that 'in 1943, I estimated that the air war was costing us, in terms of production for the Eastern Front, the equivalent of more than 10,000 heavy guns and approximately 6,000 medium-heavy and heavy tanks. Defence against air attacks requires the production of thousands of anti-aircraft guns, the stockpiling of tremendous quantities of ammunition all over the country, and holding in readiness hundreds of thousands of soldiers, who in addition had to stay in position by their guns, often totally inactive, for months at a time'.[53] Although only part of the wider bombing campaign, Operation CHASTISE was responsible for absorbing a disproportionately high ratio of German assets. The ensuing protection of the dams was to distract an entire division's worth of military assets for the following two years, including considerable quantities of searchlights, flak guns, smoke canisters and balloons.

The effect was not limited to military assets. As many as 27,000 workers would be reassigned to the reconstruction of the dams and in recovering the damage to the surrounding areas; in addition to the industrial infrastructure, there was extensive destruction of railway lines and embankments, bridges and roads, domestic dwellings, and agricultural wherewithal.[54] Many of the workers came from the Todt Organisation and the building of the Atlantic Wall;[55] this diversion of resource had the military advantage of ensuring that a future Allied invasion would face a reduced level of enemy fortification.

It is probable that one military effect achieved was not sought in advance. The raid may have had significant repercussions for the Luftwaffe and their future capabilities. Sweetman stated that, 'Before and during the attack on the Möhne, night-fighter training continued from the airfield at Werl. The Luftwaffe neither reacted nor despatched aircraft to intercept the bombers even though Gibson's crews remained in the Möhne area for over half an hour'.[56] In the aftermath of the attack, Speer's report to Hitler made 'a deep impression on the Führer'.[57] In his diary, Goebbels confirmed that, in relation to the dams raid, 'The Führer is exceedingly impatient and angry about the lack of preparedness on the part of our Luftwaffe'.[58] Hitler's reaction to the failure of the Luftwaffe to repel the attacks can only have served to galvanise his growing disaffection for the effectiveness of his fighter force. Having already dictated on 8 May 1943 that all new aircraft should be capable of carrying bombs, Hitler became increasingly

oblivious to counter-arguments in favour of the development of the jet-engined Messerschmitt Me-262 as a fighter aircraft alone, despite the enormous advantage it would have given to the Luftwaffe.[59] The subsequent delay to the development of the Me-262 represents a tangible, if unquantifiable, reprieve for Allied air superiority.

Diplomatic strategy

In the gloom of unfolding events at Stalingrad in late 1942, German diplomatic attempts were being made to achieve peace between Germany and the Soviet Union that would enable the withdrawal of German forces from the east and thus allow a greater concentration of forces against the Allies in the west.[60] The Soviets, having suffered 11 million casualties by the end of 1942 in hindering German advances,[61] may have been inclined towards a cease-fire. Stalin's Order of the Day of 23 February 1942 reinforced the potential for such a course of action; the order implied disappointment at the lack of offensive action in western Europe, and that Soviet war aims were to regain lost territories rather than to achieve total victory over Germany.[62] Soviet suspicions over Allied commitment were exacerbated by the continued failure throughout 1942 of the Allies to open a 'promised' second front in the west, despite Soviet pleas to do so, and the lack of success or cancellations of Arctic re-supply convoys from Britain to the Soviet Union. At a meeting in Moscow in August 1942, Churchill had placated Stalin's ire at a lack of offensive action and the delay of invasion until 1943, with the promise of intensified air attacks on German industry.[63] However, as the year had progressed, there had been further prevarication over the practicality of a grand invasion in 1943 following the decision to conduct an offensive in North-West Africa. Eventual confirmation of a delay until 1944 was specified at the Casablanca Conference in January 1943. These events only served to increase the tension in relations with Stalin. Naturally, Churchill feared that the Soviets' commitment to the war against Germany would wane if they were to regain lost territories whilst noting no particular backlash from the west.[64]

Alliance cohesion across the Atlantic was a further cause for mild consternation. Historical tensions had existed since the American War of Independence and from British support for the Confederacy during the American Civil War. However, the greatest frictions came from the influence of the large Irish-American community in Democratic politics and their hostility towards British rule over Ireland, and an American distaste for the imperial nature of the British. The British, for their part, held grudges over American lack of support of the peace settlement from 1919 and over the American tariff system.[65]

