

OPERATION CHASTISE:  
ATTACK ON RUHR DAMS BY AIRCRAFT OF 617 SQUADRON  
ON THE NIGHT OF 16-17 MAY 1943

**Concept:** The Air Ministry originally considered the Ruhr dams as a possible target early as 1937. A number of proposals and studies were undertaken between 1938 and 1941, though none produced a proper plan with all the necessary components of a viable weapon and feasible means of delivery.

**The Weapon:** Codenamed "Upkeep".

The brainchild of Barnes Wallis of Vickers Armstrong, who had been working separately on some method of attacking dams since 1940 but probably did not conceive of the "bouncing bomb" idea until March 1942. He was given access and assistance by a variety of research bodies, including the National Physical Laboratories at Teddington, the Road Research Laboratory at Harmondsworth and the Building Research Station at Garston near Watford. Experiments which involved exploding charges against model dams at these sites, and the destruction of a real 180 foot disused dam in Wales, gave Wallis valuable data, but also showed that the task was far from easy and that any explosion preferably needed to take place in contact with the dam wall. He persisted with a series of experiments and meanwhile attempted to persuade the powers that be of the project's viability in the face of various bureaucratic hurdles and military scepticism. Nevertheless, prior to final approval on February 26th 1943 a full-scale weapon was, in the words of one noted historian, "scarcely more than an inventor's dream". However, because the optimum time to attack the dams was in the spring, when the reservoirs were full, when approval did come it left very little time to design and produce the weapons themselves. On 26th February 1943 there were neither modified aircraft nor weapons, nor drawings of either. Wallis began to draw the first full-scale drawing of an Upkeep mine only on 27th February, just eleven weeks before the raid took place.

"Upkeep" was effectively a 9250lb cylindrical mine or depth charge containing 6,600 lbs of Torpex underwater explosive and three hydrostatic pistols set to explode at 30ft below the surface. It was just under five feet long and just over four feet in diameter. The mine was held in the bomb-bay between twin sprung callipers, and a hydraulic motor imparted back spin at a rate of 500 rpm. The mine was intended to bounce across the water rather like a skipping stone, thus avoiding any torpedo nets. When it struck the dam wall the backspin



would cause it to remain in contact with the face of the dam as it sank thus focusing the force of the explosion against the wall sufficient to rupture the massive stone structure.

**Aircraft:** Modified Avro Lancaster B Mk III Special known as "Type 464 Provisioning". The mid-upper gun turret along with the bomb-bay doors was removed and callipers along with a drive motor and belt fitted in the aircraft to hold and spin the bomb. Twin spotlights were fitted see below along with VHF radio telephone which allowed direct speech communication between aircraft, which was not normal for bomber aircraft at the time. This would allow Wg Cdr Gibson personally to direct the raid. The final approval to start modifying just three Lancasters to conduct experiments came only on 26th February 1943 with conversion sets to be prepared for thirty, later reduced to twenty, aircraft. The first plans for the necessary modifications being drawn up on 1st March and the order for the conversion of the first aircraft being signed on 8th March.

#### The Role of Industry.

With such short timescales the firms involved, some of them natural rivals, had to co-operate or the project would be stillborn. Under the direction of the Chief Designer, Roy Chadwick, Avros set to work on modifying the three Lancasters and making the additional conversion sets, whilst Vickers-Armstrong in Barrow and Newcastle made the mine casings and the small drive engine for spinning the bombs. The Royal Ordnance Factory at Chorley in Lancashire would fill the casings with the torpex explosive. The Oxley Engineering company provided the steel for the "Upkeep" mines and the Hoffman Manufacturing company made the bearings for the drive mechanism. All these components and modifications had to be designed, manufactured and delivered in the eighty days between the 26th February and 17th May. The first modified Lancasters were delivered on 8th April and the last on 13th May just three days before the raid, and one aircraft used on the raid had been used in the experimental trials and arrived at Scampton only on the day itself. Vickers Armstrong at Barrow delivered the last of its fifty "Upkeep" mines to Chorley for filling with explosive on 9th April.