Prior to the Casablanca Conference, Anglo-American relations were at a low ebb. There was significant feeling in British circles that the Americans were more interested in settling accounts with the Japanese than with the belligerents in Europe;[66] this view is supported by correspondence from the Chief of Staff to the British Joint Staff Mission in Washington who wrote to Portal in late 1942, stating, 'We must re-emphasize the swing-over taking place in the highest quarters [of the US administration] towards Pacific strategy which still does not appear to be fully appreciated in the United Kingdom . . . Not only has it [the idea] gained currency, but we daily see its practical effect in the diversion of resources to the Pacific Theatre'.[67] From a UK perspective, a diminution of American support to the European theatre had extremely serious implications both in terms of prolonging the war and in the associated negative effect on morale at home that an excessively extended conflict could create. There was a perceived need to convince the Americans to focus on Germany as the main enemy.[68] Although the divisions on where US war efforts should be concentrated were abated during the Casablanca Conference, they resurfaced shortly afterwards. By the Trident Conference of May 1943, soundly-based British reluctance to commit to Operation Roundup (a joint aspiration for an Allied invasion into Northern France) any earlier than May 1944, had resulted in intensified American threats of transferring their major war effort to the Pacific: this had resulted in deadlock.[69] UK belief that the Americans were committing too wholeheartedly to a cross-Channel invasion at the expense of other opportunities were balanced by an American view that the British were seeking

A modified Lancaster of No 617 Squadron prior to Operation CHASTISE

Operation CHASTISE, if successful, offered the opportunity through a singular spectacular strike to provide confidence that the bomber offensive was turning the course of the war in the west, and by extrapolation, would indicate that Germany's ultimate defeat was inescapable

to divert resources to further their imperial aims rather than promoting the main aim of defeating German-held Europe.[70]

Diplomatically, a critical capability in supporting the cohesion of the Tripartite Alliance was the combat strength and economic resource to mount effective offensives on two fronts. To achieve this, a critical requirement was the commitment of the Soviets not only to regain their pre-war territories, but also to continue offensive action against the retreating German forces in the East. Stalin needed to be compelled to stay in the war from a political standpoint. To do this required demonstration of the inevitability of the ultimate defeat of Germany, either with or without Soviet assistance. If German defeat was inevitable, then the Soviet Union would want to be involved in the post-war shaping of Continental Europe's frontiers, in order to satisfy her longer-term ambitions to expand communism westwards.[71] An equally critical requirement was a commitment from the Americans to focus sufficient military strength in Europe. Britain's capacity to demonstrate a credible counter-offensive capability represented a critical vulnerability.

The diplomatic strategic effect necessary to protect the friendly strategic centre of gravity was a compelling demonstration of the British capacity to strike at the heart of Germany; the air war against Germany offered, at the time, Britain's only means of doing so. Strategic bombing was therefore essential in keeping the Soviets in the war; this view is reinforced by Lord Cherwell, Churchill's personal scientific advisor, in a letter to the Prime Minister in March 1943, where he stated, 'But it will surely be held in Russia as well as here that the bomber offensive must have more immediate effect on the course of the war in 1943'.[72] Operation CHASTISE, if successful, offered the opportunity through a singular spectacular strike to provide confidence that the bomber offensive

was turning the course of the war in the west, and by extrapolation, would indicate that Germany's ultimate defeat was inescapable. That Churchill had written to Stalin only a month before the Operation promising an increase in the scale of bombing, only serves to emphasise the strategic importance of the Raid.[73] A significant British demonstration of force would also strengthen the US' perception of Britain's commitment to the aim of defeating Germany rather than protecting its wider imperial interests, and therefore augment support for a greater balance of resources towards the European theatre.

The raid occurred at a strategically fortuitous moment, if there was no political influence in its timing or objectives. Churchill was able to make great capital out of it during his visit to the Trident Conference, particularly in his speech to both Houses of Congress on 19 May 1943, the day after the breaking of the story in the media. Having pledged full British support to the United States in the defeat of Japan and stressed that the intensified Allied air bombardment of Germany was paving the way for Hitler's downfall,[74] Churchill continued:

'The Condition to which the great centres of German war industry, and particularly the Ruhr, are being reduced is one of unparalleled devastation. You have just read of the destruction of the great dams which feed the canals and provide the power to the enemy's munition works. That was a gallant operation, costing eight out of the nineteen Lancasters employed, but will play a very far-reaching part in reducing the German munition output. Wherever their centres exist or are developed, they will be destroyed.'[75]

Notwithstanding its timing, the Raid impressed both of Britain's Allies. The Joint Chiefs of Staff acknowledged a dramatic British success and it helped in gaining the acceptance of the Combined Bomber Offensive plan.[76] The Soviets were equally impressed and sought information on the operation as they were 'possibly contemplating something similar'.[77] Importantly, it demonstrated to her Allies that Britain could, using air power, strike at the heart of the enemy territory. As Speer noted, 'The real importance of the air war consisted in the fact that it opened a second front long before the invasion of Europe. That front was the skies over Germany . . . The unpredictability of the attacks made this front gigantic; every square metre of the territory we controlled was a kind of front line.[78]

To determine whether Operation CHASTISE had a pre-determined diplomatic objective requires analysis of the decision-making process that determined its viability. When the Upkeep proposal was first put to Harris, in mid-February 1943, he described it as 'tripe of the wildest description. There are so many ifs and buts that there is not the smallest chance of its working'.[79] Harris further railed at the prospect of diverting Lancaster assets for modification, when the weapon itself existed at that stage 'only within the imagination of those who conceived it'.[80] Harris's misgivings about the idea were encapsulated in his statement that 'we have made attempt after attempt to pull successful low attacks with heavy bombers. They have been, almost without exception, costly failures'.[81] Conversely, the First Sea Lord, Admiral Sir Dudley Pound had described the smaller, naval version of the weapon (codenamed Highball) as 'the most promising secret weapon yet produced.'[82] Within two days of his earlier rant, Harris met Wallis and considered his proposals, but without commitment. The following day, Wallis was advised to stop all ideas of attacking the dams, and subsequently offered his resignation. Yet, by 26 February, Wallis had been given the go-ahead for the Upkeep programme, having had authorisation to proceed with Highball four days earlier. It is unlikely that Harris had changed his viewpoint, given his contention in April 1943 that 'As I always thought, the weapon is bamy'.[83] Therefore, higher authority must have overruled him. Cooper contends that the Upkeep papers were sent to Sir Winston Churchill by Sydney Barratt, assistant to Sir Thomas Merton, the Scientific Advisor to the Ministry of Aircraft Production, to whom Wallis had spoken following his 'resignation', and that the Prime Minister subsequently gave the order for the raid to be prepared.[84] An alternative assertion is that Portal, having been a keen advocate of

attacking the Möhne dam since his time in Harris's role three years earlier, personally sanctioned the modification of three Lancasters for further trials.[85]

Regardless of its ultimate sponsor, Operation CHASTISE would proceed. The motive behind the decision is important, though. As noted earlier, Portal was aware of the limited economic impact that the Raid was likely to have. Also, Churchill was fully informed of the operation before the event, and expected much from it;[86] any intervention by Churchill in the decision to proceed would suggest, arguably, a diplomatic motive.

A further argument in support of a diplomatic objective lies in the development of Highball, designed for attack against capital ships. For maximum effect and for optimum operational security, Highball and Upkeep should have been launched together.[87] Unfortunately, Highball trials stalled and the optimum opportunity to use Upkeep approached; failure to meet temporal target validity constraints, imposed by water levels in the dams and moonlit conditions, would mean an almost certain postponement by almost 12 months to the attack on the dams. Conversely, proceeding with Upkeep would undoubtedly prejudice the future utility of Highball. The Vice-Chief of the Naval Staff, following the specific direction of the First Sea Lord, refused to agree to the decoupling of the weapons' programmes. His RAF counterpart, Air Chief Marshal Sir Douglas Evill, sent a summary of the situation to the Chiefs of Staff at the Trident Conference. The immediate response from Washington was to proceed with Upkeep. Some commentators have credited Churchill with having authorised the operation, but without corroboration.[88] Nevertheless, given the predisposition of the First Sea Lord to oppose such a move, it is reasonable to conclude that a swift response from the Joint Chiefs might only have been possible through higher-level mediation, particularly if Churchill was already familiar with the programme, appreciated its strategic potential and sought an outcome in advance of his speech to Congress.