#### Trials.

After initial trials dropping scaled down prototype weapons from a Wellington at Chesil Beach (Dec 1942 - March 1943), modified Lancasters were utilised during April and May to fly a series of tests dropping inert Upkeeps at Reculver on the Kent coast. The first trial drop was made on 13th April, just over a month before the raid. The mines



were dropped at varying height and speed and differing bomb rotation speeds while Wallis attempted to work out the optimum approach height and speed for the raid. He also had to establish that spinning a massive four ton cylinder at several hundred rpm would neither rip it from the calliper arms, nor seriously affect the aircraft's flying characteristics. These trials also established that the original design of the "Upkeep", which included a spherical outer wooden casing held in place by metal rings like a beer barrel, was not robust enough to survive initial impact with the water. Although designed to make sure the mine would bounce for a greater distance, and run true, the wooden outer sphere repeatedly shattered leaving just the inner metal cylinder which had often continued bouncing along the surface during the trials after the casing broke away. On 21st April Wallis decided to dispense with the wooden casing and run "Upkeep" as a bare cylinder. The disadvantage was that if a cylindrical "Upkeep" was dropped on any plane but the horizontal it was likely to bite into the water on one side and either not bounce as well or go off line, or both. Even the cylinders, however, broke up and sank if they were dropped from too great a height or speed. On 24th April Wallis asked Gibson if he could drop the mine at 60' and 232 miles per hour. At this speed and if it was dropped at the right distance, the mine would survive the impact with the water, the aircraft would be clear of the splash as it hit the surface, the weapon would carry all the way to the dam, and the aircraft would be flying fast enough to have some chance of getting through the defences.

#### Air crew and Training:

Number of air crew participating - 133 Number killed - 53

Number PoW: 3

RAF - 90; Royal Canadian Air Force - 29; Royal Australian Air Force - 12; Royal New Zealand Air Force - 2. Included in these figures were one American RCAF and one Anglo-American RAF and one Australian in the RAF.

A new squadron was formed at Scampton on 21st March, initially known as "X" Squadron and latterly as 617 Squadron, and the 24 year old Wing Commander Guy Gibson was personally selected to lead it by none other than Air Chief Marshal Sir Arthur "Bomber" Harris, the Commander-in-Chief of Bomber Command. Gibson had flown 71 bomber sorties and an entire tour of 99 sorties on night fighters and was already the holder of four gallantry awards - the Distinguished Service Order and bar and the Distinguished Flying Cross and bar.



Despite the "elite" tag and the presence of some very experienced airmen - e.g. the two flight commanders, Sqn Ldrs Dinghy' Young and 'Henry Maudslay, and experienced pilots such as Dave Shannon, 'Hoppy' Hopgood, Les Knight and Joe McCarthy - NOT all 617 Sqn air crew were veterans. Some had flown fewer than 10 missions and one less than 5 and some of the flight engineers on the raid were flying their first operational sortie. Not all had volunteered for 617, and not all were known to or selected by Gibson: one entire flight of 57 Squadron was simply posted en masse to 617 Squadron.

The crews, who had trained to operate their bombers at heights above 15000', with a measured approach to the target allowing accurate navigation, were put through an intensive training programme involving extensive low-level flying and cross-country navigation eventually moving on to do the same thing at night, flying at 150' over water, along with bombing practice. However, night-flying at that height with no moon was a a major problem and there were not enough moonlit nights, so four aircraft were fitted with an American system involving sheets of blue celluloid inside the Perspex and orange goggles, which gave the impression of moonlight when flying in the day. The aircraft flew very low, returning with dents and bits of foliage hanging off them and on at least two occasions birds smashed through the cockpit windscreens which could have been disastrous. However, despite many close shaves there were no serious accidents.