Psychological strategy

In February of 1943, when the critical decisions were being made on whether Upkeep development should proceed, Britain was in need of a major fillip to morale. Britain had survived through the Battle of Britain, the Blitz, the Battle of the Atlantic, the bombardment of Malta and the loss of Crete. Avoiding defeat does not in itself provide hope of ultimate victory, and morale under such circumstances is difficult to maintain. Whilst the Germans had been defeated at Stalingrad, and the tide had turned in the North Africa campaign following El Alamein in November 1942, the British had not yet registered a conclusive victory against Germany. Against the strategic backdrop of sustaining Alliance cohesion and in accordance with Clausewitz's 'Remarkable Trinity', maintaining the strong support of the people was a critical capability in both withstanding and responding to the enemy. Maintaining high morale among the population was therefore a critical requirement, and a perceived lack of tangible military success represented a critical vulnerability: hope had to be fostered both at home and abroad that the British were fighting back, and achieving success. Moreover, the impact on morale is a balancing act; that which strengthens friendly morale must surely erode the morale of the opposition.

The raid was intended to demonstrate the capacity to retaliate. However, Operation CHASTISE would fail to optimise its psychological benefits unless it exploited some aspects of indirect air power. In this case, the non-lethal air power activity constituted reconnaissance and psychological operations; the latter would be achieved through the product of the former allied to the widespread use of the media.[89] The Air Ministry was aware of the advantages of the reporting of operations, even if security implications limited much of the potential propaganda benefits. They had set up a Public Relations Department in advance of Operation CHASTISE.[90] Harris himself sought to exploit propaganda opportunities and had arranged for free access within Bomber Command to the BBC's correspondent, Richard Dimbleby.[91] Also, although Harris rarely visited his operational units, such was the potential significance of Operation CHASTISE that he broke with his tradition to be present at 5 Group Headquarters during the event,

and at RAF Scampton for the mission debrief. Within an hour of the last Lancaster aircraft's return to its home base, a reconnaissance Spitfire was airborne from RAF Benson en route to the scene of devastation. The speed with which its hitherto classified reconnaissance photographs were released to the worldwide media was exceptional, and denoted a watershed in the publication of such material.[92] That such haste was sanctioned, only serves to endorse the view that the British leadership was aware of and sought to exploit the psychological impact that such powerful and immediate images of the destruction would have, both at home and abroad. The management of the mass media continued for some time after the event, with Gibson encouraged both to write a book, published posthumously in 1946 and entitled Enemy Coast Ahead, and to run for parliament (before withdrawing his candidacy).[93]

There is no denying that Operation CHASTISE had a hugely positive effect on British morale, and, following victory in Africa, further confirmed the British capacity to strike back effectively at Germany. It was also heralded in the United States, where The New York Times reflected the general sentiment, 'The RAF has secured another triumph. With unexampled daring, skill and ingenuity it has . . . delivered the most devastating single blow dealt from the air'.[94] Naturally, by bolstering Allied morale, there was equal intent to deflate the morale of the enemy. Notwithstanding the worldwide media coverage, the British employed a leaflet drop into occupied Europe to spread news of the operation.[95] Although suppressed in Germany, news of the scale of civilian deaths spread around the Reich by word of mouth 'like wildfire', creating an air of terror until official casualty figures were published. The attack on the dams proved that the RAF was now able to reach out and strike in as precise a way as had not previously been thought possible;[96] this had the additional psychological undertone that the British were capable of technically overcoming any constraints that German defences could present, and that no target was invulnerable.
Whilst a reduction in enemy morale was less likely to bring about the downfall of a totalitarian regime than a more susceptible functioning democracy, it was nevertheless a contributory factor, even if measures of effectiveness were all but impossible. The US Strategic Bombing Survey highlighted the significant resistance of the Germans to air attack, 'Their morale, their belief in ultimate victory or satisfactory compromise, and their confidence in their leaders declined, but they continued to work efficiently as long as the physical means of production remained. The power of a police state over its people cannot be underestimated'.[97] Despite this, the raid appeared to impact morale. By destroying 3,500 hectares of arable land and killing 6800 cattle and pigs, [98] the subsequent reduction in rations had a very serious psychological effect.[99] Hans Rumpf emphasised a 'lasting effect' on morale,[100] whilst Douglas Bader recalled, 'I well remember the destruction of the Möhne and Eder dams when I was in a prison camp. It had an enormous effect on Germans and the opposite effect, of course, on the prisoners-of-war'.[101] Within two weeks of the Raid, Goebbels had recorded in his diary that, 'An interesting transformation is taking place among the German people . . . the defeatists, especially the intellectuals are outdoing each other with pessimistic utterances'.[102] Upon interrogation following the Raid, his captors informed Flight Sergeant Fraser, a captured 617 Squadron aircrew, that the mission had 'accomplished as much as 100 normal air raids'.[103] Psychologically, these quotes combine to imply degradation in the general morale of the German people. However, this effect may have been short-lived or the sentiments may be unrepresentative.