#### Attack Method.

This varied depending on the type of dam. For the Mohne and Eder aircraft approached at SIXTY feet above the water IN THE DARK flying at 220 mph. For the earthen Sorpe dam aircraft flew along the dam very low at 180 mph and dropped the bomb, without spin, in the water alongside the middle of the dam. The barometric altimeters were not sensitive enough to give that accurate a reading and in any case the pilot could not look at the instrument panel at that height for fear of hitting the water. The aircraft therefore carried two spotlights which were angled so that when the beams met on the surface of the water the aircraft was flying at sixty feet, roughly twice the height of a normal house. The navigator watched the beams and called out "up" or "down" to the pilot. Flying very fast and very low with no modern radar aids with lights burning on your aircraft to show the enemy where you were was extremely hazardous. The wingspan of a Lancaster is 102' so there was a real danger of hitting the water as the aircraft made the tight turns on the approaches to the dams. At the Eder and Sorpe the topography of the surrounding countryside with steep hills and the dams in the valleys made the approach in the dark to drop the



bomb accurately in a large bomber very, very difficult. At the Eder the aircraft had to drop down from over 1000 feet to the lake and fly a curving approach hopping over a spit of land which rose to 50 feet less than a mile from the target, and then line up at the correct height and speed, before pulling up steeply to avoid the 300 feet hill which rose precipitously immediately behind the dam. To get the Lancaster down to 60 feet round and over the spit and lined up properly at right angles to the dam at 220 mph, and then make a climbing turn to getaway in the dark, was very challenging flying. At the Sorpe the aircraft had to fly over a 180-foot hill and dip down steeply to the dam just a quarter of a mile beyond to fly along and drop the bomb before climbing out using full power over another 300-foot hill immediately behind the dam. To make matters even more difficult a tall church steeple was exactly in line with the correct line of approach to the dam. The approach at the Mohne was slightly less daunting but still involved lifting the aircraft over a spit of land which rose to some 180 feet, but did provide some cover from the flak, and then dropping down to the surface of the lake to line up on the dam about a mile away. After dropping the mine the aircraft crossed the dam and then the pilot had to turn the big bomber round to the left away from flak positions to the right.

#### Outward Flight to Target.

The route to and from dams was also flown at very low level to avoid the defences. Their primitive radio navigation aids were usually jammed over enemy territory though some apparently worked up to the River Rhine - most navigation after crossing the Dutch coast was done by map reading and dead reckoning. This was extremely difficult at low level in moonlight, and very dangerous - two, aircraft hit power cables and crashed, and one hit the surface of the sea, lost its bomb and was very lucky to make it back to Scampton. Some aircraft flew beneath power cables on their way to the target and others flew along roads below the level of the surrounding trees. Others strayed off course by just a few miles, which it was almost impossible to avoid doing, but the route had been designed to avoid flak defences, though not all were known, and some of the unlucky ones who strayed in the wrong place were shot down.

Three waves of aircraft were sent to attack.

First Wave - 9 aircraft in 3 "vics" of 3. To attack the Mohne, Eder and Sorpe dams. Aircraft Captains: Gibson, Martin, Hopgood; Young, Shannon, Maltby; Maudslay, Knight, Astell.

Second Wave - 5 aircraft. To attack the Sorpe. Aircraft Captains: Barlow, Munro, Rice, Byers, McCarthy.



Third Wave - 5 aircraft. Airborne reserve. Aircraft Captains:  
Ottley, Burpee, Brown, Townsend, Anderson.

Despatched: 19                      Attacking dam: 11                      Lost: 8  
Aborted mission: 2

The waves followed different routes and the second wave actually took off first as it had the longest route. The weather produced stronger winds than forecast and this caused serious problems for the second wave, which actually crossed the Dutch coast first. Unforecast winds had pushed the aircraft south of their intended track. One aircraft, that of Byers, strayed over the heavily defended island of Texel, rather than the intended landfall at the apparently undefended but similar looking island of Vlieland. Byers' aircraft was shot down and the crew were all killed. A short while later Munro's aircraft flew over Vlieland, but was hit by fire from a flak battery whose presence was not known. Munro's aircraft was damaged and he was forced to return to Scampton. A different disaster befell Rice, whose aircraft hit the surface of the sea, ripping the Upkeep mine free and flooding the back of the aircraft with seawater. A shaken but very lucky Rice and crew also returned to Scampton. Some while later Barlow's aircraft hit power lines, possibly after being struck by flak, and crashed with the loss of all on board. Four out of five aircraft from the second wave had thus been lost or had aborted within a short space of time. The fifth crew, McCarthy's, had hurriedly had to change aircraft at Scampton because of a technical problem and were flying twenty minutes behind the others in the second wave. They crossed at Vlieland and were fired on but not hit, McCarthy reporting that he sank down to fly between two large dunes to provide cover from the flak! Later in the trip the aircraft was hit by a cannon shell which hit the undercarriage nacelle and burst the starboard tyre.