Enduring effects

Many of the early air power theorists such as Douhet, Mitchell and Trenchard hypothesized that the hardship created by conventional area bombing would erode the morale of the people, defeat their will to resist and turn them against their regime. By 1943, the British experience of the Blitz and the Malta campaign should have given a graphic representation of the doctrinal folly of such thinking. In the immediate aftermath of the dams raid, questions were raised in the House of Commons on the reprehensible nature of indiscriminately bombing civilian centres.[104] Whilst

A Harrier GR7 armed with Paveway II laser-guided bombs (AHB RAF)

Loss of life has become the Achilles heel of modern coalition forces; equipment complexity has continued to escalate in an attempt to minimise this

Bomber Command continued to concentrate on area bombing with the aim of striking industrial centres within urban areas, this is more likely to have been through technical limits to greater precision than in a specific attempt to shatter morale. If so, then any reduction in morale will have been a by-product of the bombing offensive rather than its stimulus, as can be inferred from the Casablanca Directive.

Whilst the raid illustrated the benefits of low-level precision bombing, it also demonstrated that aircraft vulnerability would lead to unsustainable attrition rates. By reverting to higher altitude, attrition reduced at the expense of targeting accuracy. Harris, who had previously demonstrated a renowned distaste for corps d'elite, demonstrated prescience by resolving to keep 617 Squadron for the conduct of specialist projects thereafter. An attempt to combine the target-marking expertise of the Pathfinder Force (originally set up in August 1942) with the bombing accuracy of 617 Squadron proved largely ineffective against point targets, but led to the development by 617 Squadron of its own highly successful marking technique;[105] by dropping incendiaries from an extremely low-level lead aircraft onto the target, the remainder of the

squadron could bomb accurately from medium altitude using stabilised automatic bomb-sights. This technique minimised the requirement for low-level flying and was to prove extremely profitable throughout the remainder of WWII, by reducing the requirement to revisit targets. Similar effects could be achieved with a reduction in aircrew losses, or greater effect achieved for similar loss rates. Immediately following WWII, emerging British air doctrine would lead to investment in technology to further reduce risk to aircrew lives.[106] Loss of life has become the Achilles heel of modern coalition forces; equipment complexity has continued to escalate in an attempt to minimise this.

One undeniable success of Operation CHASTISE was the ingenuity and correct functioning of the weapon. Harris had a history of dismissing those 'panacea-mongers' who regularly presented him with preposterous solutions to some of his problems, but in the instant afterglow of the Möhne breach, he remarked to Wallis, 'you could sell me a pink elephant now'.[107] The credibility that Wallis subsequently enjoyed was to influence Bomber Command's future development of weapons. He would later be sponsored to develop the 12,000lb 'Tallboy' bomb that would be used to great effect by 9 and 617 Squadrons to sink the Tirpitz in November 1944, and the 22,000lb 'Grand Slam' bomb used successfully in the destruction of the Bielefield Viaduct in March 1945, again by 617 Squadron.[108]

Harris, a shrewd propagandist, would exploit the publicity of the operation in cultivating support for the strategic air offensive.[109] Operation CHASTISE enhanced Bomber Command's credibility, both in the eyes of Britain's military allies and within British political circles. In the Pointblank plan, approved by the Combined Chiefs of Staff on 14 May 1943, the 8th AAF implied that the RAF could not hit precision targets;[110] the imminent success of the mission proved just how precisely Bomber Command could strike, and suitably impressed American counterparts. The raid also offered Bomber Command political kudos, and the platform from which Harris would garner additional resources and commitment for future bomber offensives; this would heavily influence the future conduct of the war.
Finally, due to the extraordinarily complex nature of the operation, a need for airborne control of the mission had been identified during the work-up phase that had necessitated the fitting of radios similar to those in fighter aircraft.[111] Gibson was able to direct other aircraft whilst in the air and to relay information back to 5 Group Headquarters to enable appropriate tasking of the mobile reserve. Webster and Frankland described this 'Master Bomber' technique as 'the real significance of the dams raid'.[112] Gibson's direct influence on the operation extended to a degree of manipulation of the Operation Order and to autonomy in the tireless composition and training of his squadron.[113] In effect, the dams raid initiated the concept of mission command within Bomber Command.

In the Official History, Howard described Operation CHASTISE as 'a spectacular feat of skill and courage, but one whose effect on the German war effort was, unfortunately, slight'.'[114] Many recent commentators have considered the Dambusters Raid in solely economic terms, based on imprecise expectations of the raid's economic intent. Their conclusions, that predominantly discredit its strategic effectiveness, are fundamentally misleading. By retrospectively applying campaign planning methodology, a range of economic, military, diplomatic and psychological strategic objectives begin to emerge for the operation.

Economically, the raid largely achieved its strategic objectives. Industrial water supplies were undoubtedly disrupted, despite a tempering of the required effect by the remarkable and unexpected speed of the dams' reconstruction. The partial destruction of the means of production was a significant success. Eighteen industrial works of great economic importance were destroyed at a fortieth of the cost, in aircrew and aircraft terms, of an equivalent conventional bombing campaign, and with 20 times the destructive effect. Although much scholarly capital has been made of the failure to breach the Sorpe dam in conjunction with the Möhne, and thus maximise the economic benefit, the reality is that the weapon was neither optimised

for nor expected to achieve this desirable effect.

Militarily, the raid satisfied wider strategic objectives of reducing the potential combat strength and effectiveness of German forces that would oppose an allied invasion. At least a division's worth of manpower and assets would be absorbed in the defence of the dams for the remainder of the war.

Portal's correspondence to Churchill before and immediately after the operation indicated that the Prime Minister was anxious to discover the outcome of the raid as a matter of priority.[115] Churchill, an astute political opportunist, must have been aware of the strategic diplomatic benefits of breaching of the great German dams. Arguably, the timing of the raid was calculated to occur during the Trident Conference and immediately before Churchill's speech to Congress; this argument is supported by the rapid decision of the Joint Chiefs of Staff to give the operation the go-ahead, despite the implications for the Highball programme and the prior Naval resistance to decoupling it from the Upkeep programme. Also, the authorisation of a pre-determined plan to release previously sensitive reconnaissance photography to the worldwide media only serves to support the premise of high-level intervention. However, insufficient conclusive evidence supports this speculative theory. A less controversial conclusion would be that the timing of the raid was fortuitous, driven by moonlit conditions and water levels in the dams. Regardless of whether it was sought, the diplomatic effect of reassuring the Tripartite Allies of British offensive capability and thus strengthening the cohesion of the Alliance was achieved. Equally, the psychological effect sought in boosting British morale was also undeniably achieved, and there was an unquantifiable but tangible impact on the declining morale of the Germans.

Not only did Operation CHASTISE meet its stated and inferred objectives in each of its economic, military, diplomatic and psychological lines of activity, but it also provided the foundation for further developments in weaponry, bombing precision, and command and control, whilst enhancing political and military commitment for the ensuing strategic air offensive.

Operation CHASTISE achieved considerably more than it is has been given credit for, particularly by latter-day historians. The Dambusters Raid was a legendary feat and a remarkable strategic success; its undoubted accomplishments do not deserve to be belittled unjustly.

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Notes

[1] Webster and Frankland (1961), Vol. II, P168.
[2] Id.
[3] Knightley (1975), P340. Knightley attributes the quote to a Bruce Page article, How the Dambusters' Courage was Wasted, from the Sunday Times Magazine, 28 May 1972.
[4] Sweetman (1982), P xiv.
[5] Kearse (2004), Dambusters, Slide 6.
[6] Hastings (2002), P44.
[7] Sweetman (1982), P151.
[8] JWP 5-00, P2-6.
[9] Ibid, P2-7.
[10] Boog (2001), P96.
[11] Meilinger (2003), P1 who refers to a 2001 paper by Paul K Davis of RAND, entitled *Effects-based Operations: A Grand Challenge for the Analytical Community*.
[12] Ibid, P4.

[13] Ibid, P2.
[14] Spangrud (1985), P7.
[15] Meilinger (2003), P7. As the war progressed, the MEW's ability to gather information on the German economy improved, as did their analytical methodologies.
[16] Butler (1957), P72.
[17] Spangrud (1987), P7.
[18] Gwyer (1964), P22.
[19] Medlicott (1952), P388.
[20] Butler (1957), P71.
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