The first wave, unlike the second, took-off in vics of three and tried to maintain this loose formation on the way to the target, which was very unusual for a night operation. Like the second wave, some of these aircraft were also pushed off-course and the first vic, led by Gibson, crossed the coast at the ominously and appropriately named island of Overflakee, which was heavily defended. Flying very fast and very low they were luckier than the aircraft of the second wave and caught the Germans by surprise and went across unscathed. The second vic, ten minutes behind, had climbed higher to use their radio aids and discovered the unforecast wind, so were on course. However, climbing to use the radio aids probably exposed them to the German radars, and although they crossed at the right place, the defences were awake and



fired on the aircraft. The third trio, Maudslay, Astell and Knight, were on course and crossed the coast unscathed. En route to the Mohne, Gibson's vic came under fire several times and Hopgood's aircraft was damaged. - Young's vic made it to the dam without damage despite being fired on, although Shannon's aircraft was hit as it arrived at the Mohne by flak from one of the towers on the dam. The third vic was not so lucky and Astell's aircraft collided with high tension cables north of the Ruhr. The aircraft crashed in flames and all the crew were killed.

The third wave took off some time after the first two with the first aircraft taking off shortly after midnight. Each aircraft was detailed to one of the alternative targets and was also to be prepared to attack the Mohne or Eder if they did not receive a direct order in the air to attack the alternative dam. The first aircraft off was Ottley's, and it was instructed by radio at 0230 to attack the Lister dam, and the message was acknowledged by the aircraft, but two minutes later another message changed this to the Sorpe. No acknowledgement was received. Ottley had strayed over the heavily defended town of Hamm in the Ruhr and his aircraft was hit and caught fire, crashed, and the fuel tanks and then the mine exploded. Incredibly, the rear gunner, Sergeant Tees was blown clear still inside his turret by one of the explosions and survived, badly burned, to become a POW. The aircraft's demise was witnessed by other crews, including that of Gibson who was passing to the north of Hamm on his return journey and who hoped, vainly, that the exploding aircraft was a night fighter. The second aircraft in the wave, piloted by Burpee, also strayed off course, and flew over a German airfield at Gilze-Rijen near Tilburg where it was hit by flak, caught fire and exploded, before crashing on the edge of the airfield, killing all on board. Brown and Townsend were also sorely troubled by flak but survived unscathed, not least by flying below the height of the trees on occasion. The last to leave Scampton was Cyril Anderson, who was also plagued by searchlights and flak which drove him away from his prescribed route and his rear guns also malfunctioned. Deep over enemy territory Anderson and his crew could not pinpoint their position as mist obscured many of the landmarks they were looking for. Eventually, shortly after three in the morning they abandoned the mission and turned for home to fly back the way they had come whilst it was still dark.



## The Attacks.

### The Mohne.

The first dam to be attacked was the Mohne. Gibson flew over the dam once and then informed the other aircraft circling out of range of the flak that he was going to attack. As the aircraft passed over the spit of land, so low that the bomb-aimer told Gibson he was going to hit the trees, the navigator turned on the spotlights and gave Gibson instructions of "down down" until the aircraft was at 60', meanwhile the mine was spinning at 500 rpm and the bomb-aimer using the primitive but effective home-made sight waited for the right moment to release the bomb. The flak towers on the dam opened fire and the front-gunner of Gibson's Lancaster fired back. Gibson admitted to being very frightened as his brightly lit aircraft became the target for every gun in the area but concentrated on keeping the aircraft lined up and rock steady at 60' while his flight engineer adjusted the speed. At 28 minutes past midnight they dropped their Upkeep mine at 230 mph on a bearing of 330 degrees. It bounced three times, but sank short of the wall. After a short delay the hydrostatic pistols detonated the bomb at the correct depth and a great spout of water surged up and over the dam wall. At first it was thought the dam had collapsed, but as the water subsided it was seen still to be intact. After allowing the waters of the lake to settle, Gibson called Hopgood in to attack. The flak gunners now knew what to expect and the aircraft was seen to be hit several times on the approach. The bomb-aimer knew that their orders were to be sure to drop the mine correctly and was considering ordering another run when the aircraft was hit. Hopgood ordered the mine to be released. This, unsurprisingly, resulted in the bomb being dropped late, and it bounced right over the dam and exploded, wrecking the main power house. Hopgood's aircraft was on fire and he ordered the crew to bale out as the Lancaster struggled to 500' and then exploded. Only the rear gunner and the bomb-aimer baled out successfully and both men had chosen to pull the ripcord of their parachutes inside the aircraft, which undoubtedly saved their lives - all the other crewmembers perished. Martin attacked next, with Gibson flying alongside him to distract the flak gunners, and the mine was dropped at 38 minutes past midnight on a bearing of 335 degrees at 217 mph. It veered to the left and exploded near the bank of the reservoir twenty yards from the dam.

Gibson now called up Young. Martin flew on Young's left to distract the gunners while Gibson flew parallel to the dam on the downstream side hoping to divide the fire from the defences on and beyond the dam. Young made the perfect approach and drop, and his bomb hit the





centre of the dam. The dam was apparently intact after the attack, and Maltby was making his bomb run with Martin and Gibson both acting as decoys when he saw the centre of the dam crumbling. Maltby veered to one side and dropped his mine which bounced, struck the dam and exploded. The dam was already failing before Maltby's mine exploded, and now millions of gallons of water were pouring through the breach and down the valley and beyond. Gibson, who had already ordered Shannon to prepare to attack, cancelled the order and instructed Shannon, Maudslay, and Knight to accompany him to the Eder dam, along with Young, who was to act as deputy leader if anything happened to Gibson.

#### The Sorpe.

Meanwhile the sole survivor of the second wave, McCarthy, had arrived at the Sorpe which had been difficult to find because of low mist in the valleys. It was immediately apparent that the approach to the dam was extremely challenging, and so it proved. McCarthy flew the approach nine times but found it difficult to clear the high hill and then bring the Lancaster down low enough, with the church steeple on the approach proving particularly troublesome, and either McCarthy himself or his bomb-aimer were not satisfied that all was right and called for the aircraft to go around again. The other members of the crew became restless as the bomber had now been circuiting the dam for half an hour and they were also puzzled that no other aircraft from the second wave had appeared. Eventually, on the tenth approach both McCarthy and his bomb-aimer were satisfied that the approach was perfect and dropped the bomb alongside the dam. Two and a half hours later Brown, who had received a radio message directing his aircraft to attack the Sorpe while in the air, arrived at the dam and found that the ground mist was now even thicker. Brown found the approach no easier than McCarthy, and the thickening mist made flying the circuit correctly difficult even though the dam itself was clear, and after flying into a mist-bound nearby valley and nearly crashing he ordered that incendiaries be dropped round the circuit to help him. In all Brown flew five separate approaches before dropping the mine on his sixth attempt. Although both mines exploded close to the dam and caused considerable damage, no breach occurred. The loss of so many from the second wave had seriously weakened the assault on the Sorpe and it survived the attack.

#### The Eder.

The aircraft flying to the Eder all had difficult finding it in the thickening mists and when Gibson eventually located it he fired a red flare to attract the other crews. As at the Sorpe the approach proved very difficult. Shannon flew three or four approaches without being



able to get the Lancaster low enough after the steep dive and sharp turn. Maudslay then tried twice with similar results. Shannon flew two more approaches before he and his bomb-aimer were satisfied, dropping his mine at 1.39 in the morning. Maudslay then flew down the valley for the third time. The watching Gibson thought that he saw something hanging from the Lancaster as if it had previously been damaged. The mine was released but probably too close to the dam and exploded on hitting the parapet shortly after Maudslay's aircraft passed over it. It is not clear whether the aircraft was caught in the explosion of its own Upkeep or not, as the eyewitnesses differed. Maudslay made brief and indistinct radio contact with Gibson and is known to have left the area immediately, suggesting his aircraft may indeed have been damaged. Knight attacked next, making one dummy run, before dropping his mine at the correct height, speed and alignment. It hit the dam, sank, and exploded at the correct depth. The dam crumbled and collapsed and the water poured into the valley beyond.

#### The Ennepe/Bever.

Apart from Brown, the only other aircraft of the third wave to make an attack was Townsend, who believed he dropped his mine at the Ennepe dam. As with the other dams he found flying the right approach at the right speed and height difficult and made three dummy runs before dropping the weapon on his fourth approach. It exploded short of the dam and no significant damage resulted. It is almost certain that Townsend actually attacked another dam in the area, the Bever, as German sources report an attack on this dam but none on the Ennepe.

#### Homeward Bound.

Of the nineteen aircraft which left Scampton eleven had made attacks, resulting in breaches at the Mohne and Eder and damage to the Sorpe. Two aircraft had returned early, five had been lost on the outward journey and one at the Mohne dam. The surviving aircraft, including one which could not find its target, still had to make their way home across hundreds of miles of hostile territory. On the return trip two more aircraft were to be shot down. The victims were two of the most senior and experienced members of the Squadron. Maudslay's aircraft may or may not have been caught in the explosion of its own weapon over the Eder and suffered further damage. Two radio messages were heard from the aircraft after the attack and it is clear that it headed for home as soon as it had dropped its mine. Probably damaged it strayed too close to the oil refineries at Emmerich on its return journey and was shot down by the flak defences. Young very nearly made it home but fell victim to German flak batteries on the coast of Holland and crashed into the sea. There were no survivors from either aircraft.



McCarthy's aircraft also nearly came to grief when it strayed over the heavily defended marshalling yards of Hamm, flying through them so low that a member of the crew remarked that the Germans didn't need flak they only needed to change the points. Other aircraft were fired on by flak batteries on the return journey and at the coast. In all eight aircraft from the raid were lost resulting in the deaths of 53 men: three more became POWs.

#### The Results.

The flooding from the breached dams affected a wide area inundating many factories and damaging or destroying power stations, road and rail bridges, and other facilities. The loss of power and water for the Ruhr, crucial to many manufacturing processes, was also significant. Among a large number of towns temporarily deprived of water were Hamm, Hagen, Bochum and Dortmund. The Germans had to draft in tens of thousands of workers to repair the damaged dams and other facilities, including at least 7000 workers removed from building the Atlantic Wall defences against Allied invasion with direct positive results a year later during the D-Day invasion. Both ammunition and coal production fell after the attack, just at the point that the Germans mounted their last significant offensive on the Eastern Front. The raid also had political consequences. Prime Minister Winston Churchill was visiting America at the time, and news of the attack's success was telephoned through to him. He was able to make considerable capital from the attack and specifically referred to it in an address to the American Congress. American and British newspapers also made much of the attack with it appearing on the front page of British papers and the New York Times. The Germans also constructed elaborate defences at all the dams in the Ruhr and elsewhere, diverting considerable military and construction resources in the process. These included anti-aircraft batteries covering every dam - prior to the raid only the Mohne had any guns protecting it. The dams were also protected by mine barrages, ramps to deflect Upkeep mines, and wire net curtains strung in front to down low flying aircraft. Although the human cost of the raid was high, and unsustainable on a regular basis, it should be remembered that it represented less than a 1000th of Bomber Command's total losses, and the results of the attack, politically, economically and militarily undoubtedly made it worthwhile.

Decorations: Air crew decorated 34

Victoria Cross - 1; Distinguished Service Order - 5; Distinguished Flying Cross - 10; Bar to Distinguished Flying Cross - 4; Conspicuous Gallantry Medal - 2; Distinguished Flying Medal 11; Bar to Distinguished Flying Medal - 1.